

**OBESITY/OVERWEIGHT AND PHYSICAL ACTIVITY'S RELATIONSHIP WITH
DEPRESSIVE SYMPTOMS OF 13 TO 15 YEAR-OLD GIRLS IN THE NORTH-
WEST PROVINCE: THE THUSA BANA STUDY**

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Foreword

The completion of this study has been made possible by a few individuals. I would like to express my gratitude towards them.

- **First of all, my parents, Gerrit and Cecilia van Zyl.** I am grateful for your love and support. Without your help I would not have been able to complete this study. As I think of you I feel at once enriched and blessed. I dedicate this dissertation to you.
- **To my supervisor, Professor Hans De Ridder,** who patiently endured and guided me over the years. Your wisdom and insight were invaluable. I'm will be forever in your debt.
- **To my co-supervisor, Dr Alida Nienaber.** Thank you for your advice and time spend on this dissertation. It is surely much appreciated.
- **Thank you to Professor Lessing and Professor Greyvenstein** for editing the bibliography and language.
- And finally, I like to thank the **Lord Jesus Christ.** Thank you, **God,** for the inspiration and the strength to complete this project.

Nothing worth having comes without some kind of fight.

— Bruce Cockburn

The Author

August 2008

Summary

The aim of this study was firstly to determine if obesity/overweight has any statistically significant relationship with depressive symptoms in 13 to 15 year-old girls in the North-West Province, and secondly what the influence of physical activity on this probable relationship between obesity/overweight and depressive symptoms is. This study formed part of the THUSA BANA research project which was an inter-disciplinary project of the Faculty of Health Sciences of the North-West University (Potchefstroom Campus). Two of the five schools of this faculty namely the School of Biokinetics, Recreation and Sport Science and the School of Psycho-Social Behavioural Sciences participated in this project. The study commenced in April 2000 and was completed in June 2001. The Ethics Committee of the North-West University (Potchefstroom Campus) approved the study (project number 00M10) and only children whose parents signed forms of informed consent were allowed to participate. Although the THUSA BANA project consisted of 1257 children of different ethnic groups living in the North-West Province between the ages of 10 and 15 years of age, this study focused on a sub population of girls between 13 to 15 years of age ($N = 230$). Anthropometric data was collected and used to determine the percentage body fat and body mass index (BMI). The Previous Day Physical Activity Recall (PDPAR) questionnaire developed by Trost *et al.* (1999:343) was used to determine levels of physical activity. Depressive symptomatology was assessed by means of a self-report instrument, the Children's Depression Inventory (CDI), which was developed for children between the ages of 8 and 17 (Kovacs, 1985:995). A one-way analysis of variance (ANOVA) and a two-way analysis of variance (MANOVA) was used for all comparisons (Thomas & Nelson, 1996:107-115) using Statistica for Microsoft Windows (StatSoft, Inc. 1984 – 2000).

Children in the present study reported extremely high levels of depression, bordering on diagnosis of major depressive disorder (Craighead *et al.*, 1998:156; Jansen van Rensburg, 2001:16) with 71% of the total group of girls reporting an above average or very much above average level of depression. Also, the majority of the 13 – 15 year-old girls in this study had high levels of obesity with over 48% being classified as having a high or a very high level of body fat. In the total group of girls 74% reported low levels of activity, with 21% reporting normal activity levels and only 6% of girls were highly active.

According to the results of this study there was no statistical significant relationship between obesity and depressive symptoms in 13 to 15 year-old girls in the North-West Province. There is, however, a trend towards increased levels of depression with an increase in percentage body fat. Hypothesis 1 was rejected. From the results it also appears that physical activity had no influence on the probable relationship between obesity and depressive symptoms. This was mainly due to the very low levels of physical activity reported by the subjects. There is, however, an indication that low levels of physical activity can be associated with increased levels of depressive symptoms. Hypothesis 2 was rejected.

Opsomming

Die doel van die studie was eerstens om te bepaal of obesiteit/oorgewig enige statistiese betekenisvolle verwantskap met depressiewe simptome in 13 tot 15 jarige dogters in die Noordwes Provinsie het. Tweedens, wat die invloed van fisieke aktiwiteit op die moontlike verwantskap tussen obesiteit/oorgewig en depressiewe simptome is. Die studie het deel gevorm van die THUSA BANA navorsingsprojek wat 'n inter-dissiplinêre projek was van die Fakulteit vir Gesondheids Wetenskappe aan die Noordwes Universiteit (Potchefstroom Kampus). Twee van die vyf skole van die fakulteit naamlik die Skool vir Biokinetika, Rekreasie en Sportwetenskap en die Skool vir Psigo-Sosiale Gedragwetenskappe het deelgeneem aan die projek. Die studie het in April 2000 in aanvang geneem en is in Junie 2001 voltooi. Goedkeuring was verleen deur die Etiese Komitee van die Noordwes Universiteit (Potchefstroom kampus) (projek nommer 00M10) en slegs kinders wie se ouers toestemmingsvorme geteken het was toegelaat om deel te neem. Die THUSA BANA projek het bestaan uit 1257 kinders tussen die ouderdomme van 10 tot 15 jaar oud van verskillende etniese groepe wat woonagtig was in die Noord Wes Provinsie. Die studie het gefokus op dogters in die ouderdomsgroep 13 tot 15 jaar oud ($N = 230$). Antropometriese data was ingesamel en gebruik om die persentasie liggaamsvet en liggaamsmassa index (LMI) te bereken. Die 'Previous Day Physical Activity Recall (PDPAR)' vraelys, saamgestel deur Trost *et al.* (1999:343), was gebruik om die vlakke van fisieke aktiwiteit te bepaal. Depressie simptome was bepaal met behulp van die 'Children's Depression Inventory (CDI)' wat ontwikkel is vir kinders tussen die ouderdomme 8 en 17 jaar oud (Kovacs, 1985:995). 'n Eenrigting variansie analiese (ANOVA) en 'n twee rigting variansie analiese (MANOVA) was gebruik vir al die vergelykings (Thomas & Nelson, 1996:107-115) met behulp van 'Statistica for Microsoft Windows' (StatSoft, Inc. 1984 – 2000).

Die kinders in die studie het abnormale hoë vlakke van depressiewe simptome gerapporteer wat feitlik gelykstaande is aan erge depressiewe afwykings (Craighead *et al.*, 1998:156; Jansen van Rensburg, 2001:16). Uit die totale ondersoekgroep, het 71% dogters 'n bo-gemiddelde of 'n hoogs bo-gemiddelde vlak van depressie simptome gerapporteer. Die meerderheid van die dogters in die studie het hoë vlakke van obesiteit getoon met meer as 48% geklassifiseer met hoë of baie hoë persentasie liggaamsvet. In die totale groep dogters het 74% lae vlakke van fisieke aktiwiteit gerapporteer, en 21% normale vlakke. Slegs 6% het hoë vlakke van fisieke aktiwiteit gerapporteer.

Volgens die resultate van die studie was daar geen statistiese betekenisvolle verskille gevind in die verwantskap tussen obesiteit/oorgewig en depressie simptome in die ondersoekgroep nie. Daar is wel 'n aanduiding dat hoë vlakke van depressie simptome met hoë vlakke van obesiteit geassosieer kan word. Hipotese 1 is verwerp. Die resultate dui ook aan dat fisieke aktiwiteit geen betekenisvolle invloed op die verwantskap tussen obesiteit/oorgewig en depressie simptome het nie. Dit kan hoofsaaklik toegeskryf word aan die lae vlakke van fisieke aktiwiteit in die groep. Daar is wel 'n aanduiding dat lae vlakke van fisieke aktiwiteit geassosieer kan word met verhoogde vlakke van depressie simptome. Hipotese 2 is verwerp.

Declaration

The co-authors, Prof J. Hans De Ridder and Dr Alida W. Nienaber, of the research articles that might be produced from this dissertation hereby grant permission to the candidate, Mr P.S. van Zyl for it's inclusion in this Masters dissertation.

Prof. J. Hans de Ridder
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Table of Contents

Titel page	I
Foreward	II
Summary	III
Opsomming	V
Dedication	VII
Table of Contents	VIII
Appendices	XII
List of figures	XIII
List of tables	XV
 Chapter 1	 1
Problem statement and aim of study	
1.1 Introduction	1
1.2 Problem statement	2
1.3 Aim	5
1.4 Hypotheses	5
1.5 Structure of dissertation	6
 Chapter 2	 7
Obesity, depressive symptoms and physical activity	
2.1 Introduction	7

2.2	Obesity	8
2.2.1	Introduction	8
2.2.2	Hypertrophy and hyperplasia	8
2.2.2.1	Hypertrophy	9
2.2.2.2	Hyperplasia	9
2.2.3	Positive energy balance	10
2.3	Classification of obesity and overweight in children and adolescents	10
2.3.1	Introduction	10
2.3.2	Body mass index (BMI)	11
2.3.3	Waist-to-hip circumference ratio (WHR)	14
2.3.4	Skinfolds	15
2.4	Depression	17
2.4.1	Introduction	17
2.4.2	Symptomatology of depression	18
2.4.2.1	Dysphoria	18
2.4.2.2	Loss of interest	19
2.4.2.3	Anhedonia	19
2.4.2.4	Social dysfunction	19
2.4.2.5	Problems with memory and concentration	20
2.4.2.6	Self esteem	20
2.4.2.7	Shame and guilt	21
2.4.2.8	Hopelessness	21
2.4.2.9	Psychomotor agitation and retardation	22
2.4.2.10	Eating problems	22
2.4.2.11	Sleeping problems	23
2.4.2.12	Suicide attempts	23
2.4.3	Conclusion	24
2.5	Obesity and depressive symptoms	26
2.6	Physical activity, depressive symptoms and obesity	27
2.7	Conclusion	29

Chapter 3	30
Method of investigation	
3.1 Introduction	30
3.2 The subjects	31
3.3 Anthropometrical data	31
3.3.1 Subject position	31
3.3.2 The anatomical position	31
3.3.3 The Frankfort plane	32
3.3.4 The apparatus	33
3.3.4.1 Lufkin steel measuring tape	33
3.3.4.2 Harpenden skinfold callipers	33
3.3.4.3 Electronic scale	33
3.3.4.4 Portable stadiometer	33
3.4 Anthropometrical protocol	34
3.4.1 Body mass	34
3.4.2 Stature	34
3.4.3 Skinfolds	34
3.4.4 Anthropometrical landmarks for skinfolds	35
3.4.4.1 Acromiale	35
3.4.4.2 Radiale	35
3.4.4.3 Mid-acromiale-radiale	36
3.4.4.4 Subscapulare	36
3.4.4.5 Triceps skinfold	36
3.4.4.6 Sub-scapular skinfold	37
3.4.5 Girths	37
3.4.6 Anatomical landmarks for girths	37
3.4.6.1 Iliocristale	37
3.4.6.2 Waist girth	38
3.4.6.3 Gluteal (hip) girth	38

3.5	Anthropometric calculations	39
3.5.1	Percentage body fat	39
3.5.2	Body mass index (BMI)	40
3.6	Questionnaires	40
3.6.1	Children's Depression Inventory (CDI)	40
3.6.2	Previous Day Physical Activity Recall (PDPAR)	41
3.7	Statistical analysis of data	42
 Chapter 4		43
Results and discussion		
4.1	Introduction	43
4.2	Descriptive statistics	44
4.2.1	Body composition	44
4.2.2	Depression	47
4.2.3	Physical activity	48
4.3	Obesity's relationship with depression	50
4.4	The relationship between physical activity, obesity and depressive symptoms	54
4.5	Discussion of results	59
 Chapter 5		62
Summary, conclusions and recommendations		
5.1	Summary	62
5.2	Conclusions	63
5.2.1	Conclusion 1 – Hypothesis 1	63
5.2.2	Conclusion 2 – Hypothesis 2	64
5.3	Limitations and recommendations	64

References	66
THUSABANA project information	82

Appendices

Appendix A	THUSA BANA informed consent	83
Appendix B	THUSA BANA control card	84
Appendix C	THUSA BANA demographic questionnaire	85
Appendix D	THUSA BANA anthropometric profile	91
Appendix E	THUSA BANA physical activity compendium with METS classification	94

Figures

Figure 2.1	International cut off point for body mass index by sex for overweight and obesity (Cole <i>et al.</i> , 2000:5).	13
Figure 3.1	A person in the anatomical position.	32
Figure 3.2	The Head in the Frankfort plane.	32
Figure 4.1	Percentage of girls between 13 and 15 years-old in terms of low, normal, high and very percentage body fat (N = 230).	46
Figure 4.2	Percentage of girls between 13 and 15 years-old in terms of average, above average and very much above average level of depression (N = 230).	48
Figure 4.3	Percentage of girls between 13 and 15 years-old in terms of low, normal and high level of physical activity (N = 230).	49
Figure 4.4	The relationship between obesity and depression in 13 year-old girls (n = 73).	50
Figure 4.5	The relationship between obesity and depressive symptoms in 14 year-old girls (n = 72).	51
Figure 4.6	The relationship between obesity and depressive symptoms in 15 year-old girls (n = 85).	52
Figure 4.7	The relationship between obesity and depressive symptoms in the total group of girls (N = 230).	53
Figure 4.8	The relationship between physical activity, obesity and depressive symptoms in the 13 year-old group of girls.	55
Figure 4.9	The relationship between physical activity, obesity and depressive symptoms in the 14 year-old group of girls.	56
Figure 4.10	The relationship between physical activity, obesity and depressive symptoms in the 15 year-old group of girls.	57

Figure 4.11	The relationship between physical activity, obesity and depressive symptoms in the total group of girls (N = 230).	58
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Tables

Table 4.1	Descriptive statistics of percentage body fat in 13 to 15 year-old girls.	44
Table 4.2	Lohman's classification of body fat levels in girls (Lohman, 1992:84).	45

Chapter 1

Problem statement and aim of the study

- 1.1 *Introduction*
- 1.2 *Problem statement*
- 1.3 *Aims*
- 1.4 *Hypotheses*
- 1.5 *Structure of dissertation*

1.1 Introduction

Worldwide, there is considerable concern over the trend towards increasing fatness and obesity in children (Reilly *et al.*, 2000:1623). This is a global problem which contributes to a cluster of non-communicable diseases, evident in both developed and developing countries (Kalk, 2001:576). It is estimated that in many countries, 2-8% of total health care costs is attributable to obesity (Katsilambros, 2000:66). Furthermore, it has been found that 40% of children who were obese at the age of seven years will become obese adults, whereas more than 70% of obese adolescents become obese adults (Kemper *et al.*, 1999:S34). Obesity is a remarkable disease in terms of the effort required by an individual for its management and the extent of discrimination its victims suffer.

There is a common belief that overweight and obese children are unhappy with their weight and experience more psychological distress, particular depressive symptoms (Erickson *et al.*, 2002:931). Research on adult woman and female adolescents has shown a connection between depression and body weight (Pesa *et al.*, 2000:331). According to Wallace *et al.* (1993:301), it is estimated that the incidence of depression in the pediatric population is 6-10%, while the incidence of depression in an obese pediatric population is still unknown.

The role of physical activity in the treatment of both obesity and mental disorders cannot be mistaken. According to Paluska and Schwenk (2000:167), increased aerobic exercise or strength training has been shown to reduce depressive symptoms significantly and appears to be as effective as other therapeutic modalities for the treatment of mild or moderate depressive symptoms. Exercise is also considered to be one of the cornerstones of pediatric obesity treatment, along with dietary change and behaviour modification (Epstein *et al.*, 1996:428).

1.2 Problem statement

Obesity, a state of excess storage of body fat, is a public health problem of mammoth proportion with an increasing prevalence among children and adolescents (Johnson *et al.*, 2006:925; Neumark-Sztainer, 1999:S31; Pronk & Boucher, 1999:S38; Rippe & Hess, 1998:S31; Story, 1999:S43). Almost one quarter of children in the United States of America are currently obese, showing a dramatic increase of 20% in the past decade (Bar-Or *et al.*, 1998:2; Chinali *et al.*, 2006:2267). This growing incidence represents a pandemic that needs urgent attention if the potential morbidity, mortality and economic toll that will be left in its wake were to be avoided. In 2002 the cost of obesity management in the United States alone amounted to approximately \$100 billion (Uwaifo, 2002:2).

Obesity is associated with a host of potential co-morbidities that significantly increase the potential morbidity and mortality associated with the condition. While the cause and effect relationship has not been exhaustively demonstrated for all these co-morbidities, amelioration of these conditions with significant weight loss suggests that obesity probably plays a significant role in its development (Uwaifo, 2002:4). Excessive weight correlates with increased rate of diabetes, hypercholesterolemia, hypertriglycendemia, sleep disorders, hypertension, decreased release of growth hormone, respiratory disorders and orthopedic problems (Bar-Or *et al.*, 1998:2; Pronk & Boucher, 1999:S38; Young, 2001:11). The obese child suffers both psychologically and socially. Self-esteem and self-image are often damaged by ridicule and scorn (Bar-Or *et al.*, 1998:2).

Erickson *et al.* (2002:931) provide cross-sectional evidence for a relationship between depressive symptoms and body mass index (BMI) in preadolescent girls. This seems to be explained by an excess of overweight concerns. Sheslow *et al.* (1993:289) found that as the level of self-esteem decreased, depression increased. They concluded that obese pediatric patients showed significant depression and lowered self-esteem. Csábi *et al.* (2000:43) compared the appearance of depressive symptoms in 30 obese children in outpatient care and 30 normal-weight controls. By using the Montgomery-Asberg Depression Rating Scale, a significantly higher rate of depression was found in the obese children ($p > 0.01$).

Childhood depression has been generally recognized as a distinct illness for over twenty years now. Under Cytryn and Mcknew's (1996:35) classification, childhood depression can be divided into three main types – acute, chronic and masked. The depressive process in children manifests itself at several different levels. The deepest level is the unconscious (Cytryn & Mcknew, 1996:38). The child may dream for instance that he or she is being chased by a ferocious dog, cannot escape and may wake up screaming. The way that a child reacts to a movie, part of a television programme, a book or a story that he/she may tell to go along with a picture he/she has drawn, may reveal what is bothering him/her unconsciously (Cytryn & Mcknew, 1996:39; Van den Berg, 1989:17). Another

way the depressive progress might reveal itself is by means of verbal expression. Through talking and writing spontaneously or responding to questions, the child reveals that he or she feels hopeless, helpless, worthless, unattractive, unloved and guilty and that suicidal thoughts keep running through his/her mind (Javad & Kashani, 1983:11). He or she will talk about feeling sad or “blue” or hopeless or about being unable to get out of bed or not wanting to do anything. Yet another way the depressive progress might make itself known is through mood and behaviour. Just by observing, one can see signs that include sadness of facial expression and posture, crying, slowness of movements and emotional reactions, disturbances of appetite and sleep, school failure, physical complaints for which no physical cause can be found and sometimes irritability (Cytryn & Mcknew, 1996:39).

In a study where a group of psychiatrically institutionalized adolescents was assigned to a three-day-per-week running/aerobic exercise programme, Brown *et al.* (1992:555) reported improvements in depression, anxiety, hostility, confused thinking and fatigue in the treated girls, with an increase in vigor and self-efficiency for all treated subjects. Norris *et al.* (1992:55) also found that adolescents who reported greater physical activity reported less stress and lower levels of depression.

Although vigorous physical activity improves the health of both adults and children, American studies have shown an annual decline in physical activity of 4 – 8% between the ages of 12 years and 15 to 18 years for boys and girls (Van Mil *et al.*, 1999:541). According to Armstrong *et al.* (1990:203), British children have surprisingly low levels of habitual physical activity, and many children seldom undertake the volume of physical activity believed to benefit the cardiopulmonary system. Girls were also found to be less active than boys.

Goodman (1999:1552) found that socio-economic status gradients in American adolescents correlate with both depression and obesity, indicating that differences in susceptibility to socially mediated etiology mechanisms of disease may exist during

adolescence. Understanding that the social structural context and patterning of the adolescents' lives is crucial to understand clearly health and disease etiology, underlines the importance of research on South African youth.

The first question that this study will answer is whether there is a relationship between obesity/overweight and depressive symptoms in 13 to 15 year-old girls in the North-West Province. The second question that will be answered is whether physical activity will have any effect on the probable relationship between obesity/overweight and depressive symptoms. With this research the different variables will be compared. Answers to these questions will better describe the role of physical activity in the prevention and treatment of obesity and depression in children. It will help to identify those children most at risk for developing depressive symptoms. By confirming these relationships, early intervention programmes focusing on the psychological well-being and physical activity of children could be developed and evaluated.

1.3 Aim

The aim of this study is to determine:

- Whether obesity/overweight has any statistically significant relationship with depressive symptoms in 13 to 15 year-old girls in the North-West Province; and
- What is the influence of physical activity on the probable relationship between obesity/overweight and depressive symptoms in 13 to 15 year-old girls in the North-West Province.

1.4 Hypotheses

This study is based on the following hypotheses:

- There will be a statistical significant relationship between obesity/overweight and depressive symptoms in 13 to 15 year-old girls in the North-West Province; and

- Physical activity will have a positive influence on the probable relationship between obesity/overweight and depressive symptoms in 13 to 15 year-old girls in the North-West Province.

1.5 Structure of the dissertation

This dissertation will be structured as follows:

- In Chapter 1 the problem statement, aim and hypotheses of the study will be stated.
- Chapter 2 is a literature review about obesity/overweight, depressive symptoms and physical activity and their interrelationships in adolescent girls.
- Chapter 3 will consist of a complete explanation of the method of investigation.
- In Chapter 4 the results and discussion will be presented.
- Chapter 5 will contain the summary, conclusion, and recommendations of this study
- References
- Appendix

Chapter 2

Obesity, depressive symptoms and physical activity

- 2.1 *Introduction*
 - 2.2 *Obesity*
 - 2.3 *Classification of obesity*
 - 2.4 *Depression*
 - 2.5 *Obesity and depressive symptoms*
 - 2.6 *Physical activity, depressive symptoms and obesity*
 - 2.7 *Conclusion*
-

2.1 Introduction

The literature that will be reported in this chapter was selected for the purpose of this study namely, obesity/overweight and physical activity's relationship with depressive symptoms in adolescent girls. The development and classification of obesity will be discussed in terms of internationally recognised methods and standards. Furthermore, the symptomatology of depression and the manifestation in children will be reported or discussed. The chapter will conclude with a discussion of the relationship between depression, obesity/overweight and physical activity as reported by recent studies.

2.2 Obesity

2.2.1 Introduction

Obesity can be defined as the excessive enlargement of the body's quantity of fat, or the excess storage of energy in adipose tissue, to the extent that health and well-being are affected (Forbes, 1995:46; McArdle *et al.*, 1994:65; Uwaifo, 2002:3; WHO, 1998:107).

Although very similar, being overweight and being obese are two different conditions according to Arnheim and Prentice (1997:107). Being overweight implies having excess body weight relative to physical size and stature and does not specify the body composition (Arnheim & Prentice, 1997:107). Obesity is an excess of body fat (Forbes, 1995:46; Uwaifo, 2002:3). There are children who may be overweight because of increased muscle and bone (lean body mass) and will, therefore, have a high body mass index, but this does not necessarily mean that these children are “over fat” or obese (Schonfeld-Warden & Warden, 1997:340).

There are basically two theories on the development of obesity. The first theory is that of hypertrophy and the second theory that of hyperplasia of adipose tissue. Both of these theories will be discussed.

2.2.2 Hypertrophy and hyperplasia

According to the literature, adipose tissue increases in two ways namely: existing fat cells are enlarged and filled with more fat – a process called fat cell hypertrophy, or the total number of fat cells is increased – a process called fat cell hyperplasia (McArdle *et al.*, 1994:660; Norton & Olds, 1996:172; Poskitt, 1995:961). Following is a short discussion of fat cell hypertrophy and hyperplasia.

2.2.2.1 Fat cell hypertrophy

Research showed that fat cell size in newborn infants and children up to the age of 1 year is about one fourth the size of adult fat cells (McArdle *et al.*, 1994:668). Thereafter, the fat cell size tripled until the age of six with little further increase in size to the age 13 (McArdle *et al.*, 1994:668; Norton & Olds, 1996:172; Poskitt, 1995:961). One may reasonably assume a further increase in fat cell size, because cell size in adulthood is significantly larger than cell size at age thirteen or in late adolescence (McArdle *et al.*, 1994:668; Norton & Olds, 1996:172; Poskitt, 1995:961). According to Roberts (1997:1118), the size of the fat cells can reduce but the amount of fat cells will remain the same throughout life.

2.2.2.2 Fat cell hyperplasia

Cell number increases fairly rapidly during the first year of life, being about 3 times greater at this point than at birth. Beyond the age of one, cell number increases gradually to the age of about ten years (McArdle *et al.*, 1994:668). Like cell size there is a significant cell hyperplasia during the growth spurt in adolescence until adulthood, thereafter there is little further increase in number. In terms of body fat, the percentage increases from about 16% of body fat at birth to between 24-30% of body mass at 1 year. By age six, body fat decreases to about 14% in girls and 11% in boys. After that the percentage body fat increases progressively to an average of 16% in boys and 27% in girls by the age of eleven (McArdle *et al.*, 1994:668; Norton & Olds, 1996:172; Poskitt, 1995:961).

Fat accumulation occurs either by storing larger quantities of fat in existing adipose cells (hypertrophy), new fat cell formation (hyperplasia) or by both hypertrophy and hyperplasia. According to Poskitt (1995:961), fat cell size may reach some biologic upper limit and once this size is reached, the cell number becomes the key factor in determining any further extent of obesity. In comparison, a non-obese person has

approximately 25-30 billion fat cells, whereas the number of fat cells in the 'extremely obese' may be as high as 80-100 billion (McArdle *et al.*, 1994:668; Norton & Olds, 1996:172).

2.2.3 Positive energy balance

Although the pathogenesis of obesity is far more complex than a simple paradigm of an energy imbalance, this concept allows easy conceptualization of the various mechanisms involved in the development of obesity. The weight of the body is regulated by numerous physiological mechanisms that maintain balance between energy intake and energy expenditure (Schonfeld-Warden & Warden, 1997:34). Although the regulatory mechanisms are still not known in detail, they are extraordinarily precise under controlled conditions, for example, a positive energy balance of only 500 kJ (120kcal) per day (about one serving of sugar-sweetened soft drink) would produce a 50 kg increase in body mass over ten years (Björntorp, 1997:425; Schonfeld-Warden & Warden, 1997:342). With increasing degrees of positive energy balance, excess adipose tissue will be formed and stored (Bray, 1990:497). The accumulation of fat is a visible manifestation that more food energy has been stored than has been expended. Thus, any factor that raises energy intake (food and drink) or decreases energy expenditure (resting metabolic rate and activity) by even a small amount will cause obesity in the long term (Ebbeling *et al.*, 2002:474).

2.3 Classification of obesity and overweight in children and adolescents

2.3.1 Introduction

Based on the topography of adipose tissue and its association with a variety of metabolic disorders, four different phenotypes of human overweight and obesity can be recognised in children and adolescents (Bouchard, 1991:286). Type I is characterised by excess total

body mass or body fat without any particular concentration of fat in a given area of the body. Type II is defined as excess subcutaneous fat on the trunk, particularly in the abdominal area, and is equivalent to so-called android or male type of fat deposition. Type III is characterised by an excessive amount of fat in the abdominal visceral area and can be labelled abdominal visceral obesity. The last type (Type IV) is defined as gluteo-femoral obesity or gynoid obesity and is observed primarily in women (Bouchard, 1991:286). Thus, excess fat can be stored primarily in the truncal-abdominal area or in the gluteal and femoral area (Bouchard, 1991:286; McArdle *et al.*, 1994:662).

Few medical conditions can be diagnosed as confidently by untrained individuals as gross obesity. Yet there are few conditions where differentiation of the mild case from the normal individual, even for the experienced, is as difficult as obesity (Poskitt, 1995:961). In childhood, the distinction between excessive and normal fatness is made more difficult by natural, age-related, physiological variations (Poskitt, 1995:961). Ideally, any definition should reflect adiposity of the child, and should be related to the clinical outcome. Definitions currently in use are practical but have limitations both for clinical practise and epidemiology (Reilley *et al.*, 1999:217). Cole *et al.* (2000:1) proposed a new definition of overweight and obesity in childhood, based on pooled international data for body mass index. It is linked to the widely used adult cut off points of 25 kg/m² for overweight and 30 kg/m² for obesity. The definition is less arbitrary and more international than others, and should encourage direct comparison of trends in childhood obesity worldwide (Cole *et al.*, 2000:6).

Anthropometric and body composition indicators can be used to determine the degree of overweight and the proportion and distribution of body fat. A few of these classification methods will, therefore, be discussed.

2.3.2 Body mass index (BMI)

The body mass index is a reliable measure with reasonable measurement and clinical validity in children and adolescents (Dietz, 1998:192). Theoretically, BMI represents an index of weight independent of stature, such that at any age, greater relative weight may be attributed to increased body fatness (Wells, 2000:325). It is derived by dividing weight (kilograms) by height (meters) squared (Dietz, 1998:191; Smith *et al.*, 1997:466).

$$\text{BMI} = \frac{\text{Body mass (kg)}}{\text{Body height}^2 (\text{m}^2)}$$

Body mass index in childhood changes substantially with age (Cole *et al.*, 2000:1). At birth the median is as low as 13 kg/m², increases to 17 kg/m² at age 1, decreases to 15.5 kg/m² at age 6, then increases to 21 kg/m² at age 20 (Cole *et al.*, 2000:1). Thus age-dependant data for BMI are necessary for children, as changes in body composition occur during growth. Sexual maturation has also been reported as an important factor producing variations in BMI (Bini *et al.*, 2000:217).

The definition of overweight and obesity in children involves BMI's greater than the 85th percentile (commonly used to define overweight) and the 95th percentile (commonly used to define obesity), for age-matched and sex-matched controls (Guillaume, 1999:126S; Schonfeld-Warden & Warden, 1997:340; Uwaifo, 2002:2).

Proposed by the International Obesity Task Force, the adult cut off points of 25 kg/m² and 30 kg/m² for overweight and obesity respectively were linked to the body mass index centiles for children to provide child cut off points (Cole *et al.*, 2000:1). In Figure 2.1 Cole *et al.* (2000:5) provide one with international cut off points for BMI by sex for overweight and obesity, passing through BMI 25kg/m² and 30kg/m² at age 18. The data were obtained from six internationally representative cross sectional surveys on growth from Brazil, Britain, Hong Kong, Netherlands, Singapore, and the United States of

America. They recommend the use of these cut off points in international comparisons of prevalence of overweight and obesity (Cole *et al.*, 2000:6).

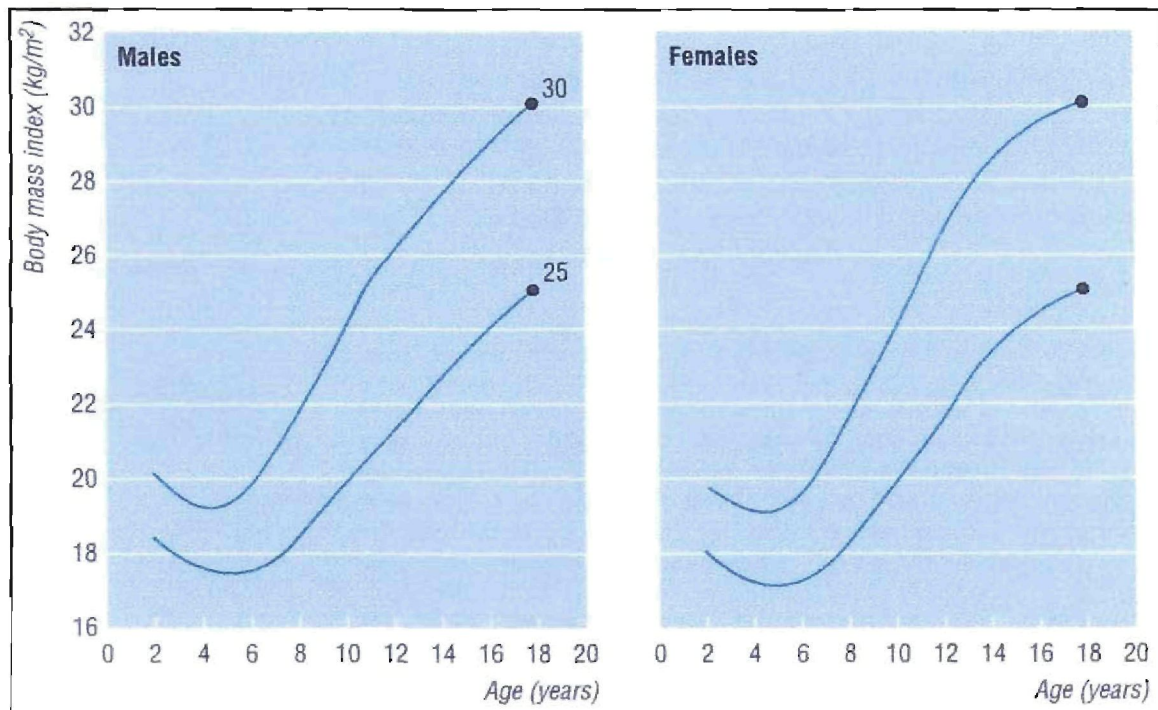


Figure 2.1: International cut off points for body mass index by sex for overweight and obesity (Cole *et al.*, 2000:5).

Following is a brief discussion of the advantages and disadvantages of using BMI as a method for classifying overweight and obesity in children and adolescents.

Advantages:

- Height and weight are routinely measured in the clinical setting and included in the medical records. BMI is easily calculated from height and weight (Dietz, 1998:1901).
- It is simplistic, inexpensive, non-invasive and provides for patient comfort and safety (Poskitt, 1995:961; Troiano & Flegal, 1999:S23).
- Can be very accurately measured (Smith *et al.*, 1997:467).

- BMI has been related to total mortality and specific morbidities. For example, it has been shown that mortality is very low for individuals with BMI's between 20 and 25 kg/m², low for BMI's between 25 and 30 kg/m², moderate for BMI's between 30 and 35 kg/m², high for BMI's between 35 and 40 kg/m² and very high where BMI's exceeded 40 kg/m² (Norton & Olds, 1996:370).

Disadvantages:

- Its relationship with body composition is influenced by various factors such as age, gender and race and where sexual development plays a major role (Bini *et al.*, 2000:214; Luciano *et al.*, 1997:6). Therefore, BMI may be recommended less confidently for application in adolescents.
- BMI may estimate both lean body mass and fat mass to a comparable degree and does not include a factor for frame size, which is known to correlate well with BMI (Smith *et al.*, 1997:469; Wells, 2000:325).
- BMI is a questionable value during periods of growth when height is continually changing and can be distorted by the proportionality of sitting height and leg length. Relatively long legs will decrease BMI scores (Norton & Olds, 1996:370).
- While increments in heaviness at a population level are most often associated with increments in fat, this assumption cannot be made at an individual level (i.e. increments in BMI may be due to increments in muscle mass). Thus, BMI should not be used exclusively to quantify an individual's fatness (Norton & Olds, 1996:371).

2.3.3 Waist-to-hip circumference ratio (WHR)

The waist-to-hip ratio is derived by dividing the waist girth (taken at the level of the narrowest point between the lower costal border and the iliac crest) by the gluteal (hip) girth (at the level of the greatest posterior protuberance of the buttocks) (Norton & Olds, 1996:58).

$$\text{WHR} = \frac{\text{Waist girth (cm)}}{\text{Hip girth (cm)}}$$

A waist-to-hip ratio equal to or greater than 0.95 in adult males, and equal to or greater than 0.85 in adult females is considered to be a health risk (Heyward, 1998:297; WHO, 1998:11). Although this measure provides an index of risk comparable to total body fat in adults, according to Dietz (1995:156) no similar data exists for children and adolescents. It is relatively simple, inexpensive, and does not require a high degree of technical skill and training to take these measurements (Heyward, 1998:297). Waist circumference and trunk skinfold measurement are better though than waist-hip ratio for the assessment of central obesity as it does not differentiate between lean body mass and fat mass (Schonfeld-Warden & Warden, 1997:340; Owens *et al.*, 1999:143).

2.3.4 Skinfolds

The skinfold method is widely used in field and clinical settings. This method is particularly useful for estimating body composition of children and adults (Heyward, 1998:289). Skinfolds are a measure of subcutaneous fat which is a good indicator of total body fat (Heyward, 1998:290; Himes, 1999:S18). From the ages of 12-18 years the subscapular skinfold thickness or the sum of four skinfolds, consistently do the best at identifying the fattest adolescents. The triceps skinfold performs equally well after the age of 14 years (Himes, 1999:S19). Skinfold thickness above the 85th percentile for age and sex suggest obesity and above the 95th percentile suggest obesity class 3 (Dietz, 1995:156; Gortmaker *et al.*, 1999:411; Schonfeld-Warden & Warden, 1997:340). The most commonly used equations for children and adolescents are from Boileau *et al.* (1985:17). The following equations from Boileau *et al.* (1985:17) are for girls:

6-11 years

$$\begin{aligned} \% \text{ Fat} = & 1.35 \times (\text{triceps} + \text{subscapular skinfold}) \\ & - 0.012 \times (\text{triceps} + \text{subscapular skinfold})^2 - 3.4 \end{aligned}$$

12-14 years

$$\begin{aligned}\% \text{ Fat} &= 1.35 \times (\text{triceps} + \text{subscapular skinfold}) \\ &\quad - 0.012 \times (\text{triceps} + \text{subscapular skinfold})^2 - 4.4\end{aligned}$$

15-18 years

$$\begin{aligned}\% \text{ Fat} &= 1.35 \times (\text{triceps} + \text{subscapular skinfold}) \\ &\quad - 0.012 \times (\text{triceps} + \text{subscapular skinfold})^2 - 5.4\end{aligned}$$

Following is a brief discussion of the advantages and disadvantages of using skinfold measurements as a method for body composition assessment.

Advantages:

- Measuring skinfold thickness can help distinguish individuals who are overfat from those who are overweight because of increased muscle and bone (Schonfeld-Warden & Warden, 1997:340).
- It is non-invasive and economical (Himes, 1999:S18).
- There is a linear relationship between the sum of skinfolds and body density (Db) for homogenous samples (population-specific skinfold equations) (Heyward, 1998:290).

Disadvantages:

- Skinfold equations are population specific and inapplicable to other populations (Lohman, 1992:84).
- The accurate measurement of skinfolds is difficult with various technical sources of error, including skinfold measurement technique, skinfold site location, skinfold calliper, and skinfold compressibility, which lead to prediction errors (Lohman, 1992:84).
- Often, in the case of the obese/overweight person, the individual's skinfold measurement exceeds the maximum aperture of the calliper, and the jaws of the calliper may slip off the fold during measurement. Therefore, it should not be

used to measure body fat of the extremely obese individuals (Heyward, 1998:289).

Other methods of determining body composition exist e.g. bioelectrical impedance analysis, densitometry, hydrometry, dual-energy x-ray absorptiometry (DXA) and air displacement, measured by the Bod Pod. Although these could be considered reference methods they all yield indirect estimates of body composition and none can be singled out as the gold standard for *in vivo* body composition assessment. They are also expensive and not cost effective for large population studies (Heyward, 1998:289).

2.4 Depression

2.4.1 Introduction

There is little doubt that emotional states play an extremely important role in people's lives. An examination of the relative balance and importance of human feelings, thoughts, and behaviour leads to a conclusion that it is moods and emotional states, ranging between despair and agony and joy or elation, that add pleasant or unpleasant significance and meaning to our experiences (Stevens *et al.*, 1995:147). The rich variations in emotional reactions, sometimes subtle but often strong, accompany every moment of human experience.

In relation to psychiatric dysfunctions, depression is one of the most difficult to define in part due to the highly personal and subjective nature of depression (Malan, 2000:9). The confusion is also reflected in the different meanings attached to the term when used by the lay public and professionals. The term can be used to describe what appears to be necessary and inevitable changes of everyday life on the one hand, and probably unnecessary and destructive pathological states on the other (Craig & Dobson, 1995:xi).

In common usage, "depression" refers to a normal human emotion that can range from a period of sorrow in response to a disappointment or loss, to a severe and incapacitating disorder accompanied by delusional thoughts. In a clinical sense, "depression" can be said to occur when the subject passes a particular threshold on an underlying continuum, beyond which depressive symptoms are so severe or incapacitating that the depression becomes a disorder (Stevens *et al.*, 1995:147, Trickett, 1997:40).

Although maturity, health and experiences dictate that children differ from adults in their reactions to situations, the features of depression in school-aged children and adolescents are similar to those found in adults (Kolvin & Sadowski, 1995:137).

2.4.2 Symptomatology of depression

According to Healy (1993:23), any model of depression must be able to account for the central effective disturbance in the illness. This is not merely a question of explaining why a person might feel sad and low, but also of accounting for the nature of the mood disturbance. There are three issues involved namely: the severity of the disturbance, the distinct quality of the effective changes in depression, and their diurnal variation (Healy, 1993:23). It means that the symptoms must be either new or intensify in relation to their pre-episode status (Malan, 2000:18). A brief discussion of the symptomatology of depression follows.

2.4.2.1 Dysphoria

Dysphoria, according to the Oxford English Dictionary (2006:479), is a state of unease or general dissatisfaction. It can be described as a general feeling of sadness, guilt, and misery (Healy, 1993:25). It is characterised by the association of tiredness, loss of control, unchangeable emotional reaction, the lack of hope and a sense of detachment from the environment (Healy, 1993:25; Malan, 2000:18).

2.4.2.2 *Loss of interest*

Considered in general, it means apathy towards nearly everything in the depressed individual's life. The positive value that the individual once awaited from, for example, friendly conversations, community activities, recreational pursuits, and occupational achievements, has dropped to the point that they no longer seem worth the trouble. Motivation for activities has shifted, if it survives at all, to the cost of not performing them. Patients complain of being unable to feel. The external observers label is often "flat affect" (Klinger, 1993:44; Trickett, 1997:22).

2.4.2.3 *Anhedonia (without pleasure)*

The term anhedonia was devised by Ribot in 1897 to denote a diminished ability to experience pleasure in normally pleasurable activities (Willner, 1993:63). It may precede the onset of depression in some individuals, stress may play a role in its onset or intensification and it may be secondary to depressed mood. The relative contribution of these factors and extent of their explanatory power are questions that remain to be answered (Robert & Stephen 2000:12, Willner, 1993:76).

2.4.2.4 *Social dysfunction*

Clinically depressed people report having smaller social networks as well as less frequent contact with individuals within their social networks. This results in a reduction of social support (Feldman & Gotlib, 1993:87). They also have significant differences in the quality of relationships. Depressed individuals report being uncomfortable in interactions with others and often perceive these interactions as unhelpful or even unpleasant or negative (Alden *et al.*, 1995:60; Brim *et al.*, 1982:423). Furthermore, depressed people, particularly depressed women, experience their interpersonal contact to be less supportive than do non-depressed controls (Gotlib & Lee, 1989:223).

2.4.2.5 Problems with memory and concentration

According to Malan (2000:20), depressed patients report impaired memory and concentration. However this does not necessarily imply an objective intellectual loss. On the contrary, intelligence and memory are unimpaired in depressive states, insofar as they are accessible for testing. As soon as the depression is successfully treated, the patient's concentration and memory is found to be intact (Watts, 1993:113).

2.4.2.6 Self esteem

Lowered self-esteem includes a sense of worthlessness which varies from feelings of inadequacy to complete unrealistic negative evaluation of one's worth (Bernet *et al.*, 1993:141). The person may reproach himself or herself for minor failings that are exaggerated and search for environmental cues confirming the negative self-evaluation (Mendelson, 1975:37). According to Johnson and Forsman (1995:417), there are two different types of self-esteem, namely "basic self-esteem" and "earning self-esteem by competence and other's approval". There is a distinction between self-esteem as something which has been given to the individual by others in very early childhood, and self-esteem as something which is acquired later by one's intentional acts and strivings. In the latter they state that the person needs constant approval and is convinced that their actions determined their own worth. Every action then which is considered a failure and for which the person does not receive approval is a threat and contributes to the lowering of self-worth (Johnson & Forsman, 1995:417).

Lowered self-esteem is a widely recognised feature of depression (Bernet *et al.*, 1993:141), but whether self-esteem is a symptom of depression or is instead implicated in the casual sequence of the disorder, however, is unclear. Some theorists argue that self-esteem is a major cause of depression while others view it as a symptom arising from the process of depression (Bernet *et al.*, 1993:141).

2.4.2.7 *Shame and guilt*

According to Tangney (1993:161), shame and guilt have been cited in connection with a number of psychological disorders, including depression. Although the terms shame and guilt are often used interchangeably, it is important to differentiate between these two emotions. In doing so Tangney (1993:162) focuses on the role of the self, with guilt involving the self's negative evaluation of specific behaviours, and shame involving the self's negative evaluation of the entire self.

Guilt involves the individual's perception of having done something bad. Because of its focus on specific behaviours, the guilt experience is uncomfortable but not debilitating. That is, the self remains "able". Shame on the other hand, is a much more global, painful, and devastating experience in which the self, not just behaviour, is painfully scrutinised and negatively evaluated. This global, negative effect is often accompanied by a sense of shrinking and being small, and by a sense of worthlessness and powerlessness. Thus it is not surprising that the shamed person often wants to hide from others - to sink under the floor and disappear (Robert & Stephen, 2000:12, Tangney, 1993:162).

2.4.2.8 *Hopelessness*

The cause of symptoms of hopelessness depression is the individual's negative expectations about the occurrence of highly valued outcomes (a negative outcome expectancy), and expectations of helplessness about changing the likelihood of occurrence of these outcomes (helplessness expectancy) (Abramson *et al.*, 1993:182; Kendall & Brady, 1995:14).

According to Abramson *et al.* (1993:182), the casual chain begins with the perceived occurrence of negative life events (or non-occurrence of positive life events). They say that there are at least three types of inferences that people make about these negative events namely: a) inferences about why the event occurred (i.e., inferred cause or casual

attribution); b) inferences about consequences that might result from the occurrence of the event (i.e., inferred consequences) and c) inferences about themselves given that the event happened to them (i.e., inferred characteristics about the self). This makes the negative life events the origin of hopelessness. Hopelessness is a cause of depression and must precede the onset of depression (Kendall & Brady, 1995:15).

2.4.2.9 Psychomotor agitation and retardation

Psychomotor agitation is indicated by behaviours such as handwriting, pacing, inability to stand or sit still, pulling or rubbing of hair, pressured speech, and outbursts of complaining or shouting. Psychomotor retardation is expressed in behaviours such as slowed speech and body movements, for example, low, monotonous, or impoverished speech and increased pauses before answering (Cloitre *et al.*, 1993:208). According to Cloitre *et al.* (1993:208), neurovegetative symptoms such as psychomotor agitation and retardation occur early in the course of depressive disorder, relative to psychological symptoms of depression such as sadness and anhedonia, and thus provide a signal for the onset of depression.

2.4.2.10 Eating problems

According to Patton (1993:227), research is conflicting in terms of the typical eating patterns of people suffering from depression. The DSM-IV (Diagnostic and Statistical Manual for Mental Disorders) states that changing eating patterns can cause an increase or decrease in appetite and in severe cases can result in a change in body weight. Some studies report that a reduced appetite and weight loss is seen more frequently with older people and an increased appetite and weight gain more typically with younger women (Malan, 2000:23).

2.4.2.11 Sleeping problems

According to Cartwright (1993:243), patients report poor quality of sleep and/or inadequate total amount of sleep, leaving them feeling disturbed at night and un-refreshed in the morning. Typically, patients describe difficulty initiating sleep, middle of the night awakenings and early morning awakenings. Thus initial, middle, and terminal insomnias are all part of the objective experience common in the disorder. At the other end of the spectrum, a few patients report being sleepy all the time despite longer than normal time asleep at night (Cartwright, 1993:243, Robert & Stephen, 2000:12, Trickett, 1997:22).

In patients with depression the rapid eye movement (REM) phase of sleep begins too early and often lasts too long. This was found to be a strong characteristic in patients with depression and may relate to the severity of the depression (Cartwright, 1993:244).

2.4.2.12 Suicide attempts

Repeated thoughts about death, suicide and suicide attempts can occur in the patients suffering from depression (Malan, 2000:24). These thoughts range from a belief that others will be better off if the person was dead, to repeated thoughts about suicide and how to commit it. The frequency, intensity and outcome of the thoughts vary. In less serious cases thoughts occur once to twice a week. When the individual is more serious he would have chosen a method, place and time for suicide. According to Baumeister (1993:259), suicide is a manifestation of the wish to escape from the self. It is chosen by people who are not thinking clearly and who are responding to personal crisis. They perceive suicide as a desperate means toward a desirable end.

2.4.3 Conclusion

Malmquist (1975:89) provides one with a composite picture of how a depressed child would appear.

1. A general picture of a sad, depressed or unhappy-looking child may be present. The child does not complain of unhappiness, or is even aware of it, but rather conveys a psychomotor behavioural picture of sadness.
2. Withdrawal and inhibition with little interest in any activities may be most prominent. It is a listlessness which gives an impression of boredom, of physical illness, and often leads an observer to conclude that the child must have some concealed physical illness.
3. Somatization takes the form of physical pain (headaches, abdominal complaints, dizziness), insomnia, sleeping or eating disturbances - "depressive equivalence".
4. A quality of discontent is prominent. An initial impression is that the child is dissatisfied and experiences little pleasure, and in time the clinician gets the added impression that somehow others, even an examiner who has barely met the child, are somehow responsible for his plight. In other cases there is at casting of blame on others in the sense of easily criticising other children.
5. A sense of feeling rejected or unloved is present. There is a readiness to turn away from disappointing objects.
6. Negative self-concepts reflecting cognitive patterns of illogically drawing a conclusion that they are worthless.
7. Reports are made of observations of low frustration-tolerance and irritability; this is coupled with self-punitive behaviour when goals are not attained.
8. Although the child conveys the sense of need or wanting comfort, it is then accepted as his due, or he remains dissatisfied and discontent although he is often in ignorance as to why.
9. Reversal of effect is revealed in clowning and dealing with underlying depressive feelings by foolish or provocative behaviour to detract from assets or achievements.

10. Blatant attempts to deny feelings of helplessness and hopelessness are seen in the "Charlie Brown syndrome", modelled after the cartoon character of a boy from seven to nine years who avoids confronting his despair and disillusionment by being self-deprecatory and then springing back with hope. These indicate a hope that self-deprecations, avoidance or rewards, dedicated effort, and other examples of being "good" will lead to rewards that are just, perhaps when one grows up or at least thereafter. In childhood, hope manages to avoid the more overt manifestations of the depressive pessimism seen in the adult when disillusionment occurs.
11. Provocative behaviour which stirs angry responses in others and leads to others utilising this child as a focus for their own disappointments. Such scapegoating exhibits suffering which leads to descriptions of him or her as a "born loser". Difficulties in handling aggression may be frequent initiator of referral.
12. Tendencies to passivity and expecting others to anticipate their needs. Since this is frequently impossible, they may express their anger by passive-aggressive techniques.
13. Sensitivity and high standards with a readiness to condemn themselves for failures. There is a preference to be harsh and self-critical. This appears as an attempt to avoid conflict associated with hostility by in effect saying, "I don't blame you, only myself". In some this extends to the point of feeling there are so bad they should be dead.
14. Obsessive-compulsive behaviour in connection with other types of regressive, magical activities.
15. Episodic acting-out behaviours as a defensive manoeuvre to avoid experiencing painful feelings associated with depression (Malmquist, 1975:89.)

2.5 Obesity and depressive symptoms

Adolescence is a time of dramatic bodily changes, as well as a time of increasing cognitive understanding of interpersonal relationships. During adolescence both self-focus and awareness of others' evaluations of self is heightened (Dittmar, 2000:887).

Despite the common belief that overweight children are more unhappy than their peers, data on the relationship between obesity and depressive symptoms of young children are inconsistent (Sheslow *et al.*, 1993:290). Wallace *et al.* (1993:303) reported an increased risk for depression in obese children presenting for treatment but no significant relationship between BMI and self-reported depressive symptoms.

However, studies have found increased psychopathology among clinical samples of obese children and improvements in psychological functioning after successful weight-loss (Erickson *et al.*, 2002:934). A study done by Erickson *et al.* (2002:934) suggests that overweight girls, but not overweight boys, manifest more depressive symptoms than their normal-weight peers. Although this relationship is quite modest it seems to be mediated by overweight concerns in girls.

Pierce and Wardle (1997:648) reported that overweight children complained of being repeatedly bullied and subjected to verbal abuse in school, their neighbourhood and even at home from brothers and/or sisters. They described how they were often called lazy, clumsy and greedy. Interestingly, these overweight children were convinced that the teasing and humiliation would stop if they lost weight. They believed they would look better if they were thinner, that they will have more friends and do better at school games and sports.

Speier *et al.* (1995:471) report that prepubertal boys and girls are equally at risk for depressive disorders, whereas there is female predominance for depression in adolescence. According to Kaelber *et al.* (1995:3), one of the most consistent findings in

the epidemiology of mental disorders has been the higher prevalence of depression in females compared to males (Hammen, 1995:82). The prevalence among women is about 1.5 to 3.0 times that among men. Although women have an increased risk of first onset of major depression, the risk of chronicity and recurrence did not appear to be substantially greater than for men (Kaelber *et al.*, 1995:14).

Obese children and adolescents are at risk for psychological and social adjustment problems, including lower perceived competencies than normative samples on social, athletic and appearance domains, as well as overall self-worth (Schwimmer *et al.*, 2003:1817).

2.6 Physical activity, depressive symptoms and obesity

Exercise promotes positive psychological growth in normal adults and adolescents (Brown *et al.*, 1992:555; Norris *et al.*, 1992:55). In a study done by Field *et al.* (2001:105), they found that students with a high level of exercise had better relationships with their parents (including greater intimacy and more frequent touching), were less depressed, spent more time involved in sport, used drugs less frequently and had higher grade point averages than students with the low level of exercise. Quality experiences in sport and exercise for children can have beneficial emotional effects in terms of reduced negative affect and increases in self-esteem and feelings of well-being (Biddle, 1993:212; Sallis, 1995:125). Cross-sectional data from observational studies consistently demonstrate that physical activity is associated with reduced symptoms of depression (Dunn *et al.*, 2001:S595; Paluska & Schwenk, 2000:168). In fact, according to Paluska and Schwenk (2000:169), physical activity appears to be as effective as other therapeutic modalities for the treatment of mild or moderate depressive symptoms. Epidemiological surveys have noted that little or no leisure-time physical activity is associated with an increased risk for developing depression among previously healthy men and women in a community sample (Paluska & Schwenk, 2000:168). However, no experimental data has

shown definitely that either acute or chronic physical activity can prevent the onset of depression (Paluska & Schwenk, 2000:168). Nonetheless, highly active individuals who develop mild depression may subsequently have a lower likelihood of severe depression (Paluska & Schwenk, 2000:168).

In general, people with depression are less physically active and more deconditioned than non-depressed individuals (Paluska & Schwenk, 2000:168). Also, studies of obese adults consistently show decreased physical functioning (Schwimmer *et al.*, 2003:1817). The obese children and adolescents in the study done by Schwimmer *et al.* (2003:1817) were five times more likely than healthy children and adolescents to have impaired physical functioning (Bar-Or *et al.*, 1998:2). Furthermore, physical functioning decreased with increased weight among British adults.

The overweight child is caught in a vicious cycle. Obesity will reduce activity due to joint discomfort and distressed breathing. Once activity is reduced, body fat will continue to increase, creating even more aversion to exercise (Sothorn *et al.*, 1999:577).

Multiple interactions exist between lack of physical activity and obesity. Increased physical activity lowers the risk of obesity, may favourably influence the distribution of body weight, and confers a variety of health-related benefits even in the absence of weight loss (Rippe & Hess, 1998:531). It is important for achieving proper energy balance, which is needed to prevent or reverse obesity (Rippe & Hess, 1998:531).

Physical activity appears not only to attenuate the health risks of overweight and obesity, but active obese individuals actually have lower morbidity and mortality than normal-weight individuals who are sedentary (Blair & Brodney, 1999:S646).

2.7 Conclusion

In this chapter the development of obesity in children and its relationship with depression and physical activity were discussed. The most important conclusions from this chapter are as follows:

- Ideally, any definition of overweight/obesity in children should reflect adiposity of the child and should be related to the clinical outcome. Definitions currently in use are practical but have limitations both for clinical practice and epidemiology (Reilley *et al.*, 1999:217)
- Cole *et al.* (2000:1) proposed a new definition of overweight and obesity in childhood, based on pooled international data for body mass index. It is linked to the widely used adult cut off points of 25 kg/m² for overweight and 30 kg/m² for obesity. The definition is less arbitrary and more international than others, and should encourage direct comparison of trends in childhood obesity worldwide (Cole *et al.*, 2000:6).
- Despite the common belief that overweight children are more unhappy than their peers, data on the relationship between obesity and depressive symptoms of young children are inconsistent (Sheslow *et al.*, 1993:290).
- Increased physical activity lowers the risk of obesity, may favourably influence the distribution of body weight and confers a variety of health-related benefits even in the absence of weight loss (Rippe & Hess, 1998:531).
- Physical activity is associated with reduced symptoms of depression (Dunn *et al.*, 2001:S595; Paluska & Schwenk, 2000:168).

Chapter 3

Method of Investigation

- 3.1 *Introduction*
- 3.2 *The subjects*
- 3.3 *Anthropometrical data*
- 3.4 *Anthropometrical protocol*
- 3.5 *Anthropometrical calculations*
- 3.6 *Questionnaires*
- 3.7 *Statistical analysis of data*

3.1 Introduction

This study forms part of the THUSA BANA research project. The word “THUSA” is an acronym for Transition and Health during Urbanization in South Africa and “BANA” means children. Thusa bana is also a Setswana word that means “help the children”. The THUSA BANA research project is an inter-disciplinary project of the Faculty of Health Sciences of the North-West University (Potchefstroom Campus). Two of the five schools of this faculty, namely the School of Biokinetics, Recreation and Sport Science and the School of Psycho-Social Behavioural Sciences participated in this project. The study commenced in April 2000 and was completed in June 2001. The Ethics Committee of the Potchefstroom University for CHE approved the study (project number 00M10) and only children whose parents signed forms of informed consent were allowed to participate.

3.2 The subjects

Although the Thusa Bana project consisted of 1257 children of different ethnic groups living in the North-West Province between the ages of 10 and 15 years of age, this study focused on a sub-population of girls between 13 and 15 years of age. In collaboration with the Statistical Consultation Services of the North-West University and the North-West Province Department of Education, a stratified random sample was selected. A list of schools in the region was obtained and grouped into 12 school districts. There were 4-7 regions within each district and approximately 20 schools (minimum 14, maximum 47) per region. Based on population density the schools and regions were randomly selected. From this sample a random selection of girls between the 13 and 15 years old was made. The surveys were carried out within school hours.

3.3 Anthropometrical data

3.3.1 Subject position

The subject stood in the anatomical position with the feet slightly apart and arms comfortably by the side with enough space for the measurer to move around the subject and manipulate the equipment easily. The subjects were asked to present themselves in their gym kit to facilitate ease of measurement and accuracy but also reserve privacy.

3.3.2 The anatomical position

For all the following descriptions of positions and directions the body can be considered to be in the anatomical position. The anatomical position is defined as the position of the living body standing erect with the arms by the sides and the palms and the feet facing forward (Ross & Marfell-Jones, 1991: 224). Please see Figure 3.1.

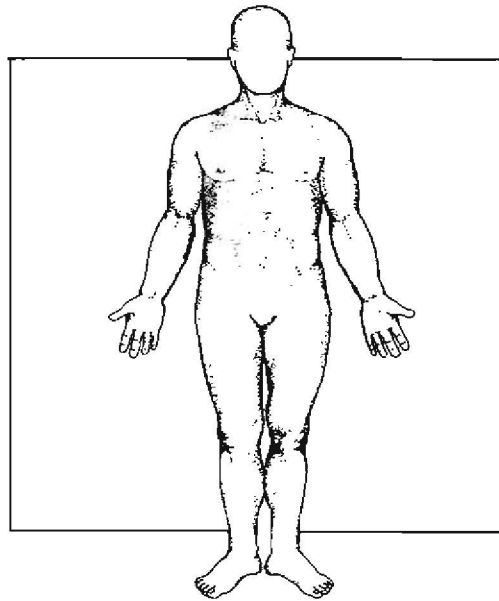


Figure 3.1: A person in the anatomical position.

3.3.3 The Frankfort plane

When measuring stature, the subject's head must be positioned in the Frankfort plane. The head is in the Frankfort plane when the line between the orbitale and tracion is horizontal. The orbital is the lower bony margin of the eye socket and the tracion is the notch superior to the tragus of the ear. (ISAK, 2001:47; Ross & Marfell-Jones, 1991:224).

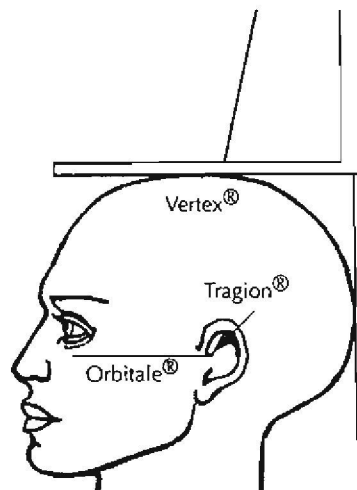


Figure 3.2: The head in the Frankfort plane.

3.3.4 The apparatus

3.3.4.1 Lufkin steel measuring tape

The Lufkin steel measuring tape is flexible, 2m in length and 7mm wide. It has a blank area of 8cm before the zero line. It is calibrated in centimetres with millimetre gradations. It is enclosed in a case with automatic retraction. In addition to assessing the girth measurements the tape is also used to locate a number of skinfold sites accurately and mark distances from bony landmarks (ISAK, 2001:9).

3.3.4.2 Harpenden skinfold callipers

The Harpenden skinfold calliper is recommended by ISAK (The International Society for the Advancement of Kinanthropometry) as the criterion instrument for measuring skinfolds. A new Harpenden calliper is reported to have a compression of 10g.mm^{-2} throughout the range of measurement. The calliper was used to measure the skinfolds (ISAK, 2001:10).

3.3.4.3 Electronic scale

A portable electronic scale accurate to within 0.005kg was used to measure body mass.

3.3.4.4 Portable stadiometer

A portable stadiometer was used to measure stature. It is calibrated in centimetres with millimetre gradations. The stadiometer was periodically checked against a standard height.

3.4 Anthropometrical protocol

3.4.1 Body mass

Technique: Check that the scale is reading zero. The subject stands on the centre of the scale without support and with the weight distributed evenly on both feet (ISAK, 2001:53).

3.4.2 Stature

Technique: The stretch stature method and stadiometer was used. This requires the subject to stand with the feet together and the heels, buttocks and upper part of the back touching the scale. The head, when placed in the Frankfort plane, need not be touching the scale. The measurer places the hands far enough along the line of the jaw of the subject to ensure that upward pressure is transferred throughout the mastoid process. The subject is instructed to take and hold a deep breath and while keeping the head in the Frankfort plane the measure applies gentle upward lift through the mastoid process. The measurer places the headboard firmly down on the vertex, crushing the hair as much as possible. The recorder further assists by watching that the feet do not come off the floor and that the position of the head is maintained in the Frankfort plane. Measurement is taken at the end of a deep inward breath (ISAK, 2001:54).

3.4.3 Skinfolds

Technique: Great care is needed when measuring skinfolds due to low accuracy and precision. The skinfold site should be carefully located using the correct anatomical marks. The skin is marked with a fine tipped felt or demographic pen for all skinfold marks to minimise location errors for repeated measures. The skinfold is picked up at the marked line. It should be grasped and lifted (raised) so that a double fold of skin and the underlying subcutaneous adipose tissue is held between thumb and index finger of the left

hand. Care must be taken not to incorporate muscle tissue in the grasp. The calliper is applied 1cm away from the edge of the thumb and the finger at a depth of approximately mid-fingernail. The calliper is held at 90° to the surface of the skinfold site. The measurement is recorded for 2sec with the full pressure of the calliper applied (ISAK, 2001:59).

3.4.4 Anatomical landmarks for skinfolds

3.4.4.1 Acromiale skinfold

Definition: The point on the superior part of the acromion border in line with the most lateral aspect.

Location: Standing behind and on the right hand side of the subject, palpate along the spine of the scapula to the corner of the acromion. This represents the start of the lateral border which usually runs anteriorly, slightly superiorly and medially. Apply the straight edge of a pencil to the lateral aspect of the acromion to confirm the location of the most lateral part of the border. Mark this most lateral aspect. The acromion has an associated bone thickness. Palpate superiorly to the top margin of the acromion border in line with the most lateral aspect (ISAK, 2001:24).

3.4.4.2 Radiale skinfold

Definition: The point at the proximal and lateral border of the head of the radius.

Location: Palpate downward into the lateral dimple of the right elbow. It should be possible to feel the space between the capitulum of the humerus and the head of the radius. Then move the thumb distally onto the most lateral part of the proximal radial head. Correct location can be confirmed by slight rotation of the forearm which causes the head of the radius to rotate (ISAK, 2001:25).

3.4.4.3 Mid-acromiale-radiale skinfold

Definition: The point equidistant from the Acromiale and Radiale

Location: Measure the linear distance between the Acromiale and Radiale landmarks with the arm relaxed and extended by the side. The best way to measure this is with a segmometer or large sliding calliper. If a tape is used be sure to avoid following the curvature of the surface of the arm. Place a small horizontal mark at the level of the mid-point between these two landmarks. Project this mark around to the posterior and anterior surfaces of the arm as a horizontal line. This is required for locating the triceps and biceps skinfold sites (ISAK, 2001:26).

3.4.4.4 Subscapulare skinfold

Definition: The undermost tip of the inferior angle of the scapula.

Location: Palpate the inferior angle of the scapula with the left thumb. If there is difficulty locating the inferior angle of the scapula, the subject should slowly reach behind the back with the right arm. The inferior angle of the scapula should be felt continuously as the hand is again place by the side of the body. A final check of this landmark should be made with the hand by the side in the relaxed position (ISAK, 2001:31).

3.4.4.5 Triceps skinfold

This skinfold is located at the posterior part of the triceps, in the mid-line, at the level of the marked mid-acromiale-radiale landmark. The fold is parallel to the long axis of the arm. The subject assumes a relaxed standing position with the left arm hanging by the side. The right arm should be relaxed with the shoulder joint slightly externally rotated and the elbow extended by the side of the body (ISAK, 2001:63).

3.4.4.6 Sub-scapular skinfold

This site is 2cm along a line running laterally and obliquely downward from the subscapular landmark at a 45° angle. The line of the skinfold is determined by the natural fold lines of the skin. The subject assumes a relaxed standing position with the arms hanging by the sides (ISAK, 2001:64).

3.4.5 Girths

Technique: The cross-hand technique is used to measure all girths. The tape is held at right angles to the limb or body segment that is being measured and the tension of the tape must be constant, i.e. there is no indentation in the skin. To position the tape, hold the case in the right and the stub in the left hand. Facing the body part to be measured, pass the stub end around the back of the limb and take hold of the stub with the right hand which then holds both the stub and the casing. At this point the left hand is free to manipulate the tape to the correct level. Apply sufficient tension to the tape with the right hand to hold it at that position while the left hand reaches underneath the casing to take hold of the stub again. The tape is now around the part to be measured. The middle fingers of both hands are free to locate the tape exactly at the landmark of measurement and to orientate the tape so that the zero is easily read. The juxtaposition of the tape ensures that there is contiguity of the two parts of the tape from which the girth is determined. When reading the tape the measurer's eyes should be at the same level of the tape to avoid any error of parallax (ISAK, 2001:75).

3.4.6 Anatomical landmark for girths

3.4.6.1 Iliocristale girth

Definition: The point on the most lateral aspect of the iliac tubercle, which is on the iliac crest.

Location: From behind the subject, locate the most lateral edge of the iliac crest on the ilium using the right hand. The left hand is used to stabilise the body by providing resistance on the left side of the pelvis. The landmark is the most lateral point made at the identified edge of the ilium (ISAK, 2001:34).

3.4.6.2 Waist girth

Method: This girth is taken at the narrowest point between the lower costal (10th rib) border and the iliac crest. The anthropometrist stands in front of the subject who abducts the arms slightly to allow the tape to be passed around the abdomen. The stub of the tape and the housing are then both held in the right hand while the anthropometrist uses the left hand to adjust the level of the tape at the back to the adjudged level of the narrowest point. The anthropometrist resumes control of the stub with the left hand and using the cross-hand technique positions the tape in front at the target level. The subject is instructed to lower the arms to the relaxed position. The tape is then readjusted as necessary to ensure it has not slipped and does not excessively indent the skin. The subject should breath normally and the measurement is take at the end of normal expiration (end tidal). If there is no obvious narrowing the measurement is taken at the mid-point between the lower costal (10th rib) border and the iliac crest (ISAK, 2001:83).

3.4.6.3 Gluteal (hip) girth

Method: This girth is taken at the level of the greatest posterior protuberance of the buttocks which usually corresponds anteriorly to the symphysis pubis. The anthropometrist passes the tape around the hip from the side. The stub of the tape and the housing are then both held in the right hand while the anthropometrist uses the left hand to adjust the level of the tape at the back to the adjudged level of the greatest posterior protuberance of the buttocks. The anthropometrist resumes control of the stub with the left hand, and using the cross-hand technique, positions the tape in front and the sides so that the tape is held in a horizontal plane at the target level. The tape is then readjusted as

necessary to ensure it has not slipped and does not excessively indent the skin (ISAK, 2001:84).

3.5 Anthropometric calculations

Three parameters were used to determine body fat mass namely the percentage body fat, body mass index (BMI), and the sum of the triceps and subscapular skinfolds.

3.5.1 Percentage body fat

For the calculation of percentage body fat the formula for children and adolescents from Boileau *et al.* (1985:17-27) was used.

6-11 years

$$\begin{aligned}\% \text{ Fat} &= 1.35 \times (\text{triceps} + \text{subscapular skinfold}) \\ &\quad - 0.012 \times (\text{triceps} + \text{subscapular skinfold})^2 - 3.4\end{aligned}$$

12-14 years

$$\begin{aligned}\% \text{ Fat} &= 1.35 \times (\text{triceps} + \text{subscapular skinfold}) \\ &\quad - 0.012 \times (\text{triceps} + \text{subscapular skinfold})^2 - 4.4\end{aligned}$$

15-18 years

$$\begin{aligned}\% \text{ Fat} &= 1.35 \times (\text{triceps} + \text{subscapular skinfold}) \\ &\quad - 0.012 \times (\text{triceps} + \text{subscapular skinfold})^2 - 5.4\end{aligned}$$

3.5.2 Body mass index (BMI)

The Heyward and Stolarczyk (1996:79) formula was used for calculation of the body mass index (BMI). It is derived by dividing weight (kilograms) by height (meters) squared (Dietz, 1998:191; Smith *et al.*, 1997:466).

$$\text{BMI} = \frac{\text{Body mass (kg)}}{\text{Body height}^2 (\text{m}^2)}$$

3.6 Questionnaires

3.6.1 Children's Depression Inventory (CDI)

School-aged children are reliable and valid informants of their own current mental state. They are, therefore, more able than their parents to provide an account of their depressive symptoms (Kolvin in Goodyer, 1995:119; Kaplan *et al.*, 1994:101). Depressive symptomatology will thus be assessed by means of a self-report instrument, the Children's Depression Inventory (CDI), which was developed for children between the ages of 8 and 17 (Kovacs, 1985:995). The instrument quantifies a range of depressive symptoms, including disturbed mood, hedonic capacity, vegetative functions, self-evaluation and interpersonal behaviour. It consists of 27 items, each of which has three responses, graded in severity from 0 to 2. The total score is obtained by adding the individual items' scores with a maximum score of 54 (Kovacs, 1992:995). The higher the score, the more depressed is the child, according to his self-report. A score of 17 is the most sensitive for discrimination of major depressive disorder (Craighead *et al.*, 1995:171). Several American studies have reported the reliability and validity of the CDI with alpha coefficients between 0.70 and 0.80 (Cerezo & Frias, 1994:923; Craighead *et al.*, 1995:171; Crowley *et al.*, 1994:705; Fitzpatrick, 1993:528; Fitzpatrick & Boldizar, 1993:424).

3.6.2 Previous Day Physical Activity Recall (PDPAR)

For the purpose of this study the Previous Day Physical Activity Recall (PDPAR) questionnaire developed by Trost *et al.* (1999:343) was used.

This questionnaire records information about the person's physical activity during the previous day. The children will be expected to recall the previous day's activity in every 30-minute period according to the activity list. The type and intensity of the activity will be completed on the questionnaire.

The intensity of the activity is classified by the fatigue factors of high, moderate and low. A MET-value is used to express the intensity of the activity in a metabolic value (Trost *et al.*, 1999:343). According to McArdle *et al.* (1994:167), a MET is defined as a multiple of the resting metabolic rate measured in millimeters of oxygen consumed per kilogram of body mass per minute (ml/kg/min). Diagrams of low (< 3 METS), moderate (> 3 METS) and high (> 6 METS) are used to explain the different classifications of intensity to the children. The MET value of the physical activity is taken directly from the compendium of physical activities and energy expenditure list of the PDPAR (Ainsworth *et al.*, 1993:73, Weston *et al.*, 1997:139). A relative energy expenditure value is used to estimate the total daily energy expenditure from the energy expended during specific time periods and in specific activities. The number of 30-minute periods with a MET value equal or greater than 3 METS, as well as the number of 30-minute periods with a MET value equal or greater than 6 METS is observed. The subject's level of activity is classified as follows: high active is when 1 or more 30-minute periods are coded as 3 METS (Pate *et al.*, 1997:241). Subjects are classified as low active when they do not fall in the moderate or high active categories (Pate *et al.*, 1997:244).

The PDPAR questionnaire has been tested (test-retest reliability coefficient was 0.99 ($p < 0.01$) as valid and reliable by Weston *et al.* (1997:141) and has been used successfully by several researchers (Prista *et al.* 1997:450; Pate *et al.*, 1997:242).

3.7 Statistical analysis of data

Statistica for Microsoft Windows (StatSoft, Inc. 1984 – 2005) of the North-West University was used for the data analysis. A one-way analysis of variance (ANOVA) and a two-way analysis of variance (MANOVA) were used for all comparisons (Thomas & Nelson, 1996:107-115). Hypothesis 1, where the assumption is made that there is a relationship between obesity and depressive symptoms, was statistically investigated by a one-way analysis of variance (ANOVA). Hypothesis 2, where the effect of physical activity on the probable relationship between obesity and depressive symptoms was investigated, a two-way analysis of variance (MANOVA) was used.

Chapter 4

Results and discussion

4.1 Introduction

4.2 Descriptive statistics

4.3 Obesity's relationship with depression

4.4 The relationship between physical activity, obesity and depressive symptoms

4.5 Conclusion

4.1 Introduction

In this chapter the results of the study will be reported and discussed. Firstly the descriptive statistics of the body composition, depression and physical activity for the individual age groups and total group will be presented. This will be indicated in Tables 4.1 and 4.2 as well as Figures 4.1 to 4.3. In the second part of the chapter the relationship between obesity and depressive symptoms will be presented by means of Figures 4.4 to 4.7. Finally the possible influence of physical activity on the relationship between obesity and depression will be presented. This will be indicated in Figures 4.4 to 4.11.

4.2 Descriptive statistics

4.2.1 Body composition

In Table 4.1 the descriptive statistics of the percentage body fat of the 13 to 15 year old girls used in the study are represented. The highest percentage body fat of $45.0\% \pm 6.2$ was found among the 14 year old girls, while the lowest percentage body fat of $10.6\% \pm 6.7$ was found among the 13 year old girls. An average percentage body fat of $24.6\% \pm 6.5$ was calculated for the total group of girls ($N = 230$), with the mean percentage body fat for the 13 year-old girls, 22.8% ($n = 73$), for the 14 year-old girls it was 25.2% ($n = 72$) and for the 15 year old girls, 25.6% ($n = 85$). There is a trend towards an increase in percentage body fat with an increase in age. This is most notable between the 13 and 14 year old girls.

Age	n	Mean	Minimum	Maximum	SD
13	73	22.8	10.6	35.6	6.7
14	72	25.2	13.4	45.0	6.2
15	85	25.6	12.3	34.6	6.2
All groups	230	24.6	10.6	45.0	6.5

Table 4.1: Descriptive statistics of percentage body fat in 13 to 15 year-old girls.

To calculate the percentage body fat in children, Lohman (1992:84) recommends that the sum of the triceps and subscapular skinfolds be used. Lohman (1992:84) developed reference tables to which percentage body fat can be represented based on the sum of the triceps and subscapular skinfolds (see Table 4.2).

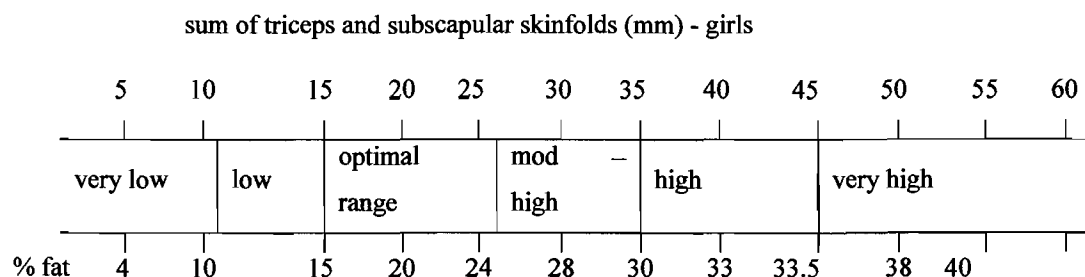


Table 4.2: Lohman's classification of body fat levels in girls (Lohman 1992:84).

According to Lohman's percentage body fat scale for girls (Table 4.2), the average value of 24.6% occurs towards the upper limit of the optimal range (between 15% and 25.5%). The lowest percentage body fat value of 10.6% falls within the very low range which can be an indication of a health risk. The highest percentage body fat value of 45.0% which occurs among the 14 year-old girls, therefore, lies within the very high percentage body fat category, which also is an indication of a health risk.

In Figure 4.1 the percentage body fat of girls between 13 to 15 years-old in terms of low, normal, high and very high categories are represented. The percentage of the total group of girls in the low percentage body fat group is 6%, with 46% of the girls classified as normal, 23% of the girls as high and 25% of the total group of girls classified as having a very high percentage body fat.

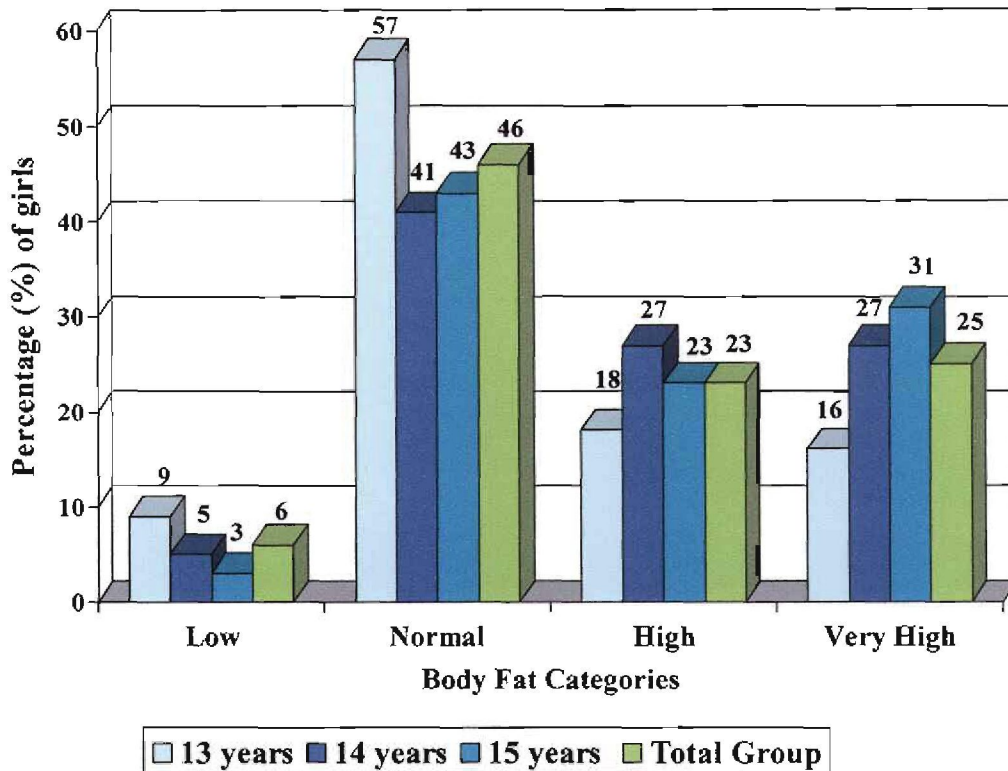


Figure 4.1: Percentage of girls between 13 and 15 years-old in terms of low, normal, high and very high percentage body fat (N = 230).

The 13 years-old group has 9% of the girls in the low percentage body fat group, 57% in the normal group, 18% in the high group and 16% in the very high percentage body fat group. There are 5% of 14 years-old girls in the low percentage body fat group, 41% in the normal group, 27% in the high group and 27% of girls in the very high percentage body fat group. In the 15 years-old group 3% of girls are classified as low percentage body fat, 43% as normal, 23% as high and 31% are classified as very high percentage body fat. It was observed that 48% of the total group of girls were classified as having a high or very high percentage body fat.

4.2.2 Depression

In Figure 4.2 the descriptive statistics of depression in the 13 to 15 years-old girls used in the study are represented. The percentage of the total group of girls with an average level of depression is 29%, with 40% of the girls classified as above average, and 31% of the girls classified as having a very much above average level of depression. The 13 years-old group has 26% of the girls in the average level of depression group, 38% in the above average group, and 36% in the very much above average group. There are 32% of 14 years-old girls in the average level of depression group, 36% in the above average group, and 32% in the very much above average group. In the 15 years-old group 29% of girls are classified as having an average level of depression, 45% as above average, and 26% as very much above average level of depression. The highest percentage value of 45% is found in the 15 year-old girls with an above average level of depression. When looking at the individual age groups there is no statistical significant difference in terms of the level of depression reported. However, interestingly a relatively higher percentage of 13 year-old girls experienced a very much above average level of depression when compared to the 14 and 15 year-old girls.

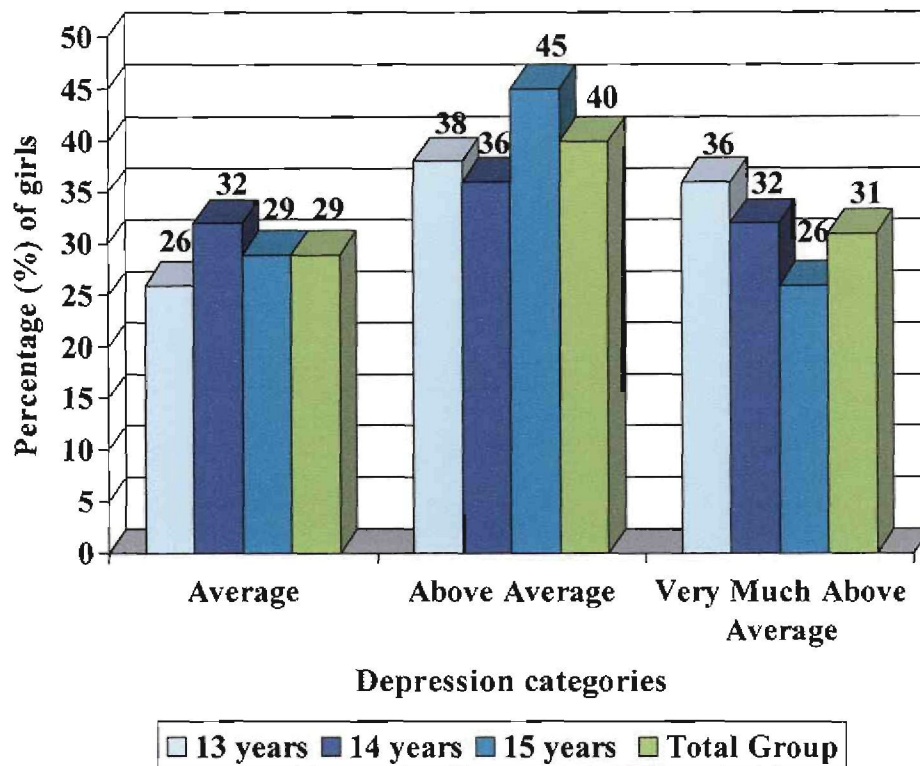


Figure 4.2: Percentage of girls between 13 and 15 years-old in terms of average, above average and very much above average levels of depression (N = 230).

4.2.3 Physical activity

In Figure 4.3 the descriptive statistics for physical activity in the 13 to 15 year-old girls used in the study are represented. For the purpose of this study the level of physical activity was classified as low, normal or highly active. The percentage of the total group of girls with a low level of physical activity is 74%, with 21% reporting normal activity levels, and 5% of the girls reporting high physical activity levels. The 13 years-old category has 67% of the girls in the low level of physical activity group, 27% in the normal group, and 6% in the highly active category. There are 79% of 14 years-old girls in the low level of physical activity category, 16% in the normal category, and 5% in the highly active category. In the 15 years-old category 74% of girls are classified as having

a low level of physical activity, 19% as normal active, and 7% as having high levels of physical activity.

There is no statistical significant difference in level activity between the age groups. There is, however, a clear difference between the levels of activity undertaken.

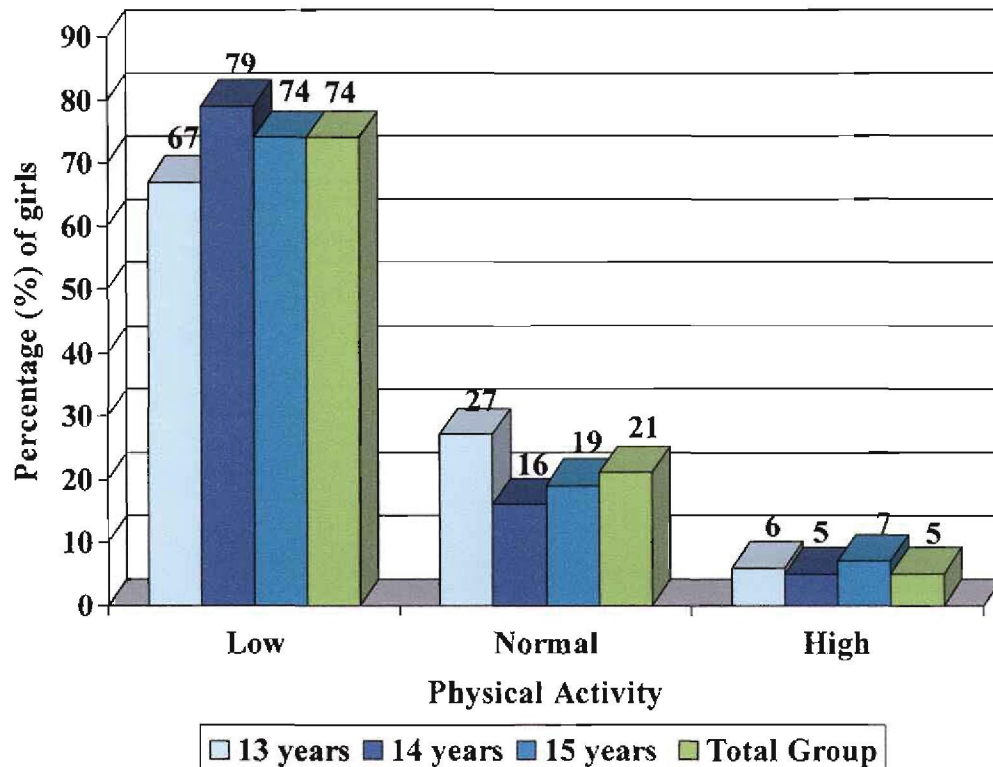


Figure 4.3: Percentage of girls between 13 and 15 years-old in terms of low, normal and high level of physical activity (N = 230).

The trend of this study in terms of low level of physical activity undertaken is in relative agreement with Armstrong *et al.* (1990:203). They showed that British children have surprisingly low levels of habitual physical activity, and many children seldom undertake the volume of physical activity believed to benefit the cardiopulmonary system. Girls were also found to be less active than boys in their study. Van Mil *et al.* (1999:541) have

also has shown an annual decline in physical activity of 4 to 8% between the ages of 12 years and 15 to 18 years for boys and girls.

4.3 Obesity's relationship with depression.

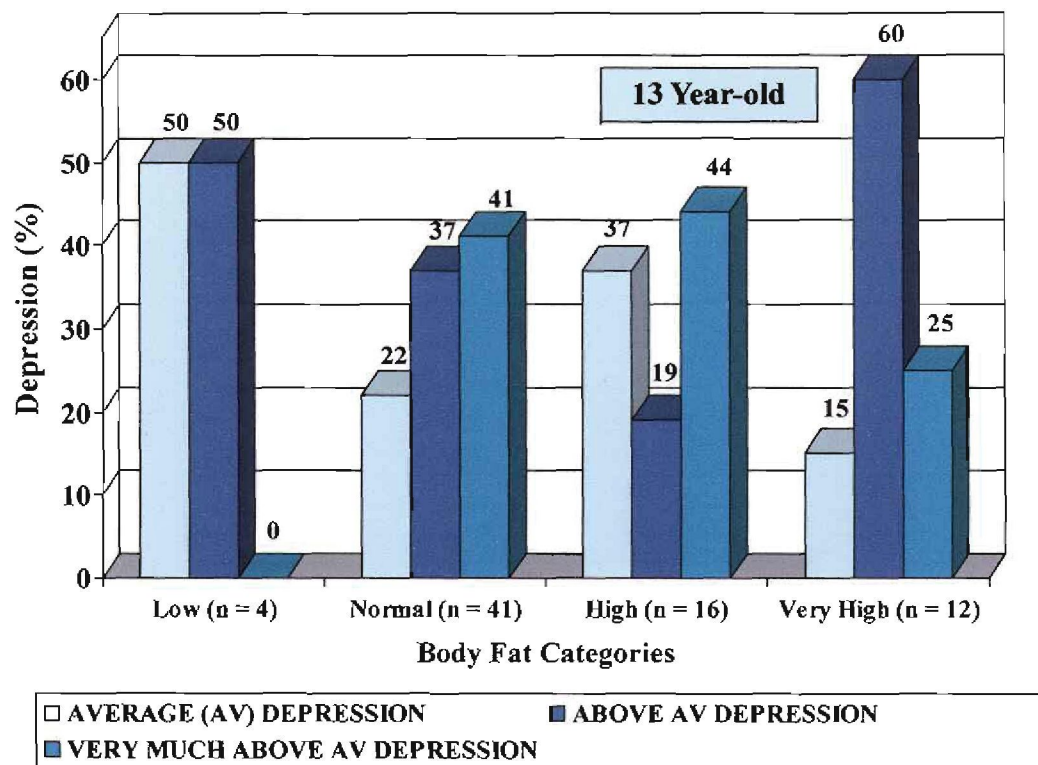


Figure 4.4: The relationship between obesity and depression in 13 year-old girls (n = 73).

In Figure 4.4 the relationship between obesity and depression in 13 year-old girls used in the study is represented. There is a statistically significant difference ($p < 0.05$) in the very high body fat category between percentage of girls being averagely depressed (15%) and above averagely depressed (60%). This indicates that the very obese 13 year-old girls show a significant above average level of depression. There was 44 % of 13 year-old girls with high body fat that reported a very much above average level of depression. In the very high body fat category 25% of girls were very much above averagely depressed.

Because there were only four subjects that had a low body fat the table appears skewed and should not be misinterpreted. Interestingly, the normal body fat girls showed relatively high levels of depression with 78% reporting an above average or very much above average level of depression. There appears to be a trend towards higher levels of depression with an increase in body fat.

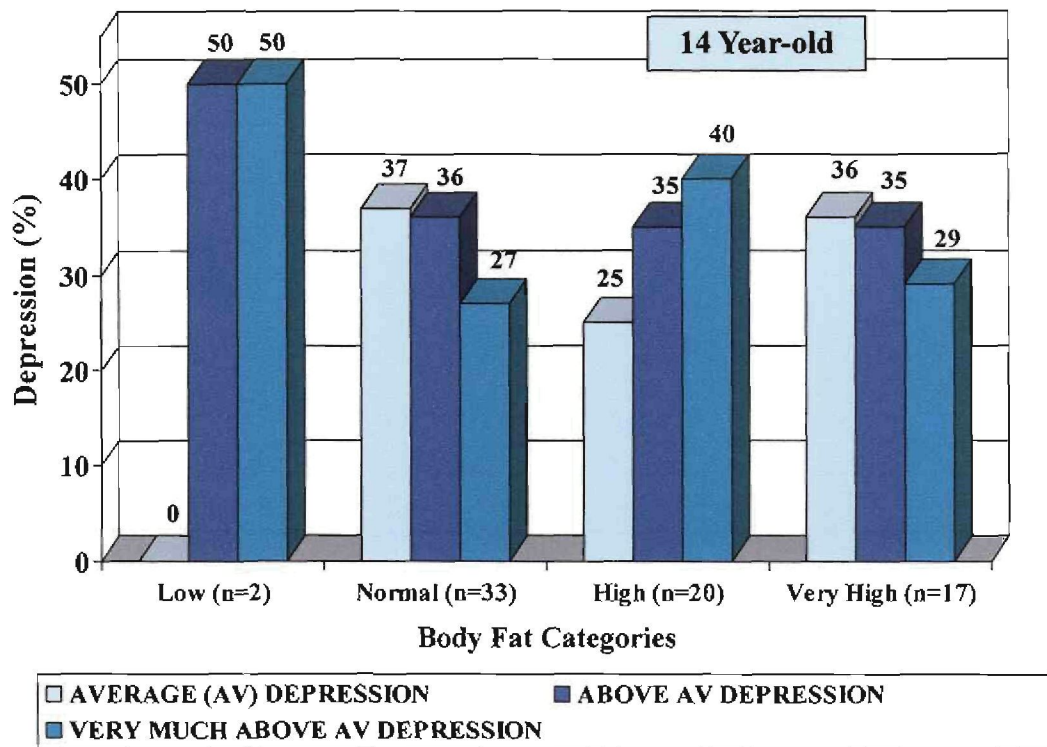


Figure 4.5: The relationship between obesity and depressive symptoms in 14 year-old girls (n = 72).

The relationship between obesity and depression in 14 year-old girls is represented in Figure 4.5. There was no statistical significant difference found in this analysis. Again the small number of subjects in the low body fat category gives a false impression of high levels of depression. For the purpose of this discussion this category will be ignored. In the normal body fat group, 37% of girls reported average levels of depression, 36% above average level of depression and 27% reported a very much above level of depression. In

the high body fat category there is a clear trend towards an increase in the level of depression reported with 35% of girls being above averagely depressed and 40% being very much above averagely depressed. In the very high body fat category 35% of girls had normal levels of depression while 64% had above or very much above levels of depression.

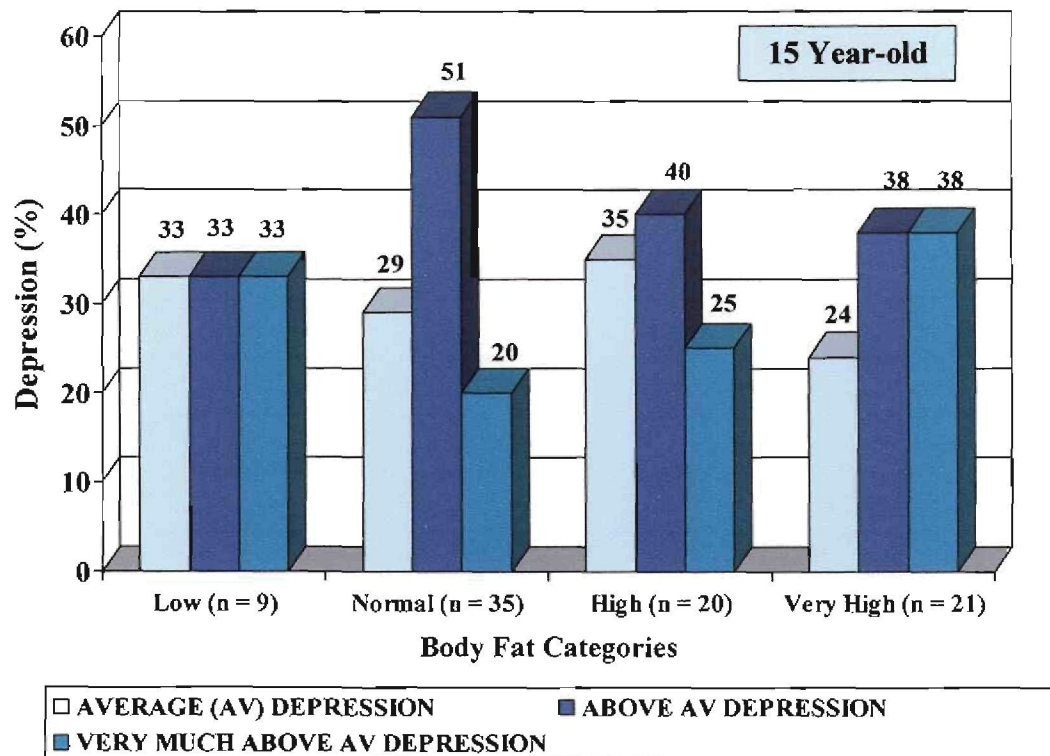


Figure 4.6: The relationship between obesity and depressive symptoms in 15 year-old girls (n = 85).

Figure 4.6 represents the 15 year-old girls in terms of body fat and level of depression. The low level of depression category had only a very small number of subjects which will render an inaccurate interpretation. There is a trend of high levels of depression in the very high body fat category with 76% of girls reporting above and very much above average levels of depression. In the high body fat category 40% of girls were above averagely depressed and 25% very much above averagely depressed. In the normal body

fat category 71% of girls reported an above average or very much above average level of depression.

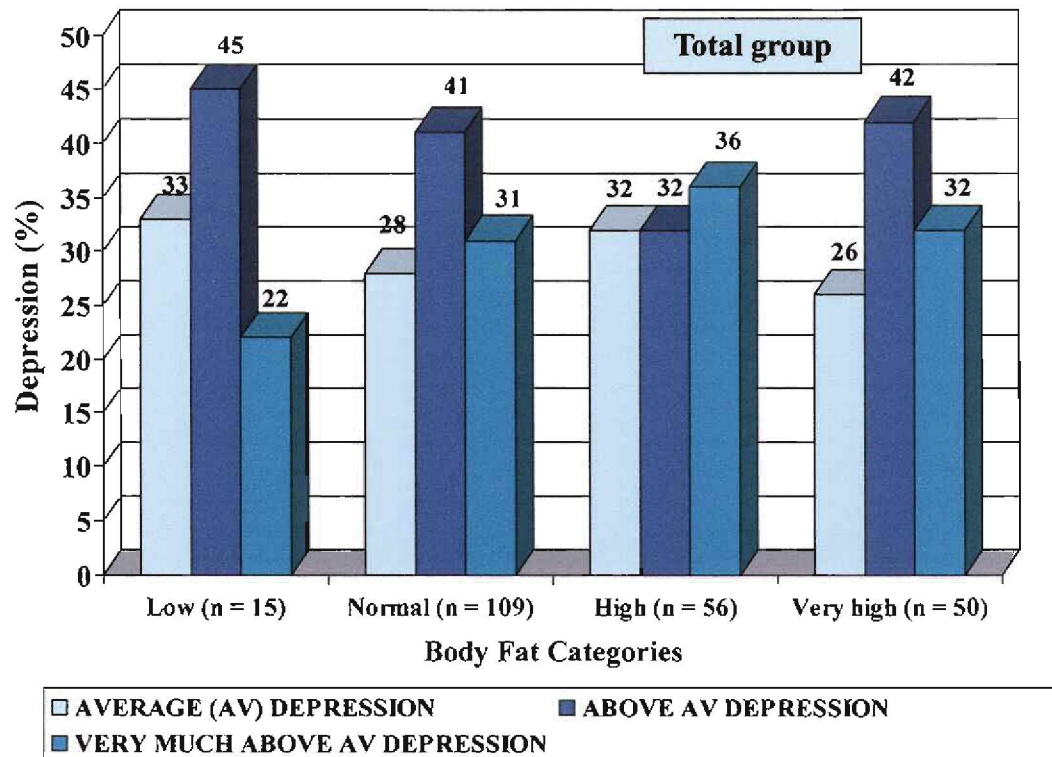


Figure 4.7: The relationship between obesity and depressive symptoms in the total group of girls (N = 230).

The relationship between obesity and depression for the total group of girls is represented in Figure 4.7. In the very high body fat category 75% of the girls reported an above average and very much above average level of depression. There were 68% of girls classified as having a high body fat that reported an above average or very much above average level of depression. In the high body fat category 32% of girls had an average or normal level of depression.

Interestingly, in the normal and low body fat groups the majority of the girls, 45% and 41% respectively, reported an above average level of depression. In the normal body fat category 72% of girls reported an above average or very much above average level of

depression with only 28% of girls reporting an average or normal level of depression. From this trend it can be inferred that body fat was not the only factor that contributed to the levels of depression reported in this group. However, there is a clear trend in the high and very high body fat groups of girls reporting above and very much above average levels of depression.

4.4 The relationship between physical activity, obesity and depressive symptoms

This section of the chapter will be devoted to the relationship between physical activity, obesity and depressive symptoms. These parameters will be dealt with in relation to the different age groups as well as the total group. There were no statistical significant differences found within the different age groups and for this reason only the obese girls will be represented in the results. There was a statistical significant difference in the total group of girls between the low active and high active girls. This was the only statistical significant difference found for these variables in this group. The chapter will be concluded with a short discussion of the results and how they relate to other research.

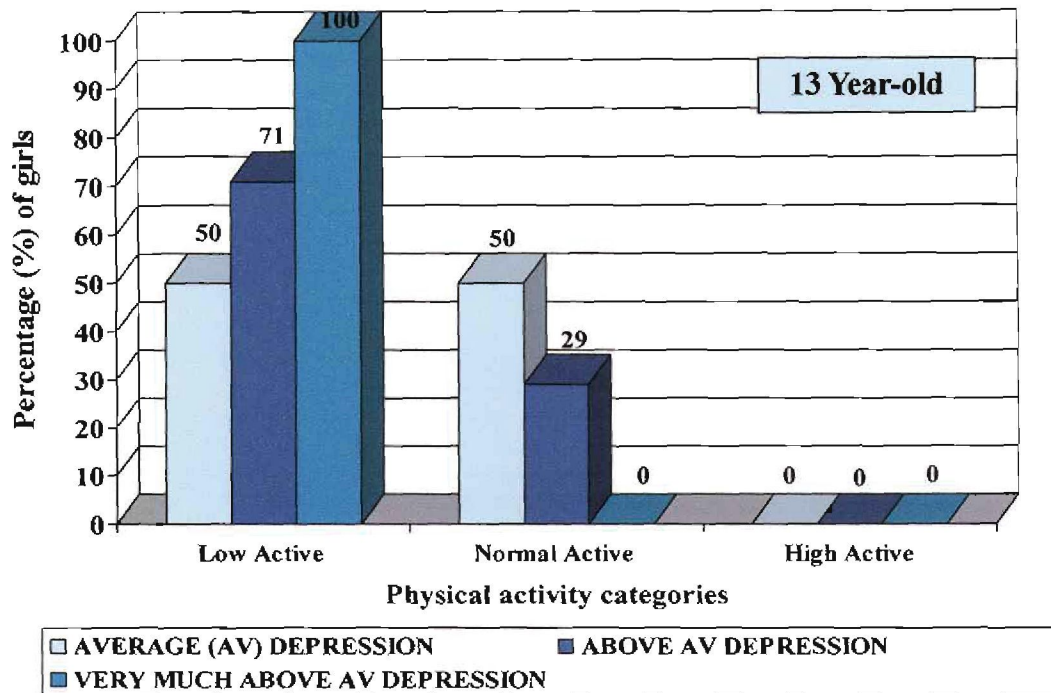


Figure 4.8: The relationship between physical activity, obesity and depressive symptoms in the 13 year-old group of girls.

In Figure 4.8, the relationship between physical activity, depressive symptoms and obesity for the 13 year-old girls is represented. There was no highly active 13 year-old girls in the obese category. In the normal active group 50% of the obese 13 year-old girls reported an average or normal level of depression and 29% an above average level of depression. The majority of the obese 13 year-old girls, had low levels of activity. All the obese 13 year-old girls that reported a very much above level of depression were low active, with 71% that reported an above average level of depression being low active and 50% of the obese girls with normal levels of depression being low active. There is a clear trend of reduced activity levels for the obese 13 year-old girls. Figure 4.8 also indicates that the obese 13 year-old girls that reported high levels of depression had low levels of activity. Because there were no highly active girls in this group one cannot determine whether physical activity has a positive influence on the relationship between obesity and

depression. However, in the normal active group 50% of the girls reported normal levels of depression. From this can then be inferred that obese 13 year-old girls that have normal levels of activity have less symptoms of depression. This trend agrees with the second hypothesis.

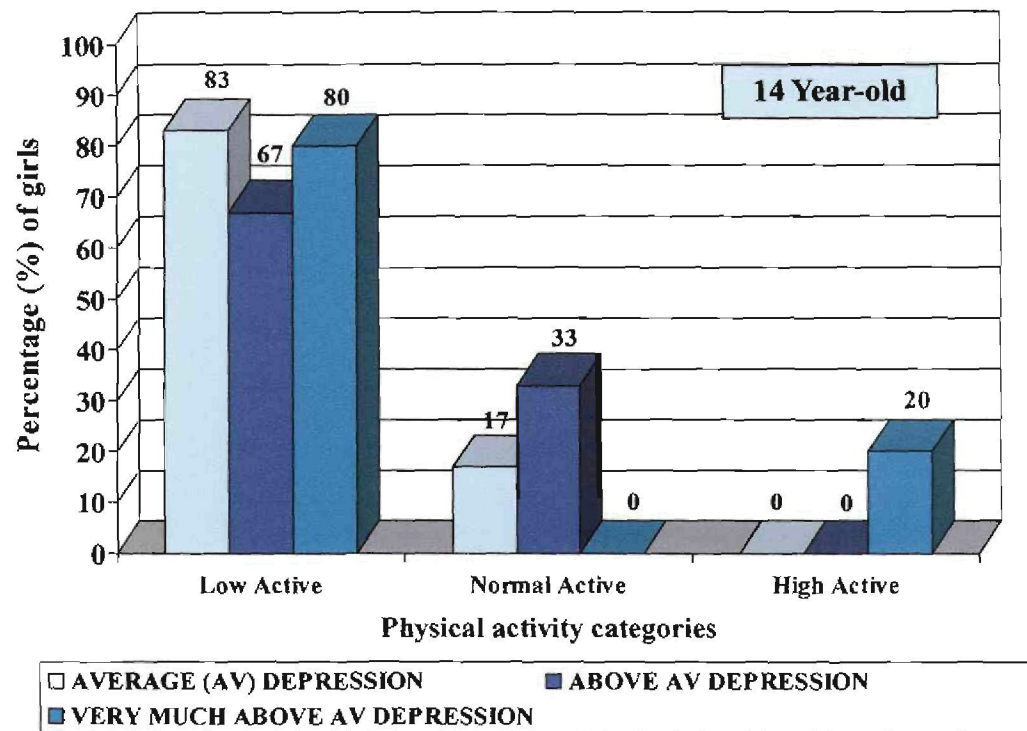


Figure 4.9: The relationship between physical activity, obesity and depressive symptoms in the 14 year-old group of girls.

The relationship between physical activity, obesity and depressive symptoms for the 14 year-old girls is represented in Figure 4.9. In this obese category, 20% of the girls were highly active and reported a very much above average level of depression. In the normal active group of girls 33% reported above average levels of depression and 17% reported normal levels of depression. As seen with the 13 year-old girls, the majority of the 14 year-old girls that were obese had low levels of activity. A total 67% of the obese girls that were low active reported an above average level of depression and 80% a very much

above average level of depression. Interestingly, 83% of the obese girls with low levels of activity reported normal levels of depression. Due to the lack of highly active girls and statistical significant differences between the variables for this group, the influence of physical activity on the relationship between obesity and depressive symptoms cannot be determined. There is, however, a strong indication that low levels of activity can be associated with obesity and above average levels of depression in 14 year-old girls. This trend will be in agreement with the second hypothesis.

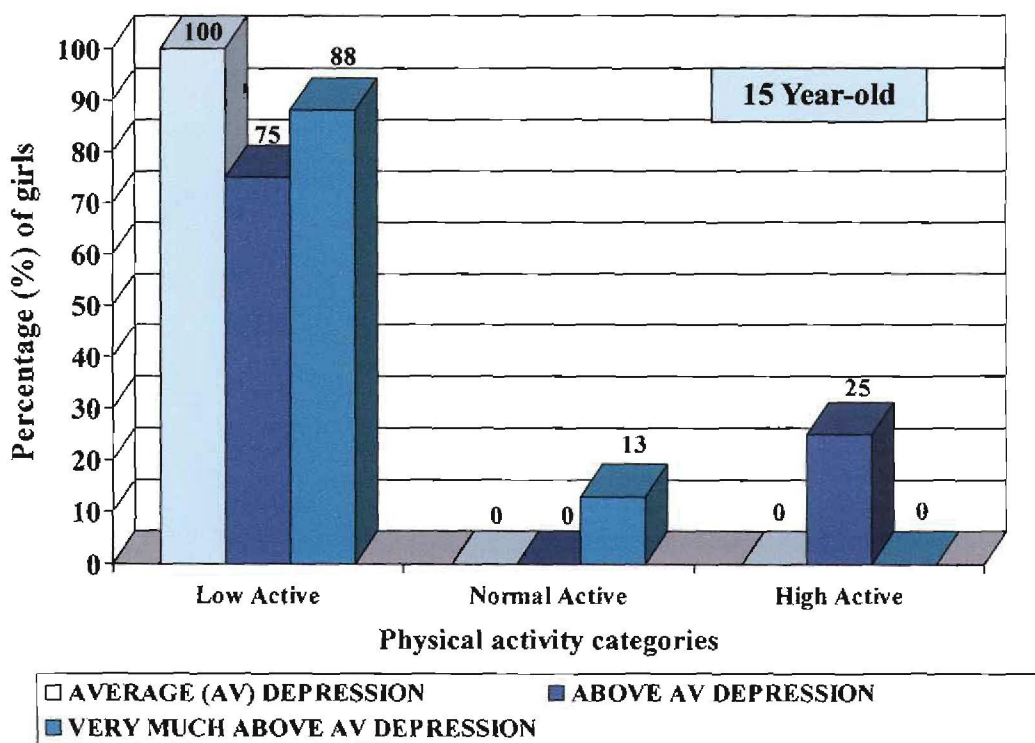


Figure 4.10: The relationship between physical activity, obesity and depressive symptoms in the 15 year-old group of girls.

In Figure 4.10, the relationship between physical activity, obesity and depressive symptoms for the 15 year-old girls is represented. There were 25% of obese girls that were highly active and reported an above average level of depression, and 13% with normal activity levels that reported and a very much above average level of depression.

Again, as seen with the 13 and 14 year-old obese girls, the majority of the 15 year-old obese girls fell in the low activity category. It is not surprising then that there are high levels of depression in this category with 75% reporting an above average level of depression and 88% a very much above average level of depression. Interestingly, all the obese 15 year-old girls that reported normal levels of depression remained low active. Due to the low level of highly active girls and statistical significant differences between the variables for this group, the influence of physical activity on the relationship between obesity and depressive symptoms cannot be determined. However, a trend can be observed that low levels of activity can be associated with obesity and above average levels of depression in 15 year-old girls. This trend agrees with the second hypothesis.

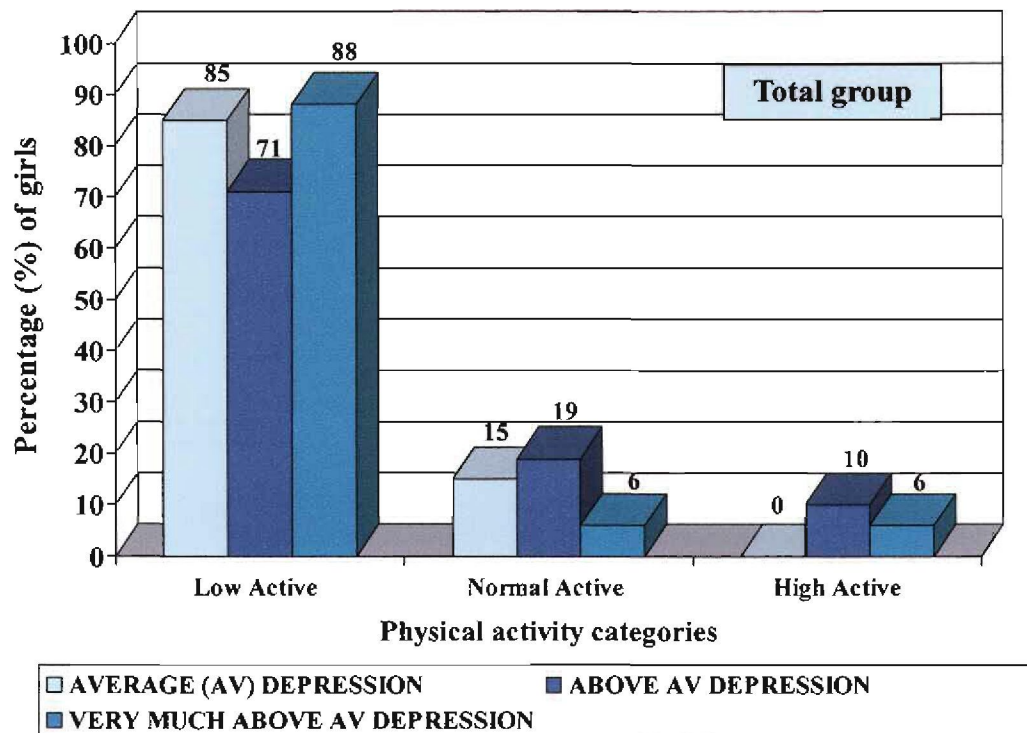


Figure 4.11: The relationship between physical activity, obesity and depressive symptoms in the total group of girls (N = 230).

In Figure 4.11 the relationship between physical activity, obesity and depressive symptoms for the total group of girls is represented. There were 16% of obese girls that reported an above average or very much above average level of depression that were highly active. A total of 6% of the obese girls with normal levels of activity reported a very much above average level of depression, 19% reported an above average level of depression and 15% reported a normal level of depression. The majority of the obese girls were classified as low active, as seen within the individual age groups. In this low active category, 88% of the girls reported a very much above average level of depression, and 71% reported an above average level of depression. There was a statistical significant difference in this obese category between the low active and the high active girls for all the levels of depression. Interestingly, 85% of the obese girls with low levels of activity reported a normal level of depression. This trend was also most notable with the 14 and 15 year-old girls.

4.5 Discussion of results

The majority of the 13 – 15 year-old girls in this study has high levels of obesity with over 48% being classified as having a high or a very high level of body fat. This trend is in agreement with current studies that indicate that obesity has reached epidemic proportions (Hedley, *et al.*, 2004:2847; Kalk, 2001:576; Reilly *et al.*, 2000:1623).

A study done by Erickson *et al.* (2002:934) suggests that overweight girls manifest more depressive symptoms than their normal-weight peers. Children in the present study reported extremely high levels of depression, bordering on diagnosis of major depressive disorder (Craighead *et al.*, 1998:156; Jansen van Rensburg *et al.*, 2001:16). According to Wallace *et al.* (1993:301), it is estimated that the incidence of depression in the paediatric population is 6-10%. The results of this study indicate that 71% of the total group of girls reported an above average or very much above average level of depression. Obese children and adolescents are at risk for psychological and social adjustment

problems, including lower perceived competencies than normative samples in social, athletic and appearance domains, as well as overall self-worth (Schwimmer *et al.*, 2003:1817). Erickson *et al.* (2002:934) found increased psychopathology among clinical samples of obese children. This is consistent with the findings in this study in the trend of the obese girls reporting very high levels of depression.

Conversely, it remains possible that the high levels of depression in this study are due to other factors. In a study done by Jansen van Rensburg *et al.* (2001:14) as part of the THUSA BANA research project of which this study forms part, it was found that the children were exposed to high levels of violence. Witnessing arrests and assaults was the most common exposure in the community, followed by seeing somebody being stabbed and shot, with an alarming number of children witnessing a murder. Children reported seeing a gun and adults shouting at one another had the highest incidence at home, whilst a relatively high number of children reported being victims of beatings (Jansen van Rensburg, *et al.*, 2001:14). They also reported that older children (13 – 15 year-old) exposed to violence had higher depression levels with symptoms of negative mood and anhedonia. Their study was in agreement with several researchers that exposure to violence was a strong predictor of depressive symptoms (Cerezo & Frias, 1994:923; Cooley-Quille *et al.*, 1995:1363; Fitzpatrick, 1993:528; Freeman *et al.*, 1993:420; Overstreet, 2000:7). American studies also reported that girls are more likely to report an increase in depressive symptoms in the face of increased violence (Cooley-Quille *et al.*, 1995:1362; Overstreet, 2000:7; Singer *et al.*, 1995:477). This might then be presented as a possible explanation as to why such a large percentage of normal weight girls reported high levels of depression in the present study. A total of 72% of normal weight girls reported an above average or very much above average level of depression. To that extent, the relationship between obesity and depressive symptoms are also attenuated. Some epidemiological studies reported an overlap between obesity and depression, but associations are sometimes small and inconsistent (Friedman & Brownell, 1995:3; Istvan *et al.*, 1993:1000). This also seems to be reflected by these results.

Leupker (1999:S12) believes that the increase in obesity in children is the directed effect of a reduction of physical activity levels and the resultant reduced energy expenditure in relation to energy intake. In the total group of girls in the present study 74% reported low levels of activity, with 21% reporting normal activity levels and only 6% of girls were highly active. There was a statistical significant difference between the low active and the high active categories for the total obese group of girls. This is not an unexpected find as obesity is commonly associated with low levels of physical activity (Jebb & Moore, 1999:S534; Pagoto *et al.*, 2006:1422).

Exercise promotes positive psychological growth in normal adults and adolescents (Brown *et al.*, 1992:555; Norris *et al.*, 1992:55). Cross-sectional data from observational studies consistently demonstrate that physical activity is associated with reduced symptoms of depression (Dunn *et al.*, 2001:S595; Paluska & Schwenk, 2000:168). However, the influence of physical activity on the relationship between obesity and depressive symptoms in this study is unclear. This is mainly due to the low levels of highly active girls in the sample. Epidemiological surveys have noted that little or no leisure-time physical activity is associated with an increased risk for developing depression among previously healthy men and women in a community sample (Paluska & Schwenk, 2000:168). This may indicate that this group of girls will be more at risk for developing depression due to lack of physical activity. The inference can be made that the high levels of depression found in this sample may in part also be contributed to by the low levels of physical activity undertaken.

Chapter 5

Summary, conclusions and recommendations

5.1 Summary

5.2 Conclusions

5.3 Recommendations

5.1 Summary

The purpose of this study was to determine the relationship between obesity/overweight and depressive symptoms in 13 to 15 year-old girls in the North West province. Furthermore, the objective was to determine the influence of physical activity on the probable relationship between obesity/overweight and depressive symptoms.

In Chapter 1 the problem statement and aim is discussed along with the structure of the study. Chapter 2 contains the literature review regarding obesity, depressive symptoms and physical activity. The development and classification of obesity is discussed in terms of internationally recognized methods and standards. Furthermore, the symptomatology of depression and the manifestation in children is reported. The chapter concludes with a discussion of the relationship between depression, obesity/overweight and physical activity as reported in recent studies.

In Chapter 3 the method of investigation is discussed. A complete discussion of the subjects, anthropometric protocol, the apparatus used and study design is presented. The Previous Day Physical Activity Recall (PDPAR) questionnaire used to determine physical activity is discussed along with the Children's Depression Inventory (CDI) questionnaire used to determine depression in children. The formulas used to calculate BMI and percentage body fat are also discussed. Finally the statistical analysis (ANOVA and MANOVA) used to interpret the data is discussed.

In Chapter 4 the results of the study are presented and discussed. Firstly, the descriptive statistics of the different variables are represented. The relationship between obesity and depressive symptoms in the 13 to 15 year-old girls are examined and represented. Finally the influence of physical activity on the relationship between obesity and depressive symptoms is discussed.

5.2 Conclusions

The conclusion of this study will be given in relation to the hypotheses made.

5.2.1 Conclusion 1

Hypothesis 1 states that there will be a statistically significant relationship between obesity/overweight and depressive symptoms in 13 to 15 year-old girls in the North West Province.

According to the results of this study there was no statistical significant relationship between obesity and depressive symptoms in 13 to 15 year-old girls in the North West Province. There is, however, a trend towards increased levels of depression with an increase in percentage body fat. Hypothesis 1 is rejected.

5.2.2 Conclusion 2

Hypothesis 2 states that physical activity will have a positive influence on the probable relationship between obesity/overweight and depressive symptoms in 13 to 15 year-old girls in the North West Province.

From the results of this study it appears that physical activity had no influence on the probable relationship between obesity and depressive symptoms. This was mainly due to the very low levels of physical activity reported by the subjects. There is, however, an indication that low levels of physical activity can be associated with increased levels of depressive symptoms. Hypothesis 2 is rejected.

5.3 Limitations and recommendations

This study, like all research, has some limitations.

First, the division of the sample into 3 age groups and a further sub-division into 3 levels of depressive symptoms, 3 levels of obesity and 4 levels of physical activity resulted in small numbers of subjects with certain variable comparisons. This rendered the samples too small to make a meaningful statistical analysis and conclusion.

Given the cross-sectional and correlational nature of the design, neither temporal nor casual relationships can be inferred. It is plausible that depression could be a consequence of being overweight, as well as a precursor of body weight change. Depression can lead to weight gain in some patients and weight loss in others (Barefoot, *et al.*, 1998:688). The direction of the change appears to be consistent within individuals across episodes. Moreover, those who were initially lean were more likely to lose weight and those who were heavy were more likely to gain weight. This pattern can be interpreted as an illustration of the tendency for depression to magnify the effects of

existing predispositions. Prospective longitudinal studies are necessary to elucidate questions regarding casual directionality.

The high levels of exposure to violence and its relationship with depression found in the THUSA BANA study renders these results less reliable. Controlling for this variable in future studies and careful selection of subject will produce more accurate data.

The present study supports the endeavour of testing causal relationships between BMI, depression and physical activity. Findings may shed light on why maintenance of exercise regimes among the obese is poor. Obese persons are confronted with social stigmas, discrimination and experience greater discomfort in performing physical activities (Pagoto *et al.*, 2006:1428). Such negative consequences would be likely to reduce the obese individual's capacity to enjoy such activities. Overweight and obese individuals may subsequently be at a disadvantage in terms of development of depressive symptoms. High levels of depression were found to be associated with treatment attrition (Werrij *et al.*, 2006:126). Obese children with comorbid depression might, therefore, be treated more effectively with an integrated approach in which depression status is taken into account.

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THUSA BANA PROJECT INFORMATION



PU FOR CHE

**SCHOOL FOR PHYSIOLOGY, NUTRITION AND CONSUMER
SCIENCE**

**SCHOOL FOR BIOKINETICS, RECREATION AND SPORT
SCIENCE**

PROF. H.H. VORSTER (DIRECTOR)

PROF. J.H. DE RIDDER (PROJECT LEADER)

THUSA BANA PROJECT : INFORMATION ON THE STUDY

THE PROJECT HAS BEEN APPROVED BY THE ETHICS COMMITTEE OF THE PU FOR CHE, ETHICS COMMITTEE NUMBER (XXXXXXXXX)

I CONFIRM THAT:

It has been explained to me, that:

1. The purpose of the research study is to collect information on the problem of overweight and obesity among schoolchildren aged 10 –15 years in the North West Province of South Africa.
2. I have been told that the research will obtain anthropometric variables of a random sample of children aged 10 – 15 years.
3. The participant will be weighed and his / her height as well as circumferences and skinfolds of his / her arm will be measured without causing any pain to the child. For those measurements boys and girls in separate groups will be asked to undress in privacy of a class-room, because some measurements must be taken with the children dressed in underwear only. The different age groups will be measured separately. The researchers and fieldworkers will work in a professional way, not to embarrass the children.
4. Appropriate methodology to classify overweight and obesity in these age groups will be developed.
5. The prevalence of obesity in children in the North West Province will be determined.
6. The anthropometry of the different ethnic groups will be compared.
7. The relationship between body mass index and adiposity in stunted children (low-height-for-age) will be determined.
8. The role of dietary practices in the development of overweight and obesity will be determined.
9. The role of physical activity levels and patterns in the development of obesity.
10. Influences of ethnicity and urbanisation on the causative factors of overweight and obesity will be determined.
11. Perceptions regarding overweight and obesity in these age groups will be measured.
12. The general health status of obese children with controls, regarding absence from school due to illness will be compared.
13. Guidelines for appropriate, culture sensitive, practical and sustainable intervention programmes for these age groups will be developed.
14. I have also been told that this research is being done for the benefit of the children and that 1200 children will take part in this study.
15. It was also explained to me that the information I will give shall be kept confidential, but that it will be used anonymously for making known the findings to other scientists.
16. It was also clearly explained to me that I can refuse to participate in this research study or I can stop answering the questions at any time during the interview.

The information in this consent form was explained to me by _____ (name of interviewer) in _____ (language) and I confirm that I have a good command in this language and understood the explanations, OR it was translated to me by _____ (name of translator) in my language _____. I was also given the opportunity to ask questions on things I did not understand clearly.

I the participant (child) hereby agree voluntarily to take part in this research survey.

Signed / confirmed at _____ on _____ 2000 / 2001.

Witness _____

Participant's / representative of participant (parent) _____

THUSA BANA PROJECT – Control card**Subject****Name :** _____ **No :** _____ **Gender :** _____

		CHECK CONTROL
STATION 1	RECRUITMENT DEMOGRAPHIC QUESTIONNAIRE	
STATION 2	BLOOD PRESSURE	
STATION 3	ANTHROPOMETRY	
STATION 4	ANTHROPOMETRY: CLOTHING	
STATION 5	PSYCHOLOGICAL QUESTIONNAIRE A	
STATION 6	DIETARY QUESTIONNAIRE: 24 HOUR	
STATION 7	MOTOR DEVELOPMENT A	
STATION 8	PSYCHOLOGICAL QUESTIONNAIRE B	
STATION 9	EATING HABITS	
STATION 10	FAMILY CIRCUMSTANCES AND HIV TRM	
STATION 11	PHYSICAL ACTIVITY	
STATION 12	MOTOR DEVELOPMENT B	
STATION 0	BACK TO STATION 1	_____ SIGNATURE



Potchefstroom University

for Christian Higher education

Subject number

Date

Place and region

Interviewer

D	M	J

Home address _____

4 Stratum of urbanisation

Rural ^a	1
Informal town ^b	2
Urban ^c	3

(Classify stratum of urbanisation)

Rural ^a = tribal land, farm schools; Informal town ^b = corrugated iron house; Urban ^c = formal town / city

5 Gender

Male	1
Female	2

6 Age

Date of birth

D	M	J

(for control purposes, do not code)

7 First Language

Setswana	1
Afrikaans	2
English	3
Xhosa	4
Zulu	5
Other	6

8 Second Language

Setswana	1
Afrikaans	2
English	3
Xhosa	4
Zulu	5
Other	6

9 Do you receive treatment for any chronic disease?

Yes	1
No	2

10 If yes – what disease?

11 Girls only: Have you started menstruating
(seeing periods) yet?

Yes	1
No	2

If yes, at what age (year)?

12 Do you take snuff?

Yes	1
No	2

13 Do you smoke?

Yes	1
No	2

14 If no – have you smoked regularly before?

Yes	1
-----	---

No	2
-----------	----------

15 If yes – what do you smoke?

Cigarettes	1
Tobacco / pipe	2
Other	3

If other - describe

16 How much do you smoke?

Per day
Per week

17 For how long have you been smoking? (years)

18 Calculate pack years

19 In which grade are you this year?

Grade 1 – 3	1
Grade 4	2
Grade 5	3
Grade 6	4
Grade 7	5
Grade 8	6
Grade 9	7

20 Does any member of your household have the right to use any property (house / flat / room) as his / her own?

Yes	1
No	2

21 What type of property?

--

22 Name the members of your household

Member	Age	Education (grade passed)	Present job

23 Who is the breadwinner in your home?

--

24 Does he / she have a job at the moment?

Yes	1
No	2

25 If yes – what kind of a job?

Doctor / nurse / teacher / professional	1
Business / taxi / self employed / formal	2
Typist / assistant / office work	3
Domestic worker / garden / contract	4
Hawker / car washer / informal sector	5

26 On which days of the week does he / she work?

Irregular (piece work)	1
Part time (1 – 4 days / week)	2
Full time (5 – 6 days / week)	3

27 Does someone in your household receive any additional pensions?

Yes	1
No	2

28 What type of house do you live in?

Traditional hut	1
Mokuku	2
Brick house	3
Other	4

Specify other

--

29 Do you share a toilet with other households?

Yes	1
No	2

30 What type of toilet do you have?

None	1
Communal	2
Bucket system	3

	Outside pit toilet	4
	Outside chemical	5
	Outside water flush	6
	Inside water flush	7

31 Where do you get your drinking water from?

Fountain / river	1
Communal tap	2
Tap on premises	3
Tap in house	4
Other	5

If other specify

--	--

32 Do you have any access to electricity inside your house?

Yes	1
No	2

33 What type of stove do you have?

None	1
Coal / wood	2
Gas or paraffin	3
Electric	4

34 What type of fridge do you have?

None	1
Paraffin	2
Gas	3
Electric	4

35 Do you watch television every week?

Yes	1
No	2

36 Do you listen to the radio every week?

Yes	1
No	2

37 Do you have a computer in your home?

Yes	1
No	2

38 If yes, do you play / work on the computer on most days?

Yes	1
No	2

39 If yes how many hours do you play / work on

--

the computer on most days?

40 Does your school week include a physical activity / training period?

Yes	1
No	2

Anthropometric Profile

Subject name _____

Subject ID

--	--	--	--

Sport

--	--	--	--	--	--	--	--

Position and/or type

--	--	--	--	--	--	--	--

Country /Provincial /School /Team

--	--	--	--	--	--	--	--

Gender M

--

F

--

Year Month Day

Year Month Day

Date of birth

--	--	--	--	--	--

Test date

--	--	--	--	--	--

Box hight

--	--	--	--

Anthropometrist ID

--	--

ID Variable	Measurement 1	Measurement 2	Measurement 3
<i>Skinfolds</i> 1 Triceps [®]			
<i>(mm)</i> 2 Subscapular [®]			
3 Chest [®]			
4 Iliac crest [®]			
5 Supraspinale [®]			
6 Abdominal [®]			
7 Front thy [®]			
8 Medial calf [®]			
9 Mid-axilla [®]			
<i>Girths</i> 10 Head			
<i>(cm)</i> 11 Neck			
12 Arm relaxed [®]			

ID Variable	Measurement 1				Measurement 2				Measurement 3			
13 Arm flexed and tensed [®]			.			.				.		
14 Forearm (max)			.			.				.		
15 Wrist			.			.				.		
16 Chest				.			.				.	
17 Waist [®]				.			.				.	
18 Gluteal (hip) [®]				.			.				.	
19 Thy (1) (1cm gluteal)			.			.				.		
20 Thy (2) (mid.)			.			.				.		
21 Calf [®]			.			.				.		
22 Ankle			.			.				.		
<i>Lengths</i> 23 Acromiale-radiale			.			.				.		
<i>and</i> 24 Radiale-styilion			.			.				.		
<i>heights</i> 25 Midstyliion-dactylion			.			.				.		
<i>(cm)</i> 26 Illiospinale			.			.				.		
27 Trochanterion			.			.				.		
28 Trochant-tib (laterale)			.			.				.		
29 Tibiale (laterale)			.			.				.		
30 Tib med.-sphyriion tib			.			.				.		
<i>Breadths</i> 31 Biacromial			.			.				.		
<i>(cm)</i> 32 Biiliocrystal			.			.				.		
33 Foot length			.			.				.		
34 Sitting height				.			.				.	
35 Transverse chest			.			.				.		

ID Variable	Measurement 1				Measurement 2				Measurement 3			
36 A-P chest depth			.				.				.	
37 Humerus [®]			.				.				.	
38 Femur [®]			.				.				.	
39 Ankle			.				.				.	
40 Wrist (bi-stylian)			.				.				.	
41 Hand			.				.				.	
42 Body mass [®]				.				.				.
43 Stature [®]				.				.				.
44 Arm span				.				.				.

Compendium with METS classification

TYPE OF ACTIVITY

A PERSONAL CARE		34 Watering the garden	1.5
1 Eat	1.5	E FREE TIME	
2 Sit still	1.0	35 Watch TV	1.5
3 Sleep	0.9	36 Go to movies / concerts	1.5
4 Shower / bath / wash	2.0	37 Listen to music	1.5
B TRANSPORT		38 Sit – play cards	1.5
5 Car / bus / train	1.5	39 Sit – draw / write	1.8
6 Walk slow	2.8	40 Sit – read books	1.3
7 Walk fast	5.0	41 Sit – talk on telephone	1.5
8 Walk / uphill	6.0	42 Sit – study	1.8
9 Walk / downhill	5.0	43 Play piano / trumpet	2.5
10 Ride bicycle / slowly	3.0	44 Play violin	2.5
11 Ride bicycle / fast	5.0	45 Play guitar	3.0
C WORK / INSIDE HOUSE		F PHYSICAL ACTIVITY	
12 Homework	1.36	46 Jog / run	7.0
13 Home tasks / sweep	2.1	47 Dance	3.0
14 Wash dishes	1.6	G SPORT	
15 Cook	2.1	48 Basketball	6.7
16 Put away food shopping	2.5	49 Boxing	10.0
17 Food shopping	2.0	50 Cricket	5.0
18 Wash clothes	3.0	51 Soccer	7.0
19 Iron clothes	2.3	52 Golf	4.5
20 Make bed	2.0	53 Gymnastics	4.0
D WORK / OUTSIDE HOUSE		54 Handball	6.7
21 Carry / load wood	5.0	55 Hockey – field / ice	8.0
22 Chop wood / make fire	6.0	56 Horse riding	4.0
23 Look after cattle	4.0	57 Netball	6.0
24 Fetch water	3.8	58 Cheerleading	6.0
25 Tidying the yard	5.0	59 Judo / Karate	10.0
26 Dig a sandpit	5.0	60 Rock climbing	11.0
27 Gardening with implements	6.0	61 Rugby	10.0
28 Laying rocks	5.0	62 Skating	7.0
29 Dig / shovel	5.0	63 Racquetball	7.0
30 Mowing the lawn	5.5	64 Squash	12.0
31 Planting seedlings	4.0	65 Tennis	7.0
32 Raking the lawn	4.0	66 Trampoline	3.5
33 Hedge trimming	4.5	67 Volleyball	4.0

68	Wrestle	6.0	106	Shoot air gun	3.0
69	Aerobic exercise	5.0	107	Touch rugby	6.0
70	Swim	10.0	108	Touchers	5.0
71	Light weights	4.0	109	Board games	2.0
G GAMES			110	Tree climbing	4.0
72	Hopscotch	5.0	111	Skateboard	5.0
73	4 – square dodge ball	5.0	112	“Onderhandjie klap”	3.0
74	Marbles	3.0	113	“Vroteier”	3.0
75	Computer games	1.5	114	“Draadkar”	5.0
76	Roller-skates	5.0	115	Wall climbing	7.0
77	Ice skating	7.0	116	Model building	2.5
78	Bicycle ride	5.5	117	Loading goods	3.0
79	Swim	5.0	118	Unloading goods	5.0
80	Water polo	10.0	119	P.T	5.0
81	Hide and seek	3.0	120	Play army	5.0
82	Rope jump	10.0	121	Kicking ball	3.0
83	“Klippië”	4.0	122	Mfrodens	3.0
84	Rounders	5.0	123	Swing	2.8
85	“Kleilat”	4.0	124	Athletics	10.0
86	Play with tins	3.0	125	Gymnastics	8.0
87	Tennis	7.0	126	Table tennis	3.0
88	House – House	3.0	127	Part time work	5.0
89	Play doll	2.5	128	Massage	5.0
90	Policeman	5.0	129	Fishing	2.5
91	Slingshot	3.0	130	Caring for animals	2.0
92	Spinning top	2.0	131	Collecting money	2.5
93	Toy cars	2.0	132	Monkey in die middle	3.0
94	“Treintjie”	3.0	133	Memory games	2.5
95	Hula Hoops	5.0	134	Flee a flee	2.8
96	Chess	2.0	135	Chasers	5.0
97	Art	1.3	136	Musical chairs	2.8
98	Play with cat / dog / bird	3.0	137	Hunt	3.0
99	Play with kite	3.0	138	Monopoly	1.5
100	Relaxing with friends	1.5	139	Ball bounce and catch	2.5
101	Church	1.5	140	Needle work	1.5
102	Sing	2.0	141	Internet	1.5
103	Snooker	2.5	142	Fixing car	3.0
104	Make fire	2.0	143	Child care	3.0
105	Barbeque food	2.0	144	Wash & wax car	4.5
			145	Youth meeting	1.5