PREVALENCE AND KNOWN RISK FACTORS FOR OVERWEIGHT AND OBESITY IN ADOLESCENTS IN URBAN MASERU

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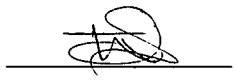
DECLARATION

I declare that this dissertation is hereby submitted by me for the Master Degree in Nutrition at the University of the Free State in my own independent work and has not been previously submitted by me to another University or Faculty. I further cede copyright of this research report in favour of the University of the Free State.



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DEDICATION

This work is dedicated to my late father, Odilon Mofo Seheri. His love, care and wisdom will always be remembered.

SUMMARY

Prevalence and known risk factors of overweight and obesity in adolescents in urban Maseru

Chronic diseases of lifestyle (cardiovascular disease, Type 2 diabetes, cancer) remain the leading causes of death and illness among people in both developed and developing countries. The prevalence of obesity, which is one of the main risk factors for developing these diseases, has risen to epidemic proportions. Overweight and obesity are becoming more and more prevalent at ever younger ages, trigerring health consequences in children and adolescents that track into adulthood. No data is available yet regarding overweight and obesity in Lesotho.

A cross-sectional descriptive study was conducted to determine the prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru, Lesotho. A sample size of 251 students (125 boys and 126 girls) was randomly selected from the 20 schools in urban area of the Maseru district. Only learners 16-year olds in Form 4 were included in the study due to limited resources. The final study population was 221 students.

Approval to undertake the study was obtained from the Ethics Committee of the Faculty of Health Sciences at the University of the Free State. Permission was also required from the Chief Inspector in the Ministry of Education and Training and the heads of the selected schools. Signed informed consent and assent was obtained from the parents and the learners, respectively.

Structured interviews were conducted on the school premises, using a questionnaire to record demographic data, birth weight and height, lifestyle factors, diet history, physical activity and knowledge, attitudes and practices (KAP) in nutrition. The participants were weighed and measured to calculate their body mass index (BMI). Reliability interviews of 10% of the sample were conducted one month after the initial interview.

Data collected were described as means and standard deviations and percentages. Pearson correlation analyses were performed to evaluate associations between parameters. The analysis was performed be the Department of Biostatistics at the University of the Free State.

The results of this study revealed that the prevalence of overweight/obesity in adolescents in urban Maseru is lower than in SA, with females having higher prevalences (11.3% and 20%,

respectively) than (2.1% and 4.1%, respectively). When comparing different standards for interpretation of results, the World Health Organisation (WHO) standards identified more overweight males (4.1%) than females (20.0%) than the Centre of Disease Control and prevention (CDC) growth standards (3.1% males and 16% females) and the International Obesity Task Force (IOTF) cut-off-points.

When using a 24-hour recall, the majority of participants reported lower than the recommended intakes of fruits (86.4%) and vegetables (91.4%), and dairy products (91.0%), but higher than the recommended intakes of grains and starchy vegetables (74.7%). These trends were confirmed by the results of a food frequency questionnaire which revealed that fruits, vegetables, diary, meat and pulses were not consumed on a daily basis. Maize porridge (56.1%) and bread (63.8%) were eaten by most on a daily basis. Margarine/butter/oil, salt and sugar were consumed daily by most. Most students (54.3%) bought food (including processed meat which are high in fat and salt) from the tuck shop on a weekly basis, while 18.6% did so daily. Despite poor eating habits, most participants had adequate nutrition knowledge and a negative attitude towards obesity.

The majority of participants were vigorously to moderately physically active, but no one out of five (22.7%) were not active. The majority of participants watched TV for less than 4 hours per a day, while computer usage outside school hours was low. Energy intake and physical activity were identified to be significantly associated with BMI. Alcohol and cigarette usage were lower than among South African adolescents.

The results indicate that overweight and obesity, and the associated risk factors are emerging problems among Lesotho adolescents. Lesotho is apparently following South Africa in undergoing a nutrition transition from a traditional diet high in unrefined grains, fruits an vegetables, to a more westernised diet high in fat, salt and sugar; accompanied by increased alcohol and cigarette usage, while more sedentary practices such as TV watching are also emerging.

Data collected from this study will be used as baseline data to enable individuals, health care teams and/or government of Lesotho to design programmes to address these identified problems.

OPSOMMING

Voorkoms en bekende risikofaktore vir oormassa en vetsug onder adolessente in stedelike Maseru

Chroniese leefstylsiektes (kardiovaskulere siektes, Tipe 2 diabetes, kanker) bly die vernaamste oorsake van dood en siekte onder mense in biede ontwikkelde en ontwikkellende lande. Die voorkoms van vetsug, wat een van die hoofoorsake van hierde chroniese siekte is, het werelwyd tot epidemiese afmetings gestyg. Oormassa en vetsug kom al meer dikwels op al hoe jonger ouderdomme voor, en sneller gesondheidsrisiko's in kinders en adolessente wat deurloop tot in volwassenheid. Geen data is tans beskikbaar oor oormassa en vetsug onder adolessente in Lesotho nie.

'n Dwarssnit observasiestudie is uitgevoer om die voorkoms en bekende risikofaktore van oormassa en vetsug onder adolessente in stedelike Maseru te beskryf. 'n Steekproef van 251 leeders (125 seuns en 126 meisies) is ewekansig uit die 20 skole in die stedelike area van die Maseru distrik getrek. Weens beperkte hulbronne is net 16-jarige leeders in Form 4 in die studie ingesluit. Die finale studiepopulasie het uit 221 leeders bestaan.

Toestemming is van die Etiekkomitte van die Universiteit van die Vrystaat verkry. Toestemming os ook van die Hoof-inspekteur van die Ministrie van Onderwys en van die skoolhoofde van die geselekteerde skole verkry. Getekende ingeligde is van die ouers en die leeders verkry.

Gestruktureerde onderhoude is op die skoolgronde met die leeders gedoen en 'n vraelys is gebruik om demografiese data, geboortemassa en –lengte, leefstylfaktore, dieetgeskiendenis, fisiese aktiwiteitsvlakke, asook kennis, houdings en praktyke tov voiding, op record te stel. Die leeders is geweeg en gemeet om hul ligaamsmassa indekse (LMI) te bereken. Onderhoude is op 10% van die steekproef een maand na die insielle onderhoud, herhaal om betroubaarheid te bepaal.

Data is an gemiddeldes en standaarfwyking en persentasies beskryf en Pearson korrelasies is gedoen om assosiasies tussen parameters te evalueer. Die statistiese analise is deur die Department Biostastistiek van die Vrystaat uitgevoer.

Die resultane van hierdie studie het aangetoon dat die voorkoms van oormasa en vetsug laer onder adolessente in Lesotho as in Suid-Afrika is, met meisies wat hoer voorkomssyfers (11.3% en 20%, respektiewelik) as seuns (2,1% en 4.1%, respektiewelik) gehad het. Die WGO groeistandaarde het meer oormassa seuns (4.1%) en meisies (20.0%) as die CDC-groeistandaarde het meer oormassa seuns (3.1% seuns en 16% meisies) en die IOTF-afsnypunte geidentifiseer.

Die meerderheid van die leeders het in 'n gewoontelike 24-uur herroep vraelys, laer as aanbevole innames van vrugte (86.4%) en groente (91.4%) en suiwelprodukte (91.0%), maar hoer as aanbevole innames van grane en styselgroentes (74.7%) gerapporteer. Die voedselfrekwensievraelys het hierde neigings bevestig, deur aan te toon dat vrugte, groente, suiwel, vleis en puelgroente nie deur die meerderheid van die meeste leeders daagliks genuttig Die meeste leeders het wel daagliks margarine/botter/olie, sout en suiker ingeneem. Die meeste leeders (54.3%) koop weekliks by die skoolsnoewinkels kos (insluitende geprosesseerde vleis wat ryk in vet en sout is), terwyl 18.6% dit daagliks doen. Ten spyte van swak eetgewoontes, het die meeste leeders egter voldoende voedingskennis en 'n negatiewe houding jeens vatsug gehad.

Die meerderheid van die leeder was matig tot baie aktief, maar een uit vyf meisies (22.5%) was nie aktief nie. Die meerderheid leerders kyk minder as 4 ure per dag TV, terwyl die gebruik van rekenaars buite skoolure lag is. Energie en fisiese aktiwiteit het betekenisvol met LMI gekorreleer. Alkoholgebruik en sigaretrokery het in 'n mindere mate as onder Suid-Afrikaanse adolessente voorgekom.

Die resulate dui daarop dat oormassa en vetsug, en die geassosieerde risikofaktore, wel ontluikende probleme onder adolessente in Lesotho is. Lesotho volg skynbaar in Suid-Afrika se voetspore mbt die voedingoorgang van die tradisionele diet hoog in onverfynde grane, vrugte en groente, na meer 'n westerse eetpatroon hoog in vet, sout, en suiker, met gepaardgande toenames in alkoholgebruik en sigaretrokery, terwyl aktiewe gedrag soos TV-kyk ook aan die toeneem is.

Die resultate van hierdie studie sal as basislyndata gebruik word om individue, gesondheidsorgspanne en/of die regering van Lesotho instaat te stel om programme te ontwikkel om die geidentifiseerde problem aan te spreek.

LIST OF ABBREVIATIONS

AHA	Assuring Health for All
AI	Adequate Intake
ATP	Triphosphate
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CHD	Coronary Heart Disease
CHO	Carbohydrates
CVD	Cardiovascular Disease
DHS	Demographic Health Survey
DRI	Dietary Reference Intakes
EAR	Estimated Average Requirements
EER	Estimated Energy Requirements
FAO	Food and Agricultural Organization
FBDG	Food Based Dietary Guidelines
FFQ	Food Frequency Questionnaire
FGP	Food Guide Pyramid
GDP	Gross Domestic Product
DHS	Demographic Health Survey
IOTF	International Obesity Task Force
IPAQ	International Physical Activity Questionnaire
KAP	Knowledge Attitude and Practices
Kg	Kilogram

PUFs	Polyunsaturated Fats
RDA	Recommended Dietary Allowance
REE	Resting Energy Expenditure
RHC	Road-to-Health-Chart
RMR	Resting Metabolic Rate
RNI	Recommended Nutrient Intake
SA	South Africa
SADHS	South African Demographic Health Survey
SD	Standard Deviation
SF	Saturated Fats
SOFI	State of Food Insecurity in the World
SSB	Sugar Sweetened Beverages
TE	Total Energy
T2DM	Type2 Diabetes Mellitus
TV	Television
UK	United Kingdom
UL	Upper Limit
UNDP	United Nations Development Programme
US	United States of America
USDA	United States Department of Agriculture
WHO	World Health Organisation
YRBS	Youth Risk Behaviour Study

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1 INTRODUCTION AND MOTIVATION FOR THE STUDY

1.1. The rising prevalence of adolescent overweight and obesity

During the 20th century, nutritional deficiencies and infectious diseases were replaced by non-communicable diseases associated with obesity as leading causes of death in developed countries (Whitney and Rolfes, 2005: 280; Lawrence, 2010: 311). Over the last few decades this epidemic of overweight and obesity has significantly emerged among even younger ages (Kimm and Obarzanek, 2002: 1).

In adults overweight and obesity are defined as having a body mass index (BMI) equal to or greater than 25kg/m^2 and equal to or greater than 30kg/m^2,respectively (Cole et al., 2000). Adiposity in children and adolescents is assessed with BMI interpreted according to different cut-off points for age and gender (Cole et al., 2000: 1240; Kuczmarski, 2000: 1; de Onis, 2007: 660).

According to the United States CDC and Prevention's Behavioural Risk Factor Surveillance System Survey, in 1990, no state in the United States of America (USA) had obesity rates of 15% or more, whereas 15 years later in 2005 only four states had obesity prevalence rates less than 20%. In 17 states prevalences were equal to or greater than 25%, with three states having prevalences equal to or greater than 30%. Among 12–19 year olds in the USA, the prevalence of overweight was as high as 21% in 2005 (WHO, 2006).

Data from some of the developing countries outside of Africa show that these countries have prevalence rates similar to those of the USA. In Kuwait for instance, the prevalences of overweight and obesity among adolescents aged 10–14 years were 30.7% and 14.6% respectively as reported by El-Bayoumy et al. in 2009. In Brazil, the prevalence of overweight tripled between the 1980s and the late 1990s, increasing from 4.1% to 13.9% among children and adolescents aged 6–18 years (Lobstein et al., 2004: 58).

In several parts of Africa childhood and adolescent obesity also appears to be an emerging problem. A Nigerian survey published in 2007 indicated that the prevalence of overweight among adolescents aged 10-19 years was 3.7% in the urban and 0.4% in the rural areas, while that of obesity was 0.4% in urban and 0.0% in the rural areas (Ben-Bassey et al., 2007: 475). In Morocco, the prevalence of obesity among pre-school children rose from 2.7%

in 1987 to 6.8% in 1992 (Lobstein et al., 2004: 59). According to Ebbeling et al. (2002: 474) the prevalence of childhood obesity in Ghana increased from 0.5% in 1987 to 1.9% in 1993/1994.

The majority of sub-Saharan countries including Lesotho, have limited available representative data on overweight and obesity prevalence because most public health and nutrition related efforts have been focused on malnutrition and food safety problems (Lobstein et al., 2004: 60). In South Africa (SA), according to the 2003 SA Demographic and Health Survey published in 2007, 16.7% of males and 12.4% of females aged 16 were overweight, while 2.4% males and 6.9% females were obese. According to the 1st South African National Youth Risk Behaviour Survey [SA YRBS], the national prevalence of overweight in adolescents aged 15 – 24 years was 17% and that of obesity was 4%, with more females (25.0%) than males (6.9%) being overweight (Reddy et al., 2002: 1).

In SA, according to the 2003 SA Demographic and Health Survey published in 2007, 16.7% of males and 12.4% of females aged 16 were overweight, while 2.4% males and 6.9% females were obese. In 2005 according to the Transition and Health during Urbanisation of South African Children (Thusa Bana) study conducted in the North West province, the prevalence of overweight and obesity was 8% among children aged 10 to 15 years, with most overweight children living in urban areas (Kruger et al., 2006: 355). Of the Black SA children in the Thusa Bana study, 5.7% were overweight and 1.4% were obese. In Bloemfontein, Mangaung, Free State the prevalence of overweight and obesity in 2009 was 10.9% in boys and 19.6% in girls aged 13 to 15 years (Meko et al., 2008:149)).

1.2. The risk factors for adolescent obesity

The nature and causes of obesity is the subject of intensive and continuing research. Both heredity and environmental factors are involved in a very complex way, but environmental factors play a major role in the prevalence of obesity. The environmental factors include psychological and cultural influences, as well as physiologic regulatory mechanisms. No single theory however, can explain the way obesity manifests in all individuals (Dehghan et al., 2005: 25; Gee et al., 2008: 540; Ahearne-Smith, 2008:1).

1.2.1. Genetic factors

Genetic factors seem only to influence the susceptibility of a child to an obesity-conducive environment (Eriksson et al., 2001: 737; Dehghan et al., 2005: 25; Gee et al., 2008:

540). Many of the hormonal and neural factors involved in normal weight regulation are determined genetically. These include the short and long-term signals that determine satiety and feeding activity. Recent studies estimated that genetic predisposition contributes 66 - 80% to risk of obesity. Genes regulating body fatness are called obesity genes because an abnormality in one or more of these genes could result in obesity (Gee et al., 2008: 540; Smolin and Grosvenor, 2008: 273).

1.2.2. Foetal undernutrition

In SA, Kruger et al. (2006: 357) and Steyn et al. (2006: 20) confirmed that adult obesity and childhood underweightand stunting commonly occur simultaneously in transitional communities (the so-called *double burden*) and that stunting was associated with an increased risk for being overweight later in life. These findings support the Barker theory which proposes that birth weight may be an important predictor of childhood obesity and that the combination of foetal undernutrition followed by neonatal overnutrition, is associated with obesity and metabolic or cardiovascular morbidity in later life (Barker et al., 2009: 446).

1.2.3. Early childhood overweight and early adiposity rebound

It has been documented that overweight children are more likely than lean children to become overweight in adulthood. Approximately half of overweight and obese children remain obese as adults. Childhood obesity also confers long-term effects on mortality and morbidity (Elgar et al., 2005: 373).

The greatest level of fatness of 25% in normal growth occurs at the age of six months. In children that are lean, fat cell size then decreases from six months to about six years. In obese children this decrease does not occur. At the age of sixyears for lean children, *adiposity rebound,* which is a normal increase in fat cell number, occurs and continues into adolescence. In obese children, adiposity rebound occurs early with a higher and faster increase in fat cell number into adolescence. An early adiposity rebound at less than five years is predictive of higher levels of body fatness at 16 years and in adulthood. After adolescence, any further increase in body fat occurs primarily by increase in fat cell size (Gee et al. 2008. 534; Ebbeling et al., 2002: 475).

1.2.4. Dietary factors

Weight gain results from taking in more energy than what the body uses. This imbalance causes excessive accumulation of body fat (Galuska and Khan, 2001: 533). High energy intakes may be achieved by active overeating which refers to the consumption of larger portion sizes than recommended. On the other hand, passive overeating refers to eating energy-dense foods, so that even smaller portion sizes may also cause excessive energy intake (Gee et al., 2008: 540).

Dietary fat specifically, has been postulated to contribute to weight gain and obesity (Frary and Johnson, 2008: 24; Corella et al., 2007: 125). Fat contributes 38kJ per gram, twice as much than carbohydrate (CHO) or protein. A meal high in fat thus contains more energy in the same volume compared to a lower fat meal. High fat diets promote overconsumption because energy from fat is less satiating than energy from CHO and protein, so when eating high energy meals more energy is consumed before feeling full (St-Onge et al., 2003: 1070). Fat is usually poorly regulated during consumption and oxidation. A high fat diet compromises the regulation of energy balance, particularly in individuals with a genetic predisposition to obesity and with low levels of activity (WHO, 1998).

The increasing consumption of sugar sweetened beverages (SSB), including soft drinks, is another factor that is being linked to childhood obesity. SSB is a very concentrated and energy dense form of dietary sugars which are easy to consume in large amounts. Excessive consumption, that is, more than 1 to 2 glasses per day, of these beverages has been positively linked to weight gain, obesity, as well as metabolic disorders such as insulin resistance, type 2 diabetes, cardiovascular diseases, hypertension, gout and non-alcoholic fatty liver disease (van den Berg, 2011: 1).

1.2.5. Physical inactivity

Lifestyles of people worldwide have changed considerably in the last few decades and this is reflected in low physical activity. The increase in television (TV) viewing, computer game usage and other sedentary activities, along with the decrease in priority given to physical education in schools, means that many children are less physically active than in previous years (Shaw and Lawson, 2004: 372), resulting in an imbalance between energy intake and energy output (Lazarou and Soteriades, 2010: 74). The SAYRBS published in

2002 found that 29% of adolescents in SA received no physical education at school (Reddy et al., 2002: 63).

1.2.6. Alcohol consumption

Adolescents make more choices for themselves than they did as children. They are also at a stage where social pressure influences the choices they make. Alcoholic beverages are commonly available at adolescents' social gatherings and this predispose them to drinking (Madu and Matla, 2002: 124). Alcohol is a drug that has short-term effects that occur soon after ingestion, as well as long-term health consequences that are associated with overuse. Alcohol provides 29.7 kJ of energy per gram, but contains no nutrients, and once ingested, also alters nutrient absorption and metabolism. Alcohol may also displace foods that are more nutritious from the diet in habitual drinkers (Rolfes et al., 2006: 540).

1.2.7. Smoking

A comparison of the diets of smokers and non-smokers found that smokers had higher intakes of total and saturated fat (Escott-Stump, 2008: 566), and consumed fewer fruits and vegetables, and thus less fiber (Smolin and Grosvenor, 2008: 627) more than non-smokers. Weight loss is a concern for adolescents and many of them start smoking in order to lose weight or to maintain it (Smolin and Grosvenor, 2008: 626).

1.2.8. Knowledge, attitudes and practices related to adolescents overweight

The primary motivator for a change in lifestyle is assumed to be an accumulation of knowledge, since knowledge is essential for making the right informative choices to provide a better quality of life. For most people however, knowledge is not motivational. Knowledge is unlikely to lead to improved attitudes or practices for those that are not interested or motivated (Backett, 1992; Moorman and Matulich, 1993 as referred by Contendo, 2007: 60).

Regarding their attitudes toward food and nutrition, most adolescents in the USA are aware of the importance of nutrition and the components of a healthy diet; but experience many barriers to choosing healthy foods and beverages (Stang, 2008: 254). Adolescents cite taste, time, and convenience as the key factors that affect their food choices. Many adolescents, however, lack the ability to associate current eating habits with future disease risk and show little interest for their future health. They are more concerned with pleasing

their peers and will adopt behaviours such as drinking and smoking that demonstrate their desire for autonomy and make them feel more like adults (Stang, 2008: 255).

According to Stang (2008: 254), food practices that are seen more frequently among adolescents than other age groups are irregular consumption of meals, excessive snacking, eating away from home, dieting and skipping meals. Many factors contribute to these behaviours, including decreasing influence of family and increasing influences of peers on food and health choices; increased exposure of adolescents to media; increasing prevalence of parents being employed outside the home; and increasing responsibilities of parents, leaving less time for adolescents to eat meals with their families.

1.3. Health risks associated with adolescent obesity

Obesity has detrimental effects on the general health and lifestyle of an individual. An adult BMI of 30kg/m^2 or greater, is associated with increased morbidity and premature death (Seipel, 2005: 1-15; Freedman et al., 2008: 822-829). The increase of obesity in adolescents has become a great concern to all nations because obesity has been directly linked with mortality and many chronic diseases such as cardiovascular diseases (CVDs) (Smolin and Grosvenor, 2008: 265; Rolfes et al., 2006: 548).

Most of the excess mortality due to being overweight or obese results from cardiovascular causes (Riley, 2005: 5-7; Stang, 2008: 261). The onset of CVD, coronary artery disease and hypertension, occur during youth in overweight and obese children and tracks with age to predict adult risk levels (van Dam et al., 2006: 96; Ebbeling et al., 2002: 475; McTigue et al., 2006: 79-86).

There are indicators that being overweight increases the risk for death from cancer of the esophagus, colon, rectum, gall bladder, pancreas, and kidney (Riley, 2005: 5-7). Adolescents who are overweight are also at a higher risk of developing type 2 diabetes compared to their normal weight peers. The risk for developing type 2 diabetes increases greatly as the degree of overweight increases (van Dam et al., 2006: 96).

In addition to being vulnerable to chronic diseases, overweight children and adolescents are facing challenges of social stigmatisation that may lead to negative body image and even eating disorders and abnormal physiological development (Swallen et al., 2005: 342).

1.4. Problem statement

According to the WHO (2006), obesity affects millions of adults worldwide. Obesity is not limited to industrialized nations, but has spread to developing countries, where over 115 million people suffer from obesity related problems. The WHO already estimated in 2006 that there were more than 1 billion overweight adults globally of which at least 300 million were obese (WHO, 2006). These figures included an estimated 22 million overweight children under five years of age worldwide. Due to this spreading pandemic of overweight and obesity, the WHO has recommended that authorities develop successful intervention programmes aimed at health promotion in children, which can be utilized in the schools amongst others, to bring about change and promote healthy lifestyles (WHO, 2006).

In SA, as in other countries, a transition to a westernized diet and low physical activity, associated with urbanisation, is also associated with an increase in the prevalence of overweight and obesity (Steyn et al., 2006: 14). Lesotho, a developing country neighbouring SA, is expected to face similar nutrition and lifestyle challenges as SA.

Lesotho is a small mountainous country of 30,333sq.km, with an estimated population of 1,880,661 million according to the 2006 population census (Lesotho Bureau of Statistics (LBS), 2007), consisting mostly of Black Basotho. The capital city of the kingdom of Lesotho is Maseru with a population of 429 823 (Lesotho National Nutrition Survey [LNNS], 2007; 49).

Lesotho is completely encircled by the Republic of South Africa. It has ten politico-administrative districts and all of them have boundaries with one of the following South African provinces: Free State, Kwazulu-Natal and the Eastern Cape. The Gross Domestic Product (GDP) per capita is US$415 with an estimated preliminary GDP growth of 5.1% in 2007. Lesotho is ranked at 132 out of 173 countries on the United Nations Development Programme's (UNDP) Human Development Index (UNDP, 2005). The country is divided into four agri-ecological zones, being lowlands, foothills, mountains and the Senqu River Valley. Lesotho has a semi-arid climate characterised by severe weather variability. Drought, heavy rainfall, frost, snow and hailstorms are all common phenomena (Common Country Assessment Report of Lesotho, 2004).

According to a survey published in 2001, 68% of Basotho were poor (May et al., 2001: 16). According to the State of Food Insecurity in the World (SOFI) report of 2004, Lesotho has made progress in bringing down the number of undernourished people as a

percentage of its total population; from 17% in 1990-1992, and 14% by 1995-1997, to only 12% by 2000-2002. As the overall numbers of undernourished are increasing in Sub-Saharan Africa, Lesotho seems to have made improvement in overall food supply at the national level (May et al., 2001: 22).

In Lesotho, primary school starts at age seven although most children in urban areas start early at five to six years, while those in rural areas start later at seven toeight years. Primary education takes seven years, followed by three years of junior secondary education, and two years of senior secondary education. Thus by the age of 13 or 14, children should have completed primary education, and are awarded a Primary School Leaving certificate. Those who choose to continue would normally complete junior secondary and senior secondary school education at ages 16 and 18, respectively (UNDP, 2005).

There is as yet no published data in Lesotho on overweight and obesity among adolescents. This study therefore intended to describe the prevalence of overweight and obesity, and identify known risk factors for overweight and obesity, among adolescents in Maseru. In neighbouring SA, as discussed above, several studies have identified a growing prevalence of childhood and adolescent overweight and obesity, raising awareness and prompting many initiatives and interventions to address the issue. Similarly it is hoped that data collected from the current study in Maseru, will provide valuable data as to whether overweight and obesity is indeed a problem among Basotho adolescents, and if the known risk factors for childhood and adolescent weight problems are also prevalent among them. This baseline data will enable individuals, health care teams and/or the government of Lesotho to design programmes to address the identified problems.

1.5. Aim and objectives

1.5.1. Aim

The aim of this study was to determine the prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru.

1.5.2. Objectives

In order to achieve the aim, the following objectives were formulated:

For 16 year old adolescents in urban Maseru, to:

1. Determine current anthropometry (body mass index (BMI) for age and gender);
2. Evaluate the known risk factors for adolescent overweight and obesity, regarding

2.1 Intrauterine growth adequacy (birth weight, birth length and growth history);

2.2 Usual dietary intake (energy, macronutrients and frequency of consumption);

2.3 Physical inactivity, TV watching and computer usage);

2.4 Lifestyle factors (alcohol consumption and smoking); and

2.5 Knowledge, attitude and practices regarding nutrition.

3. Study association between current anthropometry and the known risk factors.

1.6. Outline of the dissertation

This dissertation is divided into six chapters:

Chapter 1:

Relevant background information; introduction; motivation for the study; aim and objectives are described in this chapter.

Chapter 2:

This chapter is a literature review which discusses the prevalence of overweight and obesity; the health consequences of being overweight and obese; and the causes and/or risk factors of adolescent obesity.

Chapter 3:

Methods used to conduct the study are described in this chapter. The operational definitions; sampling and study procedure; selection and standardization of techniques to ensure validity and reliability are discussed. The pilot study and the statistical analysis of the results are described. Practical problems experienced while conducting the study and how these problems were overcome, are also discussed.

Chapter 4:

The results of the study are described in this chapter.

Chapter 5:

In this chapter the results of the study are interpreted and discussed in the context of the current body of evidence on the subject of adolescent overweight and obesity.

Chapter 6:

The conclusions from the study are set out in this chapter. Recommendations regarding the prevention of overweight and obesity among adolescents in Lesotho; and recommendations for further research, are discussed.

2 LITERATURE REVIEW

2.1 Introduction

Throughout most of human history, weight gain and fat storage have been viewed as signs of health and prosperity. Today, however, as standard of living continue to rise, weight gain and obesity are posing a growing health threat which is rapidly replacing the traditional public health problems such as under-nutrition and infectious diseases in both developed and developing countries.

Obesity is a key risk factor for various chronic and non-communicable diseases (WHO, 2004: 16). The WHO describes the escalating global epidemic of obesity, as "one of today's most patently visible, yet most neglected public health problems" (Batch and Baur, 2005: 130). In the US, for instance, obesity is the second leading cause of preventable disease and death (Lobstein et al., 2004: 4).

Obesity not only affects adults, but is becoming increasingly more prevalent among children as well. As a result of this paediatric obesity epidemic, a multitude of chronic illnesses and risk factors for adult disease are now starting to already emerge in childhood (Jebb, 2007: 93).

2.2 Defining adolescent overweight and obesity

Obesity is defined as a chronic condition characterised by an excess of body fat (Atterburn et al., 2008). In adults, excess adiposity is commonly diagnosed by means of the BMI which is calculated by dividing body weight in kilograms (kg) by height in meter squared (kg/m^2). At present, there is still no widely agreed standard for classifying overweight and obesity in children and adolescents. In recent years, however, BMI has been increasingly accepted as a valid indirect measure of adipose tissue in both children and adolescents for survey purposes (Wang and Lobstein, 2006: 23).

Three sets of reference values are mostly used to assess excess weight among children and adolescents (Cole et al., 2000; Kuczmarski et al., 2002; de Onis et al., 2007). The first set is based on growth curves produced by the CDC in the US in 2000, from US national survey data collected from 1963 to 1994 (Kuczmarski et al., 2002: 1).

The second is an alternative approach recommended in 2000 by a nutrition expert committee convened by the International Obesity Task Force (IOTF). They used observations from a large group of children and youths in Brazil, Great Britain, Hong Kong, the

Netherlands, Singapore and the Unites States to develop gender-specific BMI cut-points (Cole et al., 2000: 1).

The third is the BMI-for-age growth charts for children aged five years or younger as well as for children aged five to 19 years old released in 2006 and 2007 (WHO, 2006). These standards were based on six different cohorts representing different races and cultures (de Onis et al., 2006: 5). To formulate the WHO growth charts, the Multicentre Growth Reference Study (MGRS) followed up infants from birth to 24 months and conducted a cross-sectional survey on children aged 18 to 71 months. Data were collected from healthy breastfed children from diverse ethnic backgrounds and cultural settings. This study was unique in that it was purposely designed to select healthy infants and children living under favourable conditions that will benefit their full genetic growth. The mothers of these babies as well had to be engaged in a healthy lifestyle such as not smoking as long as breastfeeding continues (de Onis et al., 2007: 145).

The CDC growth charts on the other hand, collected data using the growth patterns of both the breast-and-formula fed infants in the USA. The data was collected from five national health surveys from 1963 to 1994. However, there was no data on children less than three months. The data on length-for-age and weight-for-length was collected from birth certificates. Children in the WHO standards seem to be slightly taller than those in the CDC (de Onis et al., 2007: 145).

In 2007, a nutrition expert committee in the US recommended that based on the 2000 CDC growth curves, children with the BMI equal to or greater than the 95th percentile for age and gender should be considered obese, and those with a BMI equal to or greater than the 85th percentile, but below the 95th percentile, should be considered overweight (Shields and Tremblay, 2010: 266). On the CDC/NCHS charts a BMI between 85th and 95th percentile is considered at risk for overweight, while a BMI for age and gender greater than the 95th percentile is defined as overweight (Stang, 2008: 257). Based on the WHO curves, children whose BMI is above 84th percentile are considered overweight, while those who have a BMI above the 97.7th percentile are considered obese (Shields and Tremblay, 2010: 267).

In a study on Canadian children to compare the different growth standards, Shields and Tremblay (2010: 270) found that the percentage of children and adolescents classified as having excess weight varied depending on the BMI cut-off-points used. The WHO cut-off-points yielded the highest estimates of overweight and the IOTF adopted age and gender specific cut-offs yielded the lowest estimates in this Canadian study. The magnitude of the

differences also varied substantially by gender and age group with the greatest difference observed for two to five year old boys. The prevalence of obesity alone was similar using the WHO and CDC cut-off-points, but lower when applying the IOTF adopted cut-offs.

2.3 Epidemiology of adolescent obesity

Until about the middle of the twentieth century, infectious diseases were the leading causes of death in developed countries, and nutritional deficiencies were common. Improved sanitation, vaccine development, improved health care, and increased quality and quantity of food have virtually eliminated infectious disease as a major killer in developed countries, and nutrient deficiencies have become less common. Obesity is now widespread and its prevalence is rising so rapidly that it is considered an epidemic (Whitney and Rolfes, 2005: 280; Lawrence, 2010: 309).

In the developed countries, the US has the highest prevalence of overweight and obesity (Gee et al., 2008: 538). In 2005 an estimated 66% of US adults were overweight and 32% were obese. Among children and adolescents aged 6–19 years, the prevalence of overweight was 16% according to data published by the CDC in 2007.

Data for overweight and obesity combined among adolescents in African countries indicate prevalences of 2.1% to 4.4% as discussed in Chapter 1. In SA, which neighbours Lesotho, prevalences of combined overweight and obesity of 3.5% to 9.6% have been reported for 15-16 year olds, and 10.5% for adolescents (15–24 years of age) in general (Kruger et al., 2004: 355; SADHS, 2003; Reddy et al., 2002: online). In SA, the reported prevalence of overweight and obesity in adolescents ranges between 0.7%-17% (Kruger et al., 2006: 354 ; Reddy et al., 2002: 60). No prevalence data is as yet available for overweight and obesity among Lesotho adolescents.

2.4 Causes and/or risk factors of adolescent obesity

The nature and causes of obesity is the subject of intensive and continuing research. Presently, no single theory can satisfactorily explain all the ways obesity may manifest (Alhearne-Smith, 2008: online). Evidence shows that both genetic and environmental factors are involved in a very complex and interrelated way through which genetic predisposition influence the susceptibility of a child to an obesity-conducive environment. The factors that play a major role in the prevalence of obesity are environmental factors, lifestyle, and

psychosocial and cultural influences (Dehghan et al., 2005: 25; Eriksson et al., 2001: 737; Kipping et al., 2008: 1824).

2.4.1 Genetic factors

The relative contribution of genes and inherited lifestyle factors to the parent-child fatness association remain largely unknown. The offspring of obese parents are consistently at risk of fatness, although few studies have followed this relationship from childhood into adulthood. Parental obesity increases the risk of obesity in the offspring. A mother's weight has shown to be a significant predictor of the obesity status of her child. This is likely to be outcome of both genetic influences as well as the environment (Griswold et al., 2007: 58)

Genes regulating body fatness are called obesity genes because an abnormality in one or more of these genes could result in obesity. To date, more than 300 genes and regions of the human genome have been linked to body weight regulation. These genes are responsible for the production of proteins that affect how much food an individual eats and how much energy they expend, as well as regulate the way the body fat is stored (Smolin and Grosvenor, 2008: 273). Although numerous genes are involved in obesity, environmental determinants such as diet, physical activity, and psychosocial and behavioural aspects must be present for obesity to occur (Gee et al., 2008: 540). The rapid increase in the prevalence of childhood overweight and obesity over recent decades, implicates environmental over genetic factors; although it does not cancel out the relationship between genes and environment.

2.4.2 Malnutrition during foetal life and early childhood

Malnutrition causing underweight during foetal life, infancy and early childhood permanently changes the structure and function of the body and this phenomenon is referred to "programming" (Barker et al., 2009). Also referred to the "fetal origins hypothesis" or Barker theory (1998, as referred to by Stocker et al. (2005: 143), it hypothesises that, children who suffer growth failure and under-nutrition *in utero* leading to low birth weight (LBW), and during the early years of life, tend to become overweight or obese when sufficient food becomes available, probably related to metabolic and endocrine adaptations.

This seemingly unexpected association between LBW and adult obesity was first published by Ravelli et al (2001: 1797) who observed that obesity occurred more frequently among men born during World War II after being exposed to a period of severe famine *in utero,* than in those not exposed. A substantial body of epidemiological evidence now

supports an association between LBW, low birth length (LBL) and stunting in early childhood, on the one hand, and adult obesity and obesity-related chronic diseases of lifestyle such as CVD, stroke, hypertension, defective cognitive function and type-2 diabetes, on the other (Corvalan et al., 2007: online; Evenssen et al., 2009; Wolf and Phil, 2003: 176; Sawaya et al., 2003: 171).

Studies conducted in SA by Kruger et al. (2004: 357) and Steyn et al. (2006: 20) found that adult obesity and childhood underweight and stunting commonly occur simultaneously in transitional communities (the so-called *double burden*), and that stunting was associated with an increased risk for being overweight – thus supporting the Barker theory.

Evidence is accumulating that fetal growth and development is dependent upon the nutritional, hormonal and metabolic environment provided by the mother. Any disturbance in this environment causing for example LBW and length (small size) at birth can modify early fetal development with possible long-term outcomes that track into adulthood. One way in which this fetal programming seems to occur is through the growth hormone-insulin-like growth factor (GH-IGF) axis. The IGF and IGF-binding proteins are nutritionally regulated in the fetus. During times of starvation fetal growth retardation occurs leading to abnormalities in the GH-IGF axis, which in turn alters metabolism in a way which is beneficial to survival under conditions of malnutrition, but predisposes to chronic diseases of lifestyle in adulthood when nutrition is abundant (Holt, 2002: 1).

2.4.3 Early childhood overweight and early adiposity rebound

Several studies have shown tracking of obesity from childhood to adulthood, suggesting that early life factors are important in promoting adult obesity. The periods proposed as being critical during childhood are the prenatal period, adiposity rebound and puberty (Eriksson et al., 2001:736; Rolland-Cachera, 2005: 35; Evenssen et al., 2009).

Similarly to children of LBW, those who have high birth weights and keep an above-average weight throughout infancy, tend to be at a higher risk of becoming overweight later in life (Dietz, 2004. 856; Johannsson et al., 2006: 1270), due to lasting changes in the proportions of fat and lean body mass, central nervous system appetite control, and pancreatic structure and function which occur in these children (Magarey et al., 2003: 505).

Children who have an early adiposity rebound are at hogher risk for obesity and persistent obesity. Obesity rebound refers to a period usually between four years and seven years of age when BMI begins to increase throughout the rest of childhood adolescence and young adulthood (Gee et al., 2008: 534). Fat mass at birth represents 12-15% of the total mass. It increases up to four to six months and remains around 21-23% until one year of age. Fat mass declines until five to six years of age then increases again to reach 11-17% in boys and 23-26% in girls by the end of the adolescent growth spurt. Thus the adiposity rebound which starts normally around six years of age corresponds to the second phase of increase in fat mass. This period of adiposity rebound is important, though it is not the only important period for the development of obesity (Daniels et al., 2005: 2010).

2.4.4 Dietary factors

Adequacy of the diet implies that the diet provides sufficient energy and nutrients to meet the needs of healthy people. A balanced diet involves eating enough, but not too much of each type of food (Whitney and Rolfes, 2005: 32). Various dietary factors may contribute to overweight and obesity.

2.4.4.1 Carbohydrates, protein and fats

In the human body, the three macronutrients, CHO, protein and fat release energy measured in kilojoules (kJ). The amount of energy a food item provides depends on how much CHO, protein, and/or fat it contains. When completely broken down in the body, a gram of carbohydrate and protein yields about 17kJ each; while a gram of fat yields 38kJ. Another substance that contributes energy (29kJ/ml) is alcohol, but it is not a nutrient and will be discussed later (Rolfes et al., 2008: 9; Smolin and Grosvenor, 2008: 8).

Most foods contain all these three energy-yielding macronutrients, as well as water, vitamins, minerals and other substances. The body uses the energy-yielding nutrients to fuel its activities. When the body uses carbohydrate, protein, or fat for energy, the bonds between the atoms in the nutrient were split, releasing energy. Some of this energy is released as heat, while the rest is stored as adenosine triphosphate (ATP) used to fuel the bodily processes such as sending electrical impulses through the brain and nerves to synthesize body compounds, and to move muscles. Nutrients not used by the body to fuel its current activities, are re-arranged into storage compounds, such as glycogen and fat; to be used between meals and overnight when fresh energy supplies run low. Thus when macronutrients or alcohol is

consumed in excess of the body's energy need, it is converted to body fat and stored in adipocytes (fat cells) both under the skin (subcutaneous fat) and around and between organs and body structures (visceral fat) (Whitney and Rolfes, 2005: 6).

Obesity is the consequence of an imbalance between energy intake and energy output, which causes excessive accumulation of body (Atterburn et al., 2008: 604). Most deposits of fat come from dietary triglycerides, but excess dietary CHO and protein are also converted to fatty acids in the liver. Under normal feeding conditions, little dietary CHO is used to produce adipose tissue and when CHO is converted to body fat, about three times as much energy is required than when excess dietary fat is converted to storage fat (Smolin and Grosvenor, 2008: 260).

Lipogenesis does however occur when high CHO diets are fed, especially in the form of simple sugars. It seems that surplus CHO energy makes individuals fatter by suppressing fat oxidation (Gee et al. 2008: 534).

There has been less research to determine the effect of protein on weight change. The reason may be that protein makes a smaller contribution to the total energy intake than fat and CHO. Evidence from observational studies relating to the association of protein and obesity are inconsistent (Jebb. 2007: 94).

Thus dietary fat has been postulated to be the main contributor to weight gain and obesity (Frary and Johnsson, 2008: 24). A meal high in fat contains more energy in the same volume as a lower fat meal. Furthermore, high fat diets promote overconsumption because energy from fat is less satiating than energy from CHO and they stimulate appetite (Pereira et al., 2005: 40; St-Onge et al., 2003: 1070) and thus contribute to increased BMI (Corella et al., 2007: 125).

Dietary fat compared to protein or CHO, is more readily stored as body fat with minimal energy costs of conversion. Different types of fat have different metabolic effects and thus may possibly affect the risk of weight gain differently. However, there is limited research on the specific types of fat in relation to weight management. Animal studies do suggest that saturated fats are easily stored, while the unsaturated fats are more easily oxidized (Pereira et al., 2005: 39).

2.4.4.2 Food habits

Food habits that are more frequently seen among adolescents than among other age groups include irregular meals, excessive snacking, eating away from home (especially fast foods), dieting and meal skipping.

(i) Meal skipping

Meal skipping is the most common behaviour among adolescents as their lives become busier (Stang, 2008: 254; Boyle and Holben, 2006: 399). Breakfast is the most commonly skipped meal among adolescents. Breakfast skipping has been associated with higher BMI, and increased risk of inadequate intake of certain nutrients, especially calcium and fiber (Croezen et al., 2009: 405-421; Huang et al., 2010: 725). Even though many studies have found an association between breakfast skipping and overweight, several studies have found no association (Dialektakou et al., 2008: 1518).

(ii) Fast foods and convenience foods

Fast food outlets and convenience stores are among the top most common places where adolescents meet with friends to do school work or socialise (Stang, 2008: 255). Adolescents access fast foods from vending machines, convenience grocery stores, tuck-shops and franchised food restaurants (Koletzko and Toschke, 2010: 102). In the USA, the proportion of foods that children consumed from restaurants and fast food outlets increased by nearly 300% between 1977 and 1996 (St-Onge et al., 2003: 1069). Changes in family dynamics, particularly an increase in dual career or single parent working families may have also contributed to an increased demand for pre-prepared foods (Anderson and Butcher, 2009: 20).

Fast food outlets expose people to higher portion sizes than are recommended, promoting ***active overeating*** which increases energy intake (Gee et al., 2008: 540). In fact, studies show that marketplace food and beverages portion sizes have now expanded to at least twice the standard serving sizes (Young & Nestle, 2003: 231). One meal offered at fast food outlets and restaurants therefore often exceeds a person's energy needs for the entire day (Gee et al., 2008: 540). This perception of excessive portions as appropriate amounts to eat in a single eating occasion is also referred to as ***portion distortion***. To further support and reinforce this distorted perception, packaging, dinnerware and serving utensils have also increased in size (Wansink & van Ittersum, 2007: 1103).

On the other hand ***passive overeating*** refers to the overconsumption of energy in the form of energy dense foods (for example chocolate, desserts or french fries) which even in smaller portion sizes have a disproportionally high energy content (Gee et al. 2008: 540). The increasing availability of energy-dense foods and beverages to children and adolescents may also contribute to excessive energy intakes and predispose them to overweight or obesity (St-Onge et al., 2003: 1070; Ebbeling et al., 2002: 476).

Sensory specific satiety has been found to play an important role in food choice and meal termination, and it has been proven to be a contributing factor to obesity. Sensory specific satiety is defined as the decrease in the pleasantness of a product after it is eaten. Knowledge of the required amount of food required to be eaten in order to reach sensory specific satiety is limited. The nutritive value, texture, flavour, and colour have been described as important factors affecting the degree of sensory-specific satiety (Miller et al., 2000: 155). Food low in energy and those high in fiber are more satiating, but those high in fat stimulate appetite because their flavour is more appealing (Rolfes et al., 2008: 251).

A clear effect of higher sensory-specific satiety was observed only for foods that are high in protein and a trend for higher sensory-specific satiety was found for products high in sweet CHO and fatty acids. The results of various studies have suggested that obese subjects show a greater preference for high fat foods than do normal weight subjects. Differences in sensory-specific satiety have been observed in subjects with eating disorders and between different age groups (Rolfes et al., 2008: 251). Obese and inactive women may be less sensitive to sensory-specific satiety than normal weight women (Gee et al., 2008: 540; Epstein, 2005: 362; Snoek et al., 2004: 823).

The above-mentioned factors may cause children to gain more weight particularly if the subsequent increased energy intakes are not compensated for by increased physical activity (St-Onge et al., 2003: 1069).

(iii) Sugar sweetened beverages

Recent concerns about excessive energy intake among adolescents have been centered around the intakes of added sugar. SSBs are also the largest contributor of added sugar in their diets and have been found to contribute 37% of all dietary sugars for females and 41% for males. These beverages are also estimated to contribute 9% of energy intake by male adolescents and 8% for female adolescents (Stang, 2008: 250).

Recent studies identify a positive association between SSB and an increase in the risk for the metabolic syndrome (MS), which is associated with various chronic diseases of lifestyle. There is growing body of evidence through experimental, observational and long term cohort studies following large populations over extended periods of time, to justify an association between SSB consumption and type 2 diabetes (Malik et al., 2006), cardiovascular disease, hypertension (Dhingra et al., 2007; Fung et al., 2009: 37) and gout (Choi and Curham, 2008: 309).

The risk for the MS and related diseases is strongly linked to excess body fat, particularly visceral fat found around the vital organs (Esckel et al., 2005: 1416). Soft drinks provide 790kJ of energy per day when just one can (340ml) is consumed (St Onge et al., 2003: 1069). A recent meta-analysis established that a regular intake of SSB of one to two drinks per day versus an intake of none or one drink per month, increase the risk for MS with 20% and for type 2 diabetes with 26% (Malik et al., 2010). Based on these findings, the American Heart Association recommends that energy from SSBs should be limited to 400-600kJ/day or a glass per day (Johnson et al., 2009: 118).

Furthermore, adolescents frequently consume soft drinks instead of fruit juice or milk (Whitney and Rolfes, 2005: 573). They consume these SSBs with their lunch, supper and snacks, while the intake of fruit juices or milk is limited to breakfast. There is growing evidence suggesting that an increase in dairy intake by about two servings per day could reduce the risk of overweight by up to 70%; and that higher calcium intake and more dairy servings per day is associated with reduced adiposity in children (Dehghan, 2005: 25).

2.4.4.3 Nutrition transition

Urbanisation is an important issue in nutrition and health. Dietary intake studies show that the black population in SA as a result of urbanization, is undergoing a transition from traditional high fibre, high carbohydrate intake, to a more typical Western diet, characterised by more fat and added sugar; less unrefined carbohydrates and more animal protein and saturated fat (Steyn et al., 2006: 5). The eating patterns of black SA children as evident from the Thusa Bana study by Kruger et al. (2004: 356) indicate a high consumption of cereals such as maize meal, bread, rice, as well as"empty kilojoule (kJ)" snack foods such as cheese curls and cold drinks, combined with low consumption of nutrient dense foods such as meat, milk, fruits and vegetables. Emerging evidence suggests that increasing the consumption of

fruits and vegetables may assist in dietary weight management strategies to prevent obesity (Bazzano, 2006: 1363).

A high consumption of fruits and vegetables may protect against excess weight gain due to high fibre and water content, both which lower dietary energy density (Rolls et al., 2005: 100; Ledikwe et al., 2006: 1362). The most recent data from the Health Survey for England indicate that although fruit and vegetable consumption has increased recently, it is still low in children and has declined over the past 40 years, suggesting that many have a role in the emergence of the obesity epidemic (WHO, 2002). Mosgfegan et al. (2005: online) indicate that the consumption of fruits and vegetables becomes lower between the ages of 14 and 18 years. In SA, according to Reddy et al. (2002: online) 57.5% of adolescents in the 2002 SAYRB survey did not eat fruits and vegetables daily as recommended. This was similar for the Thusa Bana study where adolescents also reported low consumption of fruit and vegetable (Kruger et al., 2006: 353).

Low fruit and vegetable intake is rated among the top 10 risk factors contributing to mortality according to a 2003 WHO Report. Conversely, daily consumption of a variety of fruits and vegetables ensures adequate intakes of most micronutrients, dietary fibre and a number of essential non-nutrient substances including phytochemicals, and can prevent chronic diseases of lifestyle including heart disease, cancer, diabetes and obesity. The recommended minimum intake for the prevention of these diseases is 400g of fruits and vegetables per day (WHO, 2002).

There is convincing evidence that the consumption of high levels of energy-dense foods, such as processed foods that are high in fats and sugar, promotes obesity, compared to low-energy foods such as fruits and vegetables. Tubers such as potatoes and sweet potatoes should however not be considered as fruits and vegetables as they are richer in CHO (WHO, 2003) and shall rather br included as starch.

2.4.4.4 Assessing dietary intake

There are numerous methods available to determine dietary intake each with strengths and limitations. An individual's habitual food intake is very difficult to measure and all measurements of dietary intake must be viewed cautiously. When investigating diet health relationships certain difficulties related to existing methods may present major obstacles, and

produce false negative results and inconsistencies. Therefore, consistent negative results do not necessarily proof that there is no relationship between diet and disease.

Food consumption may be measured on three major levels, namely national food supply level, household level and individual level (Katzenellenbogen et al., 1997: 1). A 24-hour recall is the first method used to determine dietary intake of individuals. An interview is conducted to determine the actual food intake during the immediate preceding 24 hours. The interviewer helps the respondent to recall the types of food and drinks (including the preparation method) consumed throughout the previous 24 hours. The interviewer also assists the respondent to estimate portion sizes (Lee and Nieman, 2010: 77). The interviewer then records this information for later coding and analysis (Hammond, 2008: 398). A 24-hour recall is probably the most widely used method of obtaining information on food intake from individuals. It is often used in national surveys because it has a relatively high response rate (Rutishauser and Black, 2002: 233) and it is also quick and easy to conduct when assessing the usual diet (Gibson, 2005: 42).

A 24-hour recall provides detailed information on types of food consumed with low respondent burden and only requires a short-term memory. The 24-hour recall can be used to estimate nutrient intake of groups and estimate nutrient intakes of individuals (Lee and Nieman, 2010: 83; Nelson, 2000: 317). The disadvantages include that respondents tend to withhold or alter information about what they have eaten because of poor memory, embarrassment or intent to please or impress the interviewer. Respondents tend to also underreport binge eating, consumption of alcoholic beverages and foods perceived as unhealthy (Lee and Nieman, 2010: 83). Another disadvantage is inaccuracy in recalling the kinds of and amount of food consumed, and tendency for persons to over report low intakes and under report high intakes of food (Hammond, 2008: 398; Lee and Nieman, 2007: 83).

A 24-hour recall is not usually representative of an individual's dietary intake due to inability to recall accurately the kinds and amounts of food consumed; difficulty in determining whether the day being recalled is a representative of a typical diet; and the tendency to exaggerate low intakes and underreport high intakes of food (Hammond, 2008: 397). It has been proven that three toseven recalls give a more accurate estimate (Lee and Nieman, 2010: 83).

The second method to estimate dietary intakes is the food frequency questionnaire (FFQ) which is used to determine the frequency of consumption of food groups rather than

specific nutrients on weekdays and weekends (Hammond, 2008: 397). FFQs are mainly used in studies that are designed to determine associations between food intake and disease. FFQs may be used for geographical, seasonal and demographic subgroups and for individuals (Rutishauser and Black, 2002: 226). The respondent indicates the usual intakes of a list of different foods, the frequency of consumption per day, per week, per month or seasonally over a period of several months, or per year. The number and type of food items included in the FFQ depend on the purpose of the assessment (Dwyer, 1999: 942). When the 24-hour recall is used concurrently with a FFQ, the accuracy of intake estimates is improved.

The advantage of FFQs is that these are useful where the purpose is to study associations of a specific food or a small number of food groups, and disease such as heart disease and diabetes (Dwyer, 1999: 943), it is relatively inexpensive for large sample sizes (Barasi, 2003: 10; Lee and Nieman, 2010: 86), it provides an overall picture of intake, and it is easy to standardize (Hammond, 2008: 397). FFQs are also easy and quick to administer (Barasi, 2010: 10; Dwyer, 1999: 943), therefore placing a low burden on respondents; causing the refusal rate to be very low (Katzenellenbogen et al., 1997: 4).

The disadvantages of FFQs include the fact that FFQs obtain information only on the frequency of consumption of a food over a given period, rather than reflecting the context in which the food was eaten (Rutishauser and Black, 2000: 235). FFQs do not provide meal pattern data; require knowledge of portion sizes, and literacy skills if self-administered (Hammond, 2004: 422; Nelson, 2000: 317). The results are culturally specific and different groups may require separate questionnaires (Katzenellenbogen, 1997: 4).

Dietary intakes can also be determined by keeping a daily food record in the form of a food diary, by a diet history, photographic or video records, as well as by weighed food intake, telephonic interviews, observation of food intake, food balance sheets, duplicate food collection (collection of identical portions of all foods and beverages) intake and computerised techniques (Lee and Nieman, 2010: 84-91).

An exchange list is used in the assessment of dietary intake to determine the amounts of energy and macronutrients consumed per day. Table 2.1 indicates the amounts of energy and macronutrients found per serving of a food item (Figure 2.1).

Table 2-1: Food Exchange List Analysis based on the American Association of Standard for Exchange List (Wheeler et al., 1996)

Food Groups	Energy (kJ)	Protein (g)	Fat (g)	Carbohydrates (g)
Milk:				
Skim	340	8	trace	12
Low fat	530	8	5	12
Full cream	640	8	8	12
Meat:				
Very lean	147	7	1	-
Lean	231	7	3	-
Medium fat	315	7	5	-
High fat	420	7	8	-
Starch/bread	285	3	trace	15
Vegetable A	-		-	-
Vegetable B	150	2	-	7
Fruit	285	-	-	15
Fat	190	-	5	-
Sugar	170	-	-	10
Alcohol	29kJ/ml	-	-	-

*vegetable A – Has little starch such as green leafy vegetables and most salad vegetables

*vegetable B – High in starch therefore has high energy content such as pumpkin, beetroot, cooked carrots, peas

2.4.5 Physical inactivity

Firm scientific evidence shows that numerous diseases are more common in individuals that engage in little or no physical activity at all, as compared to their counterparts who are physically active (Whitney and Rolfes, 2005: 565).

2.4.5.1 Defining physical activity and inactivity

Physical inactivity is defined as the lack of sufficient strong contractions of the muscles to stimulate rebuilding of worn-out muscles, the lack of sufficient metabolism to stimulate various metabolic and other regulatory systems, and the lack of sufficient amounts of skill-requiring movements to maintain the motor control of movements (Vuori, 2004: 125).

Physical activity, on the other hand, refers to any activity performed on a regular basis such as riding a bike, skipping or even doing household chores (Whitney and Rolfes, 2005: 565). Scientifically, physical activity is defined as an increase in energy expenditure due to the cost of the activity itself, but physical activity is also hypothesised to increase the resting energy expenditure (REE) (Goran and Astrup, 2002: 44).

2.4.5.2 Physical activity and disease protection

Energy balance is defined as the balance between energy intake from food and drink, and energy expenditure. A positive energy balance predicts that energy intake is higher than energy expenditure (Stang, 2008: 250), which over time may cause weight gain. Increases in energy expenditure are likely to decrease the likelihood of a positive energy balance (Goran and Astrup, 2002: 44). An assessment of physical activity is therefore required to determine adequate energy intake (kJ) for different individuals. The energy requirements may typically be classified into four levels of activity namely as high activity, active, low or medium activity, and sedentary (Stang, 2008: 250).

Increasing physical activity may be a useful approach to the management of obesity. However, some studies show that if physical activity is used as the sole intervention, only small reductions of weight are achieved. Yet, although its acute impact may be low, physical activity may play a critical role in the long-term. Many studies have shown that increased physical activity decreases insulin resistance and improves glycemic control, benefits heart health, improves lipid profiles, and lowers blood pressure even independently of weight loss that may be associated with the activity (Nnakwe, 2009: 210).

The observed relationship between little or no physical activity and increased prevalence of disease is evident from epidemiological studies (Wildman and Miller, 2004: 74). It seems that humans were designed to be active. The stimulating effects of physical activity are mediated by gene expression, and genes are thought to have adapted to a state of regular physical activity during the time when the ancestors were habitually active. In the past, activity formed part of daily work such as hunting, food gathering, and shelter building. According to Palaeolithic research, it was common for the ancestors to walk for about 32km to trade goods and visit family and friends in neighbouring villages. Today, however, walking may seem an unpleasant task to many due to a wide availability of transport (Wildman and Miller, 2004: 73-75).

2.4.5.3 Increasing physical inactivity among adolescents

Anderson and Butcher (2009: 19), as well as Stang (2008: 262), confirm that children are less active because they seem less likely to walk to school; and make use of automated transport more than was the case before. Low participation in sports and low priority given to physical education in schools have been found in studies to be associated with increased levels of overweight and obesity (Dehghan: 2005: 25; Shaw and Lawson, 2004: 372, Vuori, 2004: 140). According to the SAYBR Study (2002) the percentage of adolescents in SA had no physical education at school was 29%. Furthermore, increases in television (TV) viewing, computer game use and other sedentary activities, means that many children are less physically active than previously (Shaw and Lawson, 2004: 372), resulting in an imbalance between energy intake and energy output.

(i) The influence of TV

Modern children may prefer watching TV to spending time with their friends (Cooper et al., 2006: 105). Parents as well have become conservative, feeling it safer for their children to stay behind closed gates, rather watching TV than going out to visit others, due to an alarming increase in crime (Miller et al., 2004: 1415). The SA YBRS (2002) revealed that 25% of children in SA watch more than three hours of TV per day. TV viewing requires no energy, and in addition, even reduces the metabolic rate to a level below that of resting. Studies confirm a significant relationship between increasing numbers of hours of TV watching per week and a decrease in the REE (Cooper et al., 2006: 112). Time in front of the TV also consumes time that could be spent in energetic play, and encourages between-meal

snacking, as well as the buying and eating of food high in energy, fat and refined sugar (Harrison and Marske, 2005: 1572; Blass et al., 2006: 587). Taken together, the time spent watching TV or videos, playing video games and working on the computer, represents a major component of sedentary behaviour (Stetter et al., 2004: 900).

Food is the most frequently advertised product on children's TV programmes. Health authorities believe that the accumulation of unhealthy messages communicated to children through food advertising is a leading cause of unhealthy consumption (Brownell and Horgen, 2004: 1; Harris et al., 2010: 408). Children watch on average 15 TV food advertisements per day (Federal Trade Commission, 2007: online), and an alarming 98% of these advertisements promote products high in fat, sugar and/or sodium (Powell et al., 2007: 580; Dennison and Edmunds, 2008: 193; Thomson et al., 2008: 332). Moreover food advertising to children portrays unhealthy eating behaviours with positive outcomes. A number of reviews have examined the research on advertising to children and concluded that food advertising leads to greater preferences and purchase of the products advertised (Story and French, 2004: 3).

Smolin and Grosvenor (2008: 624), Ebbeling et al. (2002: 475) and Batch and Baur (2005: 131) report the findings that excessive TV watching impacts on the prevalence of overweight and obesity in that it introduces children to foods they might not have been exposed to; promotes snacking and reduces physical activity. Through exposure to advertising, children choose advertised food products more often than those they are not exposed to. It has been found that the more hours of TV a child watches, the more he/she is likely to ask for specific food items (Smolin and Grosvenor, 2008: 615).

TV watching also causes both children and adults to eat significantly more, even if they are not physically hungry. One of the mechanisms by which TV watching may induce one to eat more, is through causing the brain to monitor external non-food cues on the TV screen instead of the internal food satiety cues (Cooper et al., 2006: 112) TV advertisements tend to trigger eating when one sees one's favourite foods even when the body does not need food (Rolfes et al., 2009: 251), causing one to eat more than usual when eating watching TV (Sigman, 2007: 13).

(ii) The influence of computers

Computer usage is also an increasingly common sedentary behavior which may potentially displace physical activity (Marshall et al., 2003). Custers and Van den Bulck

(2010: 537-543) found that some people do skip meals to use the computers or play computer games. Skipping meals according to Dialektakou et al. (2008: 1517-1525), is a risk factor for overweight and obesity. Evidence directly linking usage of computers or other electronic devices to overweight or obesity, is however inconclusive. Batch and Baur (2005: 131) found no clear link, whereas Lazaro and Soteriades (2010: 70-77) confirmed an association between TV hours and obesity in adolescents, especially girls, who spend four hour or more per day watching TV. Lazaro and Soteriades (2010: 70-77) further observed that adolescents who spend more than four hours watching TV, are three times more likely to be overweight or obese.

(iii) Assessing physical activity levels among adolescents

Energy expenditure through physical activity is determined by the amount of oxygen metabolised by the body during the activity. Metabolic equivalents (METs) are units of measure that corresponds to a person's metabolic rate during selected physical activities of varying intensity. Physical activity level (PAL) values for various activities performed throughout the day are determined by adding up the PAL for each activity. PAL lifestyle categories are defined as sedentary, low active, active, and very active (Institute of Medicine, 2005).

PAL in populations is commonly assessed with the International Physical Activity Questionnaire (IPAQ) which was developed to serve as an international measure for physical activity in order to enable researchers to compare findings between different populations. For this purpose the IPAQ has been translated into a number of different languages. The IPAQ was first developed in Geneva in 1998, and in 2000 an extensive reliability and validity study was undertaken in 12 countries. In 2000 the IPAQ was recognised as an acceptable measure of physical activity for use in many different settings. As it is available in different languages, it is a suitable tool for national population-based prevalence studies of participation in physical activity (Booth, 2000: 114).

2.4.6 Lifestyle factors

Adolescence is the period of life that occurs between 12 and 21 years of age. It is a very exciting stage and yet probably the most challenging period in human development. During this stage lifestyle may be significantly influenced by peer behaviour and pressures, as well as the need for acceptance. These influences usually become more important than

family values, and often contribute to conflict between adolescents and parents (Stang, 2008: 246). Lifestyle factors in this study refer to alcohol consumption and smoking.

2.4.6.1 Alcohol consumption

Chemically, any molecule that contains a hydroxyl group (-OH) is considered an alcohol. However, although there are numerous molecules present in the diet and in the human body that can be classified as alcohols, the term alcohol in this case refers to ethanol (Smolin and Grosvenor, 2008: 199).

Ethanol is formed as the result of the breakdown of sugars and starches by yeast through fermentation. Modern beer is made by fermenting barley and hops. Wine is produced by fermentation of grapes or other fruits or plants, and hard liquors by the fermentation of starches derived from various grains (Liber, 1995: 348).

Alcoholic beverages are consumed as part of many social activities, while alcohol has been used among others, as a mind altering substance, disinfectant, tonic and diuretic (Liber, 1995: 348). As a drug, the short-term effects of alcohol occur soon after ingestion (Smolin and Grosvener. 2008: 627; Suter, 2005: 226). Excessive consumption may result in physical, psychological and social harm to the individual as well as to those around them. There are also long-term health consequences associated with overuse. Economic estimates suggest that health and other problems related to alcohol consumption, including time away from work, represent a heavy financial burden (Barasi, 2003: 52).

Alcoholism is a major problem in adolescence and can occur as early as in the 12^{th} grade. Alcohol is also the most commonly used substance at university (Sliva et al., 2006: 1). In the United Kingdom (UK), men drink twice as much as women and the young more than the old; while married adults drink less than single men and women. Permitted drinking hours influence the pattern of drinking and the consequences thereof (James and Ralph, 2000: 122).

As a drug, the short-term effects of alcohol occur soon after ingestion, and there are also long-term health consequences associated with overuse (Smolin and Grosvener. 2008: 627; Suter, 2005: 226).In the brain, alcohol acts as a depressant. First, it affects reasoning and if drinking continues, the vision and speech centers of the brain are affected. Next, large muscle control becomes impaired, causing lack of coordination. Finally, the individual loses consciousness. This can occur with binge drinking, which refers to a heavy consumption of

alcohol over a short period of time. In colleges and universities in the US, binge drinking causes many deaths and cases of alcohol poisoning (Smolin and Grosvenor, 2008: 203).

Alcohol also poses a risk for overweight and obesity as a result of the specific effects thereof on energy metabolism and substrate metabolism. Alcohol has a complex tendency to increase the BMI more in males than in females. The body cannot store potentially harmful alcohol, and instead quickly metabolises ethanol to remove it from the blood preventing it from accumulating and destroying cells and organs. The liver metabolises ethanol before other compounds and has alternative pathways to handle excess consumption. Ethanol is metabolised in three ways. First, the ethanol is converted to acetaldehyde, which is a toxic and highly reactive substance. The acetaldehyde is converted to acetate and then to acetyl CoA, which enters the citric cycle or is converted into fatty acids, which accumulates on the liver as fat. Fatty acid synthesis accelerates with a high consumption of alcohol. The development of a fatty liver is also the first stage of liver destruction in alcoholics (Zakhari, 2006: 246).

As alcohol provides 29.7kJ of energy per gram, but contains no nutrients (Smolin and Grosvener, 2008: 627; Suter, 2005: 226), habitual consumption of ethanol in excess of the body's energy needs favours lipid storage, and thus contributes to overweight and obesity (Janssen et al., 2004: 225; Suter, 2005: 197-227). Alcohol may also contribute to weight gain because liquid kilojoules have less satiety value, while drinking may stimulate appetite, promoting consumption of other additional energy sources (Smolin and Grosvenor, 2008: 205; Yeomans, 2010: 84).

Breslow (2005: online) states that the BMI of individuals who drink alcohol is usually related to the frequency and quantity of alcohol they consume. Alcohol energy contributes about 5% of total energy intake in the USA diet, but in the heavy drinker, it may contribute up to 50% of the daily energy intake (Bowman and Russell, 2001: 497). Breslow (online) observed that women who drank the smallest quantity of alcohol (one drink/unit per drinking day) with the greatest frequency (3-7 days per week) had a lower BMI than those who infrequently consumed the greatest quantity. It is thus evident that light to moderate alcohol consumption is associated with less weight gain and smaller chances of getting obese (Wang et al., 2010: 460; Yeomans, 2010: 86). In a study conducted by Hellmich and Vergano (2010:1), it was found that women who drink moderate amounts of alcohol also tend to eat less, especially CHO, and therefore they gained less weight and were less likely to become

overweight or obese than those who drank no alcohol. Once ingested, alcohol also alters nutrient absorption and metabolism. Alcohol consumption may also displace more nutritious foods from the diet (Smolin and Grosvener, 2008: 627; Suter, 2005: 226).

Alcoholic beverages are commonly available at social gatherings for adolescents, which predispose them to drinking (Smolin and Grosvener. 2008: 627; Suter, 2005: 226). The prevalence of alcohol consumption among adolescents is very high. In the USA, four out of five high school students have had at least one alcoholic beverage; about half drink regularly; and one in three drink heavily (Whitney et al., 2001: 527). According to the 2002 SAYRBS, more than 1 in 4 SA (28%) aged 15 years reported to have consumed alcohol. More males (14.5%) than females (7.1%) aged 15-19 years were current drinkers (Reddy et al., 2003: online).

2.4.6.2 Smoking

Cigarette smoking has been recognised as the number one cause of preventable death in the US. Smoking is linked to many health problems, from minor mouth sores to tumours in the nasal cavities, cheeks, gums and throat. Nicotine in cigarettes decreases the lower esophageal sphincter (LES) pressure and the use of tobacco products compromises the gastrointestinal (GI) integrity, and increases the risk of esophageal and other cancers (Beyer, 2008: 658). The increased risk of cardiovascular diseases and stroke from cigarette smoking has been recognised for more than 40 years. Smoking increases the risks for CVD by directly influencing acute coronary events such as thrombus formation, plaque instability and subclinical atherosclerosis, and is also being a risk factor for osteoporosis (Anderson, 2008: 630, Stopler, 2008: 849).

In adult women smoking is associated with lower body weight. Adolescents are concerned about body image and many of them start smoking in order to lose weight or maintain it. Smoking may be related to decreased body weight through increasing the metabolic rate, and decreasing metabolic efficiency, both of which are associated with tobacco use. Smoking a single cigarette has been shown to induce a 3% rise in REE within 30 min (Dallosso and James, 1994: 365; Chiolero et al., 2008: 803). Smoking four cigarettes with 0.8 mg nicotine increase REE by 3.3% for three hours (Collins et al., 1994: 554). Furthermore, smoking suppresses appetite and produces a marked mood elevation; causing a smoker to be unaware of the need for food for a long period of time (Larson et al., 2007:1a), which may also contribute to weight loss.

Despite the role of smoking to curb weight gain, smokers generally follow a poor diet. A comparison of the diets of smokers and non-smokers found that smokers had higher intakes of total and saturated fats, and consumed fewer fruits and vegetables, and thus less fiber (Smolin and Grosvenor, 2008: 626). Smokers were also found to often consume energy dense foods with a low nutrient density, such as doughnuts, chips, soft drinks and cream-filled cakes (Larson et al., 2007:1a). Smokers also generally have low intakes of dietary fiber, milk, fruits, vegetables and water. Low fruit and vegetable intakes cause smokers to have generally low intakes of dietary antioxidants, and thus low antioxidant status (Rolfes et al., 2006: 541; Farugue et al., 1995). Smokers also have a higher intake of alcohol than non-smokers (Hendricks et al., 2004; Mammas et al., 2004; Sizer and Whitney, 2003: 467).

Smokers also often do not want to quit because they fear that they will gain weight. Studies have indeed shown that about 4.5kg of weight is gained during the first year after quitting smoking (Smolin and Grosvenor, 2008: 626).

2.4.7 Knowledge, attitude and practices regarding nutrition

Knowledge in a certain subject matter is assumed to influence choices made in everyday life. The fact that many chronic diseases including obesity are to a large extent the result of individual and social patterns of behaviour means that knowledge should play a major role in determining these lifestyle related diseases (Contendo, 2007: 2). Contento (2007: 60) further hypothesises that if people acquire knowledge in nutrition and other health areas, their attitudes are expected to change and changes in attitude lead to changes in behaviour or practices.

Thus the primary motivator is assumed to be an accumulation of knowledge, since knowledge is essential for making the right informative choices to provide a better quality of life. For most people however, knowledge is not motivational. Knowledge is unlikely to lead to improved attitudes or practices for those that are not interested or motivated (Backett, 1992; Moorman and Matulich, 1993 as referred by Contendo, 2007: 60). Although the public may have knowledge on the relationship between health and diet, eating attitudes remain unhealthy (Sun YC, 2008: 47).

Most adolescents are aware of the importance of nutrition and the components of a healthy diet; but experience many barriers to choosing healthy foods and beverages (Story and French, 2004: 2). Adolescents cite taste, time, and convenience as the key factors that

affect their food choices. Many teens lack the ability to associate current eating habits with future disease risk and show little interest for their future health. They are more concerned with pleasing their peers and will adopt health behaviors that demonstrate their desire for autonomy and make them feel more like adults such as drinking alcohol, and smoking (Larson et al., 2007: A1).

According to Stang (2008: 254), food habits/practices that are seen more frequently among adolescents than other age groups are irregular consumption of meals, excessive snacking, eating away from home, dieting and skipping meals. Many factors outside contribute to these behaviours, including decreasing influence of family and increasing influence of peers on food and health choices, increasing exposure to media, increasing prevalence of employment of parents outside the home, increasing responsibilities of parents, leaving less time for adolescents to eat meals with their families.

2.5 Health consequences of childhood overweight and obesity

The epidemic of paediatric obesity is having a huge impact on the physical and social well-being of children who are increasingly suffering chronic complications of obesity that were once only observed in adults (Hannon et al., 2005: 473).

Excess body fat, particularly the visceral fat (fat accumulated around the waistline; also referred to as central obesity) increases the risk for numerous diseases. The increased risk results from the metabolic consequence of enlarged fat cells, the increased mass of body fat, and endocrine alterations, all of which do not become apparent for a long time, but may be demonstrated biochemically before they cause clinical symptoms. The increased risk for the chronic diseases associated with obesity, tracks into adulthood and considerably increases the risk for morbidity and mortality in adulthood (Barker, 2007: 47).

Studies have identified a positive association between weight increase and the so-called metabolic syndrome (MS) which refers to a cluster of traits including hyperinsulinaemia, obesity, hypertension and hyperlipidaemia (Alberti et al., 2009: 1641). MS is believed to be triggered by a combination of genetic factors in combination with environmental factors which include excess energy intake and reduced levels of physical activity. The primary cause of MS appears to be obesity which leads to excess insulin production. This excessive insulin production is associated with an increase in blood pressure, dyslipidaemia, hyperglycemia and various other metabolic changes which

eventually results in the chronic diseases of lifestyle associated with central obesity (Daniels et al., 2005: 2000).

Hyperglycemia, related to insulin resistance, may develop into T2DM even in children. Most children diagnosed with T2DM are diagnosed during puberty, but as children become more obese and less active, the trend is shifting to younger children. Children or adolescents with T2DM may experience microvascular complications such as renal insufficiency and chronic renal failure, retinopathy leading to blindness, and limb-threatening neuropathy, as well as macrovascular complications such as atherosclerosis vascular disease, stroke, myocardial infarction, at a younger age than is expected (Arens, 2009: 440; Kahn et al., 2006: 842; Hannon et al., 2005: 473).

Overweight and obese children and adolescents are thus at an increased risk of cardiovascular diseases. This relationship is apparent throughout childhood, and the magnitude increases with age (Rolfes et al., 2006: 548). Children who are overweight and have high blood cholesterol are also likely to have parents who develop heart disease at an early age (Rolfes et al., 2006: 548). Most cardiovascular diseases involve atherosclerosis which develops when regions of an artery's walls become progressively thickened with plaque. Fatty streaks may begin to appear in children within the first decade of life and start to accumulate fibrous connective tissue during adolescence. The extent of the atherosclerotic lesions in childhood and adolescence is predicted by the number of cardiovascular risk factors present (Rolfes et al., 2006: 547). The degree of obesity is consistently more strongly associated with high total cholesterol and abnormal lipoprotein profiles in male than in female adolescents.

The proportion of cholesterol excreted into the bile is elevated in obesity in comparison with the excretion of bile acids and phospholipids, increasing the likelihood of gallbladder stones. Gallstones are not so common in adolescents, but in a study conducted by Kaechele et al. (2006: 66), 10 out of 493 (2%) of adolescents studied, were detected with gallbladder stones.

Obesity also appears to increase the risk of the development of asthma, while overweight is also associated with more severe symptoms in subjects with asthma. Furthermore obesity is associated with sleep apnea and possible pathophysiology mechanisms which contribute to this association include increased airway closing pressure, altered chest wall mechanisms and an abnormality of ventilator control. Traditionally a child

with obstructive sleep apnea was underweight. However, as a result of the epidemic proportions of obesity, obstructive sleep apnea syndrome now seems to increase more in children who are obese (Arens, 2009: 436; Kaditis et al., 2007: 28).

Childhood obesity also introduces a host of emotional and social problems. People frequently judge others on appearance more than on character. Overweight adolescents are usually victims of prejudice. Many suffer discrimination by adults and rejection by peers. Television shows which are a major influence in children's lives often portray overweight people as misfit figures who are lazy and stupid. Overweight children themselves may come to accept this negative stereotyping (Whitney and Rolfes et al., 2005: 564). This may result in poor self-image and a sense of failure. During adolescence these children seem to be more lonely and depressed. They have a low self-esteem and experience difficulties in peer-group relationships and as a result have fewer friends (Daniels, 2006: 47; Daniels et al., 2005: 1999).

Adolescents with low levels of self-esteem demonstrate higher rates of sadness, loneliness, nervousness and are more likely to engage in high risk behaviours such as smoking or consuming alcohol. Teasing in overweight adolescents has been shown to be associated with increased suicidal attempts and suicides (Daniels et al., 2005: 2001). The long term consequences of psychological problems during childhood and adolescence are more prevalent in girls than in boys (Goedecke et al., 2006: 1995). Yet, some overweight or obese children show few psychological problems. This phenomenon is seen especially in children who come from families in which obesity is a common problem. These children appear active, happy and without negative adverse psychological effects from being overweight or obese (Daniels, 2006: 48).

2.6 Recommendations for healthy living and the prevention of obesity

Recommendations are developed by nutrition experts using results from extensive research. These nutritionists set standards to help determine amounts of energy, nutrients, and other dietary components and physical activity that support a healthy lifestyle. Nutrient recommendations, food based dietary recommendations and physical activity recommendations are to be discussed in this section.

2.6.1 Nutrient recommendations

As discussed before, food provides macro- and micronutrients used in the body to provide energy, structural materials, and as regulating agents to support growth, maintenance, and tissue repair. In the body the macronutrients CHO, fat and proteins can be used to provide energy. In contrast, the micronutrients namely vitamins and minerals, and water do not yield energy in the human body (Rolfes et al., 2006: 7).

2.6.1.1 The development of dietary standards

The intake level of key nutrients that will meet specified criteria of nutritional adequacy and thereby prevent the risk of deficit or excess is referred to as the individual requirement. Nutrient recommendations are used as standards for evaluating the energy and nutrient requirements of healthy individuals (Sizer and Whitney, 2000: 28).

The first dietary standards for the USA were published in 1943 by the Food and Nutrition Board of the National Research Council of the National Academy of Sciences, and were called the Recommended Dietary Allowances (RDA) for healthy people in the United States. The Canadian equivalent of the RDA's was the RNI (Recommended Nutrient Intakes). Since at that time malnutrition in the US and Canada was mostly due to undernutrition and micronutrient deficiencies, the RDA (and RNI) was primarily designed to prevent nutrient deficiencies (Food and Nutrition Board, 1989). The RDAs were revised every 10 years, with each revision maintaining the original goal to protect against nutrient deficiencies and associated overt clinical signs (Dodd and Bayerl, 2008: 319).

The last edition of the RDA (RNI) was published in 1989, but by then new scientific knowledge indicated that the RDA system was flawed. In 1994 the scientists of the US Food and Nutrition Board of the Institute of Medicine of the Academy of Sciences began revising the former RDAs into Dietary Reference Intakes (DRI) to address the limitations of the former system. From 1997 new DRIs used in place of the US RDA and the Canadian RNI was systematically implemented (IOM, 2000).

The DRIs are not just based any longer on avoiding deficiency diseases, as determined by clinical manifestation, but focuses on supporting optimal activities within the body and preventing chronic diseases, thereby maximising health and increasing quality of life as well (IOM, 2006). Similar sets of recommendations have been published for

populations in at least 40 different countries, as well as organizations like the WHO. These standards may differ slightly between countries and organizations due to variations in the interpretation of the scientific data on which the standards are based, and on the other hand to differences in the food habits and physical activity levels of the population they were designed for. The WHO and Food & Agricultural Organization (FAO) recommendations are considered sufficient to maintain health in nearly all healthy people worldwide (Story and Stang, 2005: 23).

2.6.1.2 The Dietary Reference Intakes (DRIs)

The Dietary Reference Intakes (DRIs) consist of four reference values for the intakes of nutrients that may be used for planning and assessing the diets of healthy people (Smolin and Grosvenor, 2008: 35; Rolfes et al., 2009: 16). DRIs are based on specific criteria of adequacy for the nutrient in question. The parameter chosen to represent adequacy of the nutrient, is specifically selected to reflect the function of the nutrient in the body, such as the amount of a nutrient or a breakdown product thereof excreted in the urine; the blood level of the nutrient; or the activity of an enzyme which is dependent on that nutrient as a coenzyme. Since evidence reveals that male requirements differ from those of females, and that needs change as a person grows from birth through old age, recommendations are clustered into groups by age/life stage and gender (Smolin and Grosvenor, 2008: 35; Rolfes et al., 2006: 19; Dodd and Bayer, 2008: 320).

Another important factor that is taken into account when setting DRIs for a particular population is the average bioavailability of the nutrients in the typical diet of that specific population. Bioavailability refers to the amounts of a nutrient that can actually be absorbed from the gastrointestinal tract and be utilized by the body (Smolin and Grosvenor, 2008: 35).

DRIs include RDAs as well as AI, Tolerable Upper Intake level (ULs), and Estimated Average Requirements (EARs). The EAR represents the average requirements of a nutrient in a given population and can be viewed as the amount of a nutrient with which about 50% of individuals would have their needs met and the other 50% would not. The EAR should therefore be used for assessing the nutrient adequacy of populations, and not of individuals. The RDA is the amount of a nutrient needed to meet the requirements of almost all individuals (97% - 98%) in the healthy population and is calculated as twice the standard deviation of the EAR of a nutrient in a given population (Smolin and Grosvenor, 2008: 35; Rolfes et al., 2009: 16).

The AI is a nutrient recommendation based on observed or experimentally determined approximation of nutrient intake by a group or groups of healthy individuals when sufficient scientific evidence is not available to calculate an RDA or EAR. Either RDA or AI may be used as a goal for dietary intake of individuals (Smolin and Grosvenor, 2008: 35; Rolfes et al., 2009: 17).

An UL is the highest level of daily nutrient intake that is unlikely to have any adverse health effects on almost all individuals (97% - 98%) in the general population (Earl and Escott-Stump, 2008: 338-339). The ULs were established (for nutrients which adequate scientific data available) to reduce the risk of adverse or toxic effects from increased consumption of nutrients in concentrated form either alone or combined with others (not including food sources) or from enrichment and fortification (Grosvenor and Smolin, 2008: 35; Rolfes et al., 2009: 18).

(i) DRIs for energy

Energy requirements vary greatly among males and females because of variations in growth rate, body composition, and physical activity levels. The macronutrients in food provide a lot of energy when digested, absorbed and metabolized in the tissues. Energy requirements are expressed as estimated energy requirements (EER) (Rolfes et al., 2009: 18). DRIs for energy and macronutrient intakes are summarised in Table 2.2.

Table 2-2: DRIs for macronutrients and water for adolescents aged 14-18 years (Story and Stang, 2005: 22)

	Male (14-18)	**Female (14-18)**
Energy (kJ/day) (EER)	13 238	9 946
Carbohydrate(g/day) (RDA)	130	130
Protein (g/day) (RDA)	46	52
n-6 polyunsaturated (g/day) (RDA)	11	16
n-3 polyunsaturated (g/day)(RDA)	1.1	1.6
Fiber (g/day) (RDA)	28	38
Water (L/day) (AL)	2-3	2

(ii) DRIs and other recommendations for macronutrients and water

(a) Carbohydrates (CHO)

According to the FAO and the WHO (FAO/WHO, 1998), CHO is the single most important source of energy in the world. Intakes vary enormously among countries and among groups and individuals within countries. CHO-containing foods provide between 40% and 80% of total food energy intake, depending on cultural considerations and economic status. CHO containing foods are also important vehicles for proteins, vitamins, minerals, and other food components, such as phytochemicals and antioxidants. Cereals (rice, wheat, maize, barley, rye, oats, millet, and sorghum) are the major sources of CHO energy worldwide (Mann, 2001: 59).

CHO is categorised as starch, fiber and sugar. Fiber refers to the part of the dietary plant material which resists digestion by the human digestive tract and is thus not available as an energy source. It is recommended that one consumes 25-30g of fiber per day.

Recommendations to increase fiber intake are as follows (Flegal et al., 2010: 45):

- Replacing refined grains with whole grains;
- Increasing intake of fruits, vegetables, nuts and legumes;
- Increasing intake of raw fruit with its seeds and peels; and
- The fiber must be increased gradually by choosing a wide variety of fiber rich foods.

The recent concerns on excessive energy intake among the youth has been centered on the intakes of added fats and sugars in their diet (Stang, 2008: 250).The human passion for sweetness has resulted in sugar cane production increasing to the extent that it is now produced on a larger scale globally than the other major CHO-containing foods in the human diet (Mann, 2001: 59). The recommended intake of sugar is 5 to 10% of total energy consumed per day (Escott-Stump, 2008: 339).

(b) Protein

Protein is needed for growth, repairing or replacing tissue and fighting infections in the body. Protein can also be an energy source and contain 17kJ/g. However, using protein for energy necessitates the removal of the amino group and the formation and excretion of urea in a process involving deamination (Gallagher, 2008: 62-63; Wildman and Miller, 2004: 139).

The RDA for protein for adolescents is 0.8g/kg/day for girls and 1.0g/kg /day for boys. To obtain this quantity of protein, dietary protein should provide approximately 10% to 15% of the total energy intake. Protein requirements increase during times of stress and disease. Foods rich in protein are obtained primarily from animal flesh or animal products such as eggs and milk. Most plant foods are relatively poor sources of protein, with the exception of legumes and beans (Gallagher, 2008: 62-63; Wildman and Miller, 2004: 139).

(c) Fat

Dietary fat is an essential component of the diet and constitutes a concentrated source of energy and essential fatty acids. Dietary fat is also essential for the digestion, absorption, and transport of the fat-soluble vitamins and phytochemicals such as carotenoids and lycopenes (Gallagher, 2008: 50). Body fat is needed to insulate the body, preserve body heat and maintain body temperature. One gram of fat yields 38kJ of energy (Paterson, 2005: 8).

There are different types of fat; saturated (SFs), monounsaturated (MUFs), polyunsaturated fats (PUFs) and cholesterol. The intake of SFs is associated with a high risk of cardiovascular diseases and hence a low intake is recommended. High concentrations of cholesterol are associated with a high risk of dyslipidaemia and CVD. A higher proportion of daily intake of fat should be from the MUFs and PUFs (Gallagher, 2008: 52). The sources of SFs are full cream milk, hard margarine, chocolate, and butter fat. MUFs and PUFs are easily absorbed, and do not cause toxic substances when used in cooking. Examples of sources of MUFs are avocado, peanuts or peanut oil, canola oil, and olive oil; while those of PUFs are vegetable oils such as sunflower, soy bean and fish oil. Sources of cholesterol include eggs, liver, kidneys, brain and heart (Walsh and Joubert, 2008: 112).

The Dietary Guidelines for US, recommend that adolescents should consume not more than 10% of kJ derived from SFs (Flegal et al., 2010: 24). The recommended range for total fat intake is 20%-35% of total energy intake (Gallagher, 2008: 59; Wildman and Miller, 2004: 166; Ettinger, 2004: 51), with 10% from MUFs and PUFs. Dietary cholesterol should be limited to 300mg or less per day (Walsh and Joubert, 2008: 113).

Dietaryrecommendations to reduce fat intake are as follows (Flegal et al., 2010: 65):

- ***Meat, Fish and poultry***

Use lean meat;

Use more fish and poultry to replace red meat;

Remove visible fat;

Cook, grill or stew rather than fry; and

Avoid adding fat during the cooking process.

- ***Milk and milk products***

Use low fat milk (2%, 1% or skimmed milk) in place of full cream milk; and

Avoid or reduce the use of cream, ice cream, and full cream cheese.

- ***Visible fats and oils***

Replace butter and hard margarine with soft margarine and vegetable oil; and

Use oil in the preparation of food to replace fat or hard margarine.

- ***Water***

Water is an essential component of all body tissues as it renders many solutes available for cell function, while being the medium needed for all reactions. Water is also a substrate in many metabolic reactions, and as a structural component provides form to cells. Water is essential for the physiologic processes of digestion, absorption, and excretion and plays a key role in the structure and function of the circulatory system, and acts as a transport medium for nutrients and all body substances (Smolin and Grosveor, 2008: 8; Charney, 2008: 145). Water also maintains the physical and chemical constancy of intracellular and extracellular fluids and has a direct role in maintaining body temperature (Smolin and Grosveor, 2008: 8; Charney, 2008: 145).

Water is the only macronutrient that does not provide energy. Water contributes about 60% of the weight of the human body and is required in large amounts in the daily diet. A suitable daily allowance for water is 3.7 liters for boys and 2.7 liters for females depending on body size (based on 35ml/kg) (Charney, 2008: 147).

(iii) DRIs and other recommendations for micronutrients

Micronutrients are nutrients needed by the body in small amounts. These include vitamins, minerals and phytochemicals. Vitamins are organic molecules that do not provide

energy but are needed to regulate body processes. Each vitamin has a unique structure and function. There are 13 essential vitamins, with some being water soluble (such as vitamin B, and C) and others being fat soluble (vitamin A, D, E and K) (Smolin and Grosvenor, 2008: 302).

- ***Vitamins***

Vitamins are carbon-containing compounds which do not provide energy. They are naturally found in foods and are essential in the diet to promote and regulate specific body functions of growth, maintenance and reproduction (Gallagher, 2008: 68). Vitamins are required by the body in small amounts. A lack of a compound in the diet results in specific deficiency symptoms that are relieved by its addition to the diet. Almost all foods contain vitamins in varying amounts and combinations. A person need not consume the exact requirement every day but can consume an average intake over a period of days. When consuming a varied balanced diet a person can meet their needs. People who cannot meet their requirements should supplement (Smolin and Grosvenor, 2008: 302).

- ***Minerals***

Minerals form about 4 to 5% of the body. Like vitamins, they do not provide energy. There are seven macro-minerals namely calcium, phosphorus, magnesium, sulphur, sodium potassium and chloride are essential to form the largest part of the body's mineral content. The micro-minerals are essential for bone formation, and regulate metabolism. The minerals are categorised into macro and micro-minerals. The table below illustrates these categories and the required amounts.

Table 2.3: DRIs for micronutrients for adolescents aged 14-18 years (Story and Stang, 2005: 22)

Micronutrients	Male (14-18yrs)	Female (14-18yrs)
Water soluble vitamins		
Vitamin B_1 (mg/day)	1.2	1.0
Vitamin B_2 (mg/day)	1.3	1.0
Vitamin B_3 (mg/day)	16	14
Vitamin B_6 (mg/day)	1.3	1.2
Pantothenic acid (mg/day)	5*	5*
Biotin (mcg/day)	30*	25*
Vitamin B_{12} (mcg/day)	2.4	2.4
Folic acid (mcg/day)	400	400#
Vitamin C (mg/day)	75	65
Fat soluble vitamins		
Vitamin A (mcg/day)	900	700
Vitamin D (mcg/day)	5*	5*
Vitamin E (mg/day)	15	15
Vitamin K (mcg/day)	75*	75*
Macro-minerals		
Calcium (mg/day)	1300	1300*
Phosphorus (mg/day)	1250	1250
Magnesium (mg/day)	410	360
Sodium (g/day)	1.5	1.5
Potassium (g/day)	4.7	4.7
Chloride (g/day)	2.3	2.3
sulphur	ND	ND
Micro-minerals		
Iron (mg/day)	11	15
Copper (mcg/day)	890	890
Manganese (mg/day)	2.3*	1.6*
Selenium (mcg/day)	55	55
Iodine (mcg/day)	150	150
Fluoride (mg/day)	3*	3*
Chromium (mcg/day)	35*	24*
Molybdenum (mcg/day)	43	43

Note: **indicates adequate intakes*

 # indicates women capable of becoming pregnant should consume 400mcg from supplements or fortified foods in addition to folic acid obtained from the diet

***ND** indicates that it was not determinable due to lack of data of adverse effects in this age group. Source of intake should be from food only to prevent high levels of intake.*

2.6.2 Food based dietary recommendations

Amongst others, food based dietary recommendations include the South African F BG and the United States DHHS food guide pyramid

2.6.2.1 South African Food-Based Dietary Guidelines

The South African FBDGs were formulated to address the existing under and over-nutrition in different communities in South Africa. The guidelines are based on eating patterns appropriate to the various South African dietary cultures and embody the SA strive towards equity in diet and health. The aim of South African FBDG is to optimize nutritional status in both disadvantaged and affluent communities. The guidelines can be used as a basis in planning, implementing and evaluation public health nutrition strategies. The aims of developing guidelines for South Africans were to help individuals and groups choose an adequate and prudent diet; to improve dietary intake, nutritional status and health; as well as in the prevention of diet-related diseases (Gibney and Vorster, 2001: 52). However, the focus is placed on the development of paediatric FBDGs for infants and young children from birth up to the age of seven years, the age at which nutrition interventions can be to curb the increasing prevalence of overweight and obesity. The following SA FBDGs have been formulated for paeds according to age category (Bourne, 2007: 228):

- ***Birth to 6 months***

Enjoy time with your baby;

Breastfeeding is best for your baby for the first 6 months of life;

Clean your baby's mouth regularly; and

Take your baby to the clinic every month.

- ***6 months to less than 12 months***

Enjoy time with your baby;

Keep breastfeeding your baby;

Teach your baby to drink from a cup;

Start giving your baby small amounts of solid foods;

Increase your baby's meals to up to five times a day; and

Take your baby to the clinic every month

- ***Above 1 year to less than 7 years***

Feed children five small meals per day;

Encourage children to eat enjoy a variety of foods;

Offer children clean, safe water regularly;

Take children to the clinic every three months;

Encourage children to be active every day;

Make starchy foods the basis of the child's main meals;

Children need plenty of vegetables and fruits every day;

Children need to drink milk every day;

Children can eat chicken, fish, meat, eggs, beans, soya or peanut butter every day; and

If children have sweet treats or drinks, offer small amount with meals.

The following SA FBDGs have been formulated for children above 7 years and adolescents (Gibney and Vorster, 2001: 48):

- ***Enjoy a variety of food***

Foods contain numerous nutrients and other substances that are helpful to the body. There is no single food that contains all the nutrients in the amounts required by the body. Choose a variety of foods to ensure that the nutrient requirements are met.

- ***Make starchy food the basis of most meals***

Starchy foods provide the body with energy. They are a very cheap source of energy. Starchy food is low in fat, but high in complex carbohydrates.

- ***Meat, fish, chicken, milk and eggs can be eaten every day***

Animal foods provide a valuable contribution of nutrients to the diet, but overconsumption of these foods increase the risk for various diseases because of their high fat content.

- ***Eat dry beans, peas, lentils and soy beans often***

Legumes are a rich and economical source of protein, carbohydrates, fiber and a variety of vitamins and minerals. They are low in fat and can help to protect the body against disease.

- ***Eat plenty of vegetables and fruits every day***

Vegetables and fruits contain vitamins, minerals, fiber and phytochemicals to protect the body against disease.

- ***Eat fats sparingly***

A high fat intake is associated with heart disease, obesity and certain types of cancers.

- ***Eat salt sparingly***

A high intake of salt is associated with a rise in blood pressure.

- ***Drink lots of clean and safe water (at least 2 liters per day)***

The body is largely made up of water and good hydration is crucial for optimal body functions.

- ***Be active***

Food eaten should be balanced with physical activity to improve or maintain weight. Gaining weight is linked to high blood pressure, heart disease, diabetes, stroke, and certain cancers.

- ***If you drink alcohol, drink sensibly***

Alcoholic beverages supply energy, but no nutrients. Alcohol alters judgment and can lead to dependency and other health problems including liver disease and birth defects. A recommended intake is 1 beer or 1 glass of wine.

These guidelines do not however, quantify nutrient intakes. They are used in conjunction with the Food Guide Pyramid to ensure that the required nutrients by the body are met (Escott-Stump, 2008: 345).

USDA/DHHS Food Guide Pyramid

The Food Guide Pyramid (FGP) (Figure 2.3) was developed based on the nutrition problems, food supplies, eating habits and cultural beliefs of North American populations. The aims of these guidelines are to promote good health and reduce the risk of chronic diseases such as heart disease, certain types of cancer, diabetes, stroke and osteoporosis. The USDA FGP encourages greater consumption of milk and milk products, whole grains, fruit and vegetables and also assignsfood to five major food groups with recommended daily amounts of those food groups (Dodd, 2008: 279; Smolin and Grosvenor, 2008: 43).

Figure 2.3 indicates how many servings an adolescent (14-18 years) need from each of the six food groups every day. A FGP is designed as a guide to the selection of a diet that meets all nutrient needs, both the macronutrients and micronutrients. It is important to follow the serving recommendations from the different food groups because no one food has all the nutrients the body needs (Sizer and Whitney, 2003: 38). Having the amount and type of food recommended in the FGP is following the FBDGs, which will help meet one's vitamins and minerals requirements (Escott-Stump, 2008; 345).

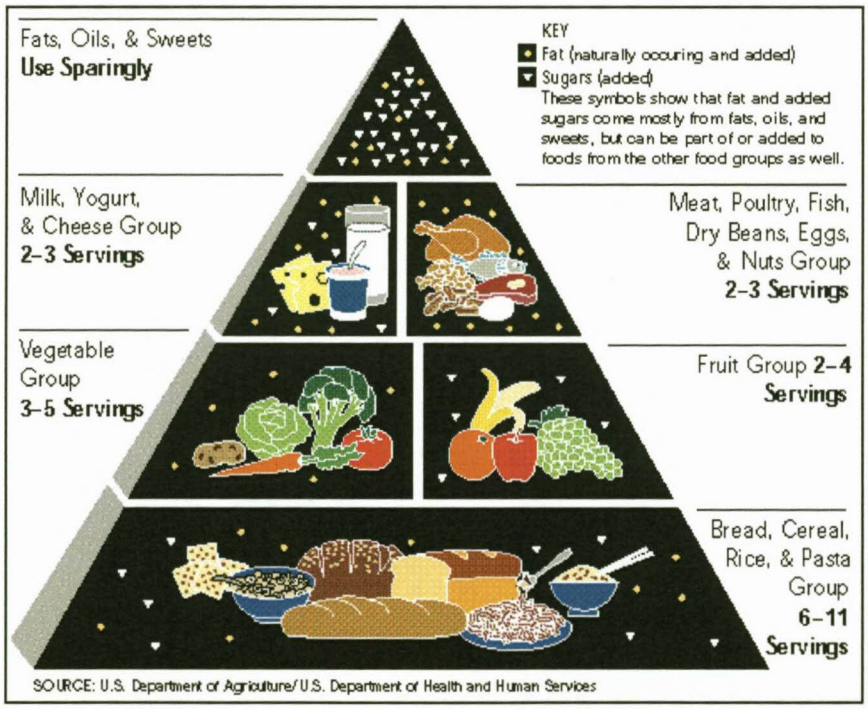

Figure 2-1: USDA/DHHS Food Guide Pyramid (Smolin and Grosvenor, 2008: 44):

Portion size (a serving) is equal to the following:

- ***Bread, Cereal, Rice and pasta***: 1 slice of bread, ½ cup cooked cereal/ 30g dry cereal
- ***Vegetables:*** ½ cup cooked, 1 cup raw vegetables
- ***Fruit:*** 1medium fruit, ½ cup chopped fruit, ¾ cup fruit juice
- ***Milk, Yoghurt and Cheese***: 1 cup milk, ½ cup yoghurt, 45g cheese
- ***Meat, Poultry, Fish, Dry beans, Eggs and Nuts*:** 30g meat/ fish/ poultry, 1 egg, 1cup beans, and 10 nuts
- ***Fats, Oils and Sweets:***Use sparingly

2.6.3 Recommendations for physical activity

A routine exercise program is important for all people. The most beneficial exercise programme differs for each individual. Walking is considered ideal for obese individuals. Exercises such as bicycling, stair climbing, swimming and aerobic dancing are good alternatives to walking (Anderson, 1999: 1386). A person can undertake a range of different activities during the course of a typical day.

Exercise programmes for both prevention and rehabilitation are effective when they are individualised. Exercise programs must be based on the person's current fitness and health status with emphasis on intensity, frequency, duration and type of exercise. Prior to engaging in a regular exercise programme it is suggested that participants receive a physical examination by a physician. The basic exercise routine or regime should consist of the following exercise prescription (Wildman and Miller, 2004: 71).

- ***Warm-up:*** A 5-10 minute light aerobic warm-up should be performed prior to any other exercise to increase body temperature and prepare the body for work;
- ***Stretch:*** Should follow a warm-up in order to increase muscle and soft connective tissue temperature and decrease viscosity;
- ***Strength training:*** Should be performed for 3 days/week using all muscle groups;
- ***Cardio-respiratory:*** Perform 30-60 minutes of continuous rhythmic movement 3-5 days/week;
- ***Warm-down:*** Gradually decreasing the intensity level allows the pumping of the skeletal muscles to maintain adequate venous return to heart and hence keep blood from pooling in the extremities; and

- ***Stretch:*** Performing static stretches after a training session helps bring the muscle tissue back to normal resting lengths.

According to Corbin and Pangrazi (1998) as referred to by Lucas (2008), children should be active for at least 60 minutes a day, with activity including moderate to vigorous activity. To prevent weight gain and support weight loss, 60 minutes of moderate intensity physical activity a day in addition to activities of daily life are recommended CDC (2004).

Adults should engage in moderate intensity physical activities for at least 30 minutes on five or more days of the week and vigorous intensity physical activity for three or more days per week for 20 or more minutes CDC (2004).). A physically active life with abstention from smoking, moderate alcohol consumption and consumption of healthy foods maximises the chances of having a normal weight (Koski et al., 2002: 810; Yeomans, 2010: 82-89).

Goedecke et al. (2006: 142) recommend the physical activity (PA) pyramid to make people aware of the importance of exercise. The PA pyramid indicates the activities that are good for children and adolescents.

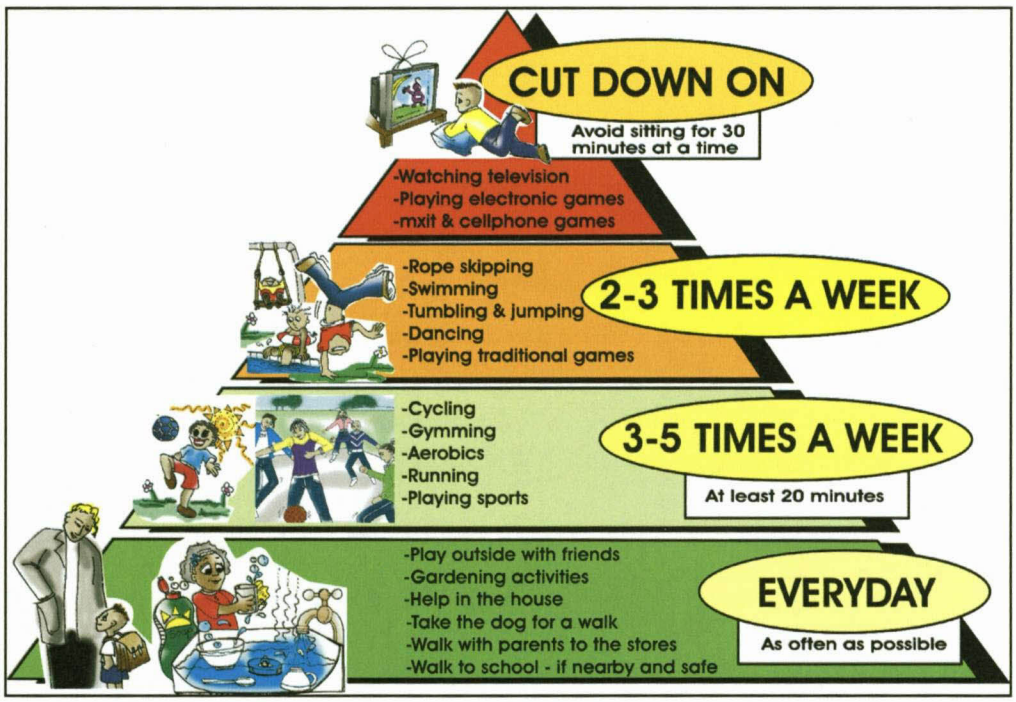

Figure 2-2: Physical Activity Pyramid (Goedecke et al., 2006: 142).

2.6.4 Benefits of physical activity

Throughout much of recorded history, physical activity has been promoted for improved health, function and longevity. Physical activity combined with a healthy diet and rest, is an important contributor to overall well-being (Wildman and Miller, 2004: 73-75). Physical activity promotes flexibility of the joints, strength and endurance of the muscles, including the heart muscle (Goran and Astrup, 2002: 84).

Physical activity also has beneficial effects on substrate metabolism, with an increased reliance on fat relative to fuel utilisation, and it has been hypothesized that highly active individuals can maintain energy balance on a high-fat diet (Goran and Astrup, 2002: 44-45).

Various epidemiological studies have shown that activity increases energy expenditure and is, therefore, important for the maintenance of energy balance and normal weight. Regular physical exercise may be important in lowering diastolic blood pressure, protects against the development of heart disease, reduces cardiovascular mortality, prevents colon cancer, regulates blood glucose levels, lowers blood lipid levels and modifies associated risk factors such as hypertension, insulin resistance, lower risk of suicidal behaviour and obesity. It also lessens coronary heart disease (CHD) risk by retarding atherogenesis, increasing the vascularity of the myocardium, increasing fibrinolysis, and modifying other risk factors, such as improving glucose tolerance and insulin sensitivity (Krummel, 2008: 849).

Physical activity also improves tolerance and the body's ability to withstand both physical and physiological stress, as well as to deal with anxiety (Irazusta et al., 2006; Wildman and Miller, 2004: 73-75; Whitney and Rolfes, 2005:464).

Physical activity also offers psychological advantages; whereby a fit person looks and feels healthy, and, as a result, gains self-esteem. A high self-esteem motivates a person to persist in seeking good health and fitness (Whitney and Rolfes, 2005: 284-255). Physical activity can therefore preserve and improve health, help individuals to avoid illness, and play a role in rehabilitating patients (American College of Sports Medicine, 1998).

Physical activity furthermore promotes the maintenance of muscle mass and sense of balance, which is important with increasing age to preserve independence in the elderly and to prevent falls (Barasi, 2003: 382-383). Physical activity combined with an optimal calcium

intake, is associated with increased bone mineral density in children and adolescents (Lucas, 2008: 241).

Strenuous physical activity is associated with a reduced risk of breast cancer in both pre-and postmenopausal women, while short bouts of regular low to moderate intensity exercise are important in reducing fatigue in women with breast cancer (Dorna et al., 2003).

The opposite of a physically active life is a sedentary life. Sedentary lifestyle fosters the development of several chronic diseases (Whitney and Rolfes, 2005: 464).

2.7 Summary

The worldwide obesity problem is increasing, even in developing countries that usually experience high rates of under-nutrition. More disconcerting is the fact that this epidemic is rising among younger children and adolescents.

The causes of childhood obesity, like many public health problems, are complex. Factors such as birth weight, feeding practices in the first year of life, hereditary and ethnicity are all factors that need intense consideration when looking at possible causes of over-nutrition. While consensus has not been reached on the exact role of nutrition in the development of over-nutrition, substantial evidence does show that increased energy intakes, combined with ever more sedentary life styles, contribute to obesity. Genetics and ethnic, hormonal, psychological and sociological factors also influence the prevalence and progression of paediatric obesity.

The presence of obesity and a sedentary lifestyle in adolescents are associated with many health problems including early onset of cardiovascular risks like hypertension and the initiation of atherosclerotic plaque formation, which tends to track into adulthood, in turn increasing the later prevalence of CVD, diabetes, hypertension, dyslipidaemia and certain cancers.The younger children are at the onset of overweight and obesity, the more likely these health problems are. Thus preventing and managing childhood weight problems are important health care goals.

3 METHODOLOGY

3.1 Introduction

This study assessed the prevalence and known risk factors for overweight and obesity among adolescents in Maseru, the capital of Lesotho. This chapter describes the ethical considerations, study design, study population, sampling methods, variables and work definitions, as well as the methodology and techniques used in the execution of the study. The study procedures and the methods used in statistical analysis of the results are included.

3.2 Ethical considerations

The ethical principles which should be considered when conducting a research study include autonomy, beneficence and non-maleficence, justice, voluntary participation, informed consent, and confidentiality. These ethical principles aims to protect human rights, balance benefits and risks in the study, and prevent misconducts (Burns et al., 2005: 830).

For the purpose of this study ethical approval was obtained from the Ethics Committee of the University of the Free State (ETOVS NR 162/09). Permission to conduct the study at schools in Maseru was obtained prior to the study from the Chief Inspector in the Ministry of Education in Lesotho (Appendix F^1); and the heads of the schools involved in the study (Appendix F^2). A meeting was scheduled for the researcher to meet with the participants to brief them on the study. All participants were notified of all the procedures that were to be used during the research study and were given the choice to discontinue with the studywhen they so wish.

Each participant completed a consent form (Appendix G^1), written in English and Sesotho. Written consent was acquired from the parents/guardians of participants (Appendix G^1), as well as written assent from the participating learners (Appendix G^2). An information document explaining the purpose of the study as well as procedures to be followed during the study, were attached to both the consent and assent forms (Appendix H). The interviews were conducted in the language of preference.

No compensation was given to participants, but participants who remembered to bring their RHCs were promised and given an incentive (peanuts and raisins and a small box of juice) in order to try and increase the number of participants with available birth

anthropometry data. Participants identified as having a health problem (illness) during the study, were referred to the nearest clinic, and those overweight were referred to a dietician and/or nutritionist.

All information obtained during the research was kept confidential, and was used only for the purposes of the study.

3.3 Study design

A cross-sectional descriptive study was conducted to determine the prevalence and known risk factors for overweight and obesity among adolescents in urban Maseru.

3.4 Sampling

3.4.1 Population

The study was conducted by a single researcher; therefore the sample was restricted to one age group to be able to obtain some idea of the prevalence of overweight and obesity among adolescents in urban Maseru. The age of 16 was chosen since literature states that childhood obesity and early adiposity rebound is predictive of body fatness at 16 years and into adulthood (Gee et al., 2008: 534: Ebbeling et al., 2002: 475). In the Lesotho school system the majority of 16-year-olds are in Form 4.

There are 20 schools in urban Maseru, of which two are private schools and three are single-gender schools. The private and the single-gender schools were non-randomly included in the sample. A further five schools were randomly selected from the remaining 15 schools, so 10 schools were selected for the purpose of the study. From each school, a random number of respondents were chosen proportionate to the size of the Form 4 class of that school.

There were 2602 students enrolled in Form 4 in 2010. A 10^{th} of the population in the sample was considered representative and practically achievable by the researcher who was the sole investigator on this project, therefore a sample of 251 students was selected to participate in the study as indicated in Table 3.1. Table 3.1 demonstrates the enrolment of 2010 students.

Table 3-1: List of schools in Maseru, and the enrolment and sample size per school

Group	Gender	Type	No. of learners enrolled in Form 4 (2009)	Sample size (n)	Male (n)	Female (n)	I^{th} student
NUL International School	Co-Ed	Private	32	6	3	3	5
Lithabaneng High School	Co-Ed	Public	60	0	0	0	
Mazenod High School	Co-Ed	Public	70	0	0	0	
Machabeng College	Co-Ed	Private	80	15	8	7	5
Abia Secondary School	Co-Ed	Public	90	0	0	0	
St Joseph High School	Co-Ed	Public	94	0	0	0	
Maseru High School	Co-Ed	Public	100	0	0	0	
Life Secondary School	Co-Ed	Public	100	0	0	0	
Maseru Day High School	Co-Ed	Public	110	20	11	9	6
St Mary's High School	Girls	Public	117	21	0	21	6
Mabathoana High School	Co-Ed	Public	120	22	12	10	6
Itekeng High School	Co-Ed	Public	128	0	0	0	
Masianokeng High School	Co-Ed	Public	130	0	0	0	
Thetsane High School	Co-Ed	Public	150	27	15	12	6
St Catherine's High School	Girls	Public	160	29	0	29	6
St James High School	Co-Ed	Public	180	33	18	15	5
Christ the King High School	Boys	Public	210	38	38	0	
Lesotho High School	Co-Ed	Public	220	40	21	19	6
Sefika High School	Co-Ed	Public	221	0	0	0	
Seventh Day Adventist High	Co-Ed	Public	230	0	0	0	
		Totals	**2602**	**251**	**126**	**125**	

An alphabetical list of students aged 16 years and in Form 4 was obtained from the Administration office at each school. The sample was further divided into two discrete strata, namely boys and girls. A systematic sampling was conducted; every I^{th} (the number indicated in the table above) student on the list was selected.

3.4.2 Inclusion criteria

The sample included adolescents who:

- Attended school in urban Maseru; and
- Were aged 15 years (turning 16 in 2010) or 16 years.

3.4.3 Exclusion criteria

Adolescents were excluded from the study if:

- They were aged 16 years, but not in Form 4.

3.5 Definition of variables

Discussion of the different variables measured for the study as well as the techniques used to measure these variables follows in greater detail. For the purpose of this study, the following were defined:

3.5.1 Demographic information

The demographic data refers to the participant's gender, place of residence as well as the type of school the participant attends. For the purpose of this study the place of residence referred to place of stay during school days (at home or at hostel).

3.5.2 Current anthropometry

Anthropometry is the measurement of body size, weight and proportion. It involves obtaining physical measurements of an individual and relating these measurements to standards that reflect the health, growth and development of the individual. These physical measurements form part of nutritional assessment and are useful for evaluating overnutrition or undernutrition (Hammond, 2008: 421; Lee and Nieman, 2010: 164).

Various methods can be used to determine anthropometric measurements. For the purposes of this study, anthropometry refered to weight and height expressed as the BMI. According to the WHO (1997:10), BMI is considered a valid tool to determine overweight or obesity in adolescents.

BMI refers to the current weight in kilograms in relation to height in meter squared (kg/m^2). Currently, three sets of reference standards are available to interpret the BMI of adolescents. Age-specific cut-off-points for BMI was compiled in 2000 by a nutrition expert committee convened by the International Obesity Task Force, based on the adult overweight and obesity cut-offs of 25 kg/m^2 and 30kg/m^2 respectively (Cole et al., 2000: 1240). The International Obesity Task Force cut-off- points for BMI at age 15 and 16 (Form 4 in Lesotho schools) are listed in Table 3.2.

Table 3-2: International Obesity Task Force Age-specific cut-off-points for BMI (kg/m^2) of 15- and 16-year olds (Cole et al., 2000: 1241)

Age	BMI cut-points for overweight		BMI cut-points for obesity	
	Boys	Girls	Boys	Girls
15	23.29	23.94	28.30	29.11
16	23.30	24.37	28.88	29.43

Two sets of BMI percentiles for children and adolescents are also available; the first, based on cross-sectional data of a sample of mainly white, mainly formula-fed children from a middle income American population, was compiled by the Centers for Disease Control and Prevention (CDC) in the US (Kuczmarski et al., 2000: 1), and the second, based on longitudinal data of exclusively breast-fed children from six multi-centers across the world, representing different cultures and incomes, were compiled by the WHO (de Onis et al., 2006: 660).

For the purpose of this study BMIs of the participants was interpreted using and comparing all the three sets of standards. The 2000 CDC percentile charts for BMI in boys and girls are included as Appendices I and J, respectively. In 2007, a nutrition expert committee in the US recommended that children with a BMI at, or above the 85th percentile for age and gender, but below the 95th percentile, should be considered overweight, and those at, or above the 95th percentile on these charts should be considered obese (Krebs et al., 2007: 193).

The WHO percentile charts for BMI in boys and girls are included as Appendix K and L, respectively. The WHO recommends that children whose BMI is between one and two standard deviations (SD) above the mean, should be considered overweight. Children whose BMI is more than two SDs above the mean should be considered obese (de Onis, 2006: 5-101), and Shields and Tremblay (2010: 267) also state that according to the WHO curves, children whose BMI is above 84th percentile are considered overweight, while those who have a BMI above 97.7th percentile are considered obese.

3.5.3 Growth history

For the purpose of this study, growth history included evidence of intrauterine growth adequacy and early childhood malnutrition.

3.5.3.1 Intrauterine growth adequacy

In this study, birth weight and birth height (length) were used as measures of intrauterine growth adequacy. In Lesotho, as in SA, birth weight is measured and recorded on the RHC issued to each infant directly after birth. Birth height is sometimes, but not always recorded as well. The researcher asked learners in advance to bring their RHC to the interview. Birth weight and birth length were categorised according to Tables 3.3 and 3.4.

Table 3-3: Categories of birth weights (Sallout and Walker, 2003: 556)

Birth Weight	Indication
<2500g	Low birth weight
2500 – 4000g	Normal birth weight
>4000g	Overweight

Table 3-4: Categories of birth lengths (Henning, 2002: 15)

Birth Weight	Indication
<48 cm	Low birth length
48-53 cm	Normal birth length
>53cm	Tall for age

3.5.3.2 Early childhood malnutrition

For the purposes of this study, **early childhood malnutrition** was defined as any period of growth faltering during the first five years, as evident by underweight and stunting, which was expressed as Z-scores for weight-for-age and height-for-age, will be calculated with *Epi Info* (Epi Info, 2004: online) and categorized according to Tables 3.5 and 3.6

Table 3-5: Categories for weight-for-age in Z-scores (Torun, 2006: 889)

Z-score	Indication
-1 to 1	No malnutrition (normal weight)
-1.1 to -2	Mild malnutrition
-2.1 to -3	Moderate malnutrition (underweight)
< -3	Severe malnutrition (severe underweight)

Table 3-6: Categories for length-for-age in Z-scores (Torun, 2006: 889)

Z-score	Indication
-1 to 1	No malnutrition (normal height)
-1.1 to -2	Mild malnutrition
-2.1 to -3	Moderate malnutrition (stunted)
< -3	Severe malnutrition (severe stunting)

3.5.4 Usual dietary intake

For the purposes of this study, usual diet refers to the usual daily food intake, including daily energy and macronutrients intakes, and frequency of consumption of a particular food item.

3.5.4.1 Usual food intake

The usual food intake was evaluated according to the recommendations of the USDA FGP (USDA, 1992) (Figure 2.1) based on food groups (Smolin and Grosvenor, 2008: 59-60). Foods were assigned to six food groups (Table 3.6) using a standard exchange list. The standard exchange list was compiled by the Department of Nutrition and Dietetics of the University of the Free State according to the guidelines of the American Dietetic Association (Wheeler et al, 1996), with portion sizes quantified from the SA Medical Research Council Food Composition Tables and the SA MRC Food Quantity Tables. Usual food intake less than the recommendations of the Food Guide Pyramid from a food group was considered inadequate, whereas an intake equal to the recommendations was considered adequate, and an intake higher than the recommendations was considered high (Johnson and Hankin, 2003: 227).

Table 3-7: Serving recommendations according to the Food Guide Pyramid (USDA, 1992)

Food Groups	Serving Portions Per Day
Grains and starchy vegetables	6 – 11
Fruit	2 – 4
Vegetables	3 – 5
Meat and meat substitutes	2 – 3
Milk and milk products	2 – 3
Fat, oils and sweets	Use sparingly

The original Food Guide Pyramid recommends eating sugar and fats sparingly without quantifying them. However, in 2005 the USDA/DHHS published recommendations that indicated that the intakes of these two food groups in an average 8400kJ diet should be limited to less than 12 tsp of sugar (6 portions) per day and 41g of added fats (8 portions) per day (Dodd and Bayer, 2008:278). The intakes of added sugar and added fats will be compared to these recommendations.

3.5.4.2 Macronutrient intake

Macronutrient intake refers to the total intake in grams of carbohydrates, proteins, and fats. Macronutrients were quantified from the data collected in the usual dietary intake questionnaire, using the above-mentioned standard exchange list, in which macronutrient intake was expressed as percentages (%) of total energy (TE) intake and compared to prudent recommendations (Table 3.7). Usual macronutrient intake less than the recommended percentages were considered inadequate, intakes within the recommended percentages were considered adequate, and intakes above the recommended percentages were considered high.

Table 3-8: Macronutrient intake expressed as percentage (%) of total energy (TE) intake (Whitney and Rolfes, 2005:180

Nutrient	Low	Within range	High
Protein	<10% × TE	10 –15% × TE	>15% × TE
Carbohydrates	<45% × TE	45 – 65% × TE	>65% × TE
Fat	<20% × TE	20 – 35% × TE	>35% × TE

3.5.5 Physical activity, TV watching and computer usage

For the purpose of this study, physical activity is defined as all movements in everyday life, including work, recreation, exercise and sporting activities. Data was obtained by a questionnaire adapted from the SA YRBS, which was in turn adapted specifically for South African adolescents from the International Physical Activity Questionnaire [IPAQ] (Reddy et al., 2002: 4).

For the purpose of this study, students were categorised as being:

- **Vigorously physicall active** - referring to a learner participating **in at least 20 minutes** of activity that would make him/her to sweat and breath harder than

normal **on at least three days in the past week**. Learners were considered to have participated in vigorous physical activity if they reported to have engaged in activities such as soccer, netball, basketball, volleyball and running for at least 20 minutes or more on at least three of the seven days preceding the survey.

- **Moderately physically active** - referring to a learner participatingin at **least 30 minutes activity** that would not make the learner sweat or breathe hard **on at least five days in the past week**. Learners were considered to have participated in moderate physical activity if they reported to have engaged in activities such as walking, slow bicycling, pushing a lawn mower, mopping, polishing or sweeping floors for at least 30 minutes on at least five days of the seven days preceding the survey.
- **Insufficiently active** – referring to a learner participating in some physical activity during the seven days preceding the survey, but not meeting the above levels during the seven days preceding the survey.
- **Inactive** - referring to a learner not reporting any participation in physical activity during the seven days preceding the survey.

For the purpose of this study, for learners who reported different combinations of both moderate and vigorous activity, the frequencies were aggregated.

Questions also included the daily hours spent watching TV and/or using a computer.

3.5.6 Lifestyle factors

Lifestyle factors refer to the way in which an individual lives. For the purpose of this study, alcohol consumption and smoking habits were measured as these lifestyle factors are linked to adolescent weight as discussed in Chapter 2.

3.5.6.1 Alcohol consumption

For the purpose of this study alcohol consumption referred to thenumber of daysin a week that the learner drinks alcohol and the quantity consumed per day. Learners were categorised as follows (Janssens et al., 2004: 226).

- Non – drinkers: Learners who has never consume alcohol;
- Occasional drinkers: Learners who consumed <1 unit per week;

- Low–drinkers: Learners who consumed 1-10 units per week for males and 1-7 units for females;
- Moderate–drinkers: Learners who consumed 11-21 units per week for males and 8-14 units for females; and
- Heavy drinkers – Learners who had >21 units per week for males and >14 units for females.

The types of alcohol consumed were also recorded.

3.5.6.2 Smoking

The smoking questionnaire was adapted from the SA YRBS. For the purpose of this study, learners were categorised as follows and smoking only referred to cigarettes:

- Never smokers – Learners who have never smoked cigarettes ;
- Occasional smokers – Learners who smoked cigarettes before, but not during the past month;
- Current smokers – Learners who smoked cigarettes on one or more days in the past month;
- Current frequent smokers – Learners who smoked cigarette on 20 or more days in the past month.

Smoking also refers to the use of smokeless tobacco (snuff). Participants were required to indicate their usage of snuff.

3.5.7 Knowledge, attitude and practices

For the purposes of this study, knowledge, attitude and practices regarding nutrition and obesity were analysed. For the purpose of this study, nutrition knowledge, attitude and practices refer to the knowledge that the participant has in relation to nutrition; food selection practices; and ways and methods that food is handled and prepared (Appendix E).

3.6 Measuring techniques

For the purpose of this study, participants were asked to bring their RHC when they come for interviews; and anthropometric techniques and structured interviews with questionnaires were used.

3.6.1 Current anthropometry

Weight and height were measured to determine BMI. Anthropometric assessment provides a fast, inexpensive method of assessing the body composition and size (Gibson, 2005: 10). The measurements vary with age and degree of nutrition. The researcher, who was trained in anthropometric techniques, performed all the measurements in order to ensure consistency and to improve reliability (Katzenellenbogen et al., 1997: 126-275).

3.6.1.1 Weight

Weight was determined using an electronic scale. The scale was placed on a hard, flat surface, and checked and adjusted for zero-balance before each measurement. The participants were weighed in minimal clothing (after removing jacket, shoes, and jewelry) and asked to stand still in the middle of the scale's platform without touching anything and with the weight equally distributed on both feet. The weight was recorded to the nearest 100g. The measurement was done after the bladder has been emptied and before a meal (Gibson, 2005: 370; Hammond, 2008: 399-400).To ensure reliability, the scale was calibrated every day before assessments.

3.6.1.2 Height

Height is defined as the distance from the floor to the top of the head (Gibson, 2005: 247; Hammond, 2008: 399-400). Height was determined by means of a stadiometer to the nearest 0.1cm. Participants stood without shoes, heels together and back as straight as possible. The heels, buttocks, shoulders, and head touched the vertical surface of the measuring device. The hands hung freely by the sides, with palms facing the thighs. Subjects maintained a fully erect position.

3.6.2 Intrauterine growth adequacy

Birth weight and heights were noted from the past anthropometric measurements recorded on the learner's RHC record which they were asked to bring along during the assessments. Anthropometric measurements, unlike other measurement techniques, can provide one with the past nutritional history (Gibson, 2005: 273). To determine that the data used for growth history was reliable, the name and age on each RCHs record were cross-checked against the information obtained from the school records to ensure that the participant had presented his/her own record. Each RHC was photocopied, or when no

photocopier was available, the RHC was photographed with a digital camera to ensure reliable and retraceable capturing of the data.

3.6.3 Questionnaires

Questionnaires included socio demographic data, usual dietary intake, physical activity, lifestyle factors and knowledge, attitude and practices in nutrition. Questions were formulated to include open and closed questions. The researcher completed all the questionnaires herself during structured interviews which were conducted with the participants in the language of choice; which was mostly Sesotho.

3.6.3.1 Usual dietary intake

(i) Adapted 24-hour recall

Usual dietary intake was determined by a questionnaire during an interview with each participant. To assess dietary intake a 24-hour recall (Appendix B) was adapted to reflect, not the previous 24 hours food intakes, but the foods usually eaten on a regular day; and wascalled a usual 24-hour recall for the purposes of this study (Smolin and Grosvenor, 2008: 62). Subjects were asked to recall all the foods eaten on a typical day. The participant was asked to give a detailed description of each food and beverage consumed, estimate the amounts consumed in terms of household measures, and relate the cooking method and brand names if possible. Local household utensils and food models were used to aid reliable quantification of food consumed. Information on the ingredients of mixed dishes was also collected. The researcher also used probing questions to elicit specific details of each food item consumed (Gibson, 2005: 41-42).

(ii) Food Frequency Questionnaire (FFQ)

The purpose of the FFQ (Appendix C) used in this study was to assess the frequency of food and beverage consumption to determine which foods are commonly eaten (Bishop, 2007: 33-34). The FFQ in this study was also used along with the adapted 24-hour recall to ensure that data provided was valid. For example, if a food item was not included in the adapted 24-hour recall, but the FFQ suggests that it was consumed on more than three days a week, it was included in the adapted 24-hour recall to give a more accurate estimation of regular daily intakes (Smolin and Grosvenor, 2007: 64; Hammond, 2008: 397).

The FFQ was adapted from a FFQ developed by the Department of Nutrition and Dietetics by including typical traditional dishes used in Lesotho (Appendix C) to increase the content validity.

During the structured interview, subjects indicated the food they usually eat and the frequency with which each food item is eaten. Foods that are consumed on more than three days a week was included in the adapted 24-hour recall. The researcher once again used probing questions to elicit specific details of each food item (Gibson, 2005: 41-42).

3.6.3.2 Physical Activity

Participants completed a questionnaire during the interview, in which they were required to recall the activities they performed during the last seven days. The physical activity questionnaire (Appendix D) measures activities by asking the respondent to recall recent or usual participation in activities or in sedentary behaviours over a set period of time. These activities range in intensity from taking the stairs regularly, dancing and walking briskly, to jogging, biking and practicing in sports. The level of physical activity needed to obtain a health benefit does not have to be strenuous. The activity questionnaire used in the present study was based on the questionnaire used by the MRC in the SA Youth Risk Behavior Survey of 2002 (Reddy et al., 2002:online). The latter questionnaire was in turn based on the IPAQ which was validated in Geneva in 2000 (Booth, 2000: 114).

3.6.3.3 TV watching and computer usage

The researcher completed a questionnaire during individual interviews with the participants, in which they were to recall the number of minutes or hour they took watching TV or playing games on the computer a day.

Data were obtained by a questionnaire adapted from the SA YRBS, which was in turn adapted from the IPAQ (Reddy et al., 2002: online).

3.6.3.4 Lifestyle factors (alcohol consumption and smoking)

The researcher completed a questionnaire during individual interviews with the participants indicating their use of alcohol and smoking. To ensure reliability, participants were assured beforehand that the information they gave would be treated with utmost confidentiality. The researcher also used probing questions to elicit details on the use of alcohol and smoking.

(i) Alcohol consumption

The researcher completed a questionnaire during individual interviews with the participants completed a questionnaire (Appendix A) during the interview to indicate their use of alcohol. Questions were based on the categories developed by Graham et al. (1998: 1137) and used by Janssens et al. (2004: 223) to determine the association between overweight, obesity and beer consumption. Questions were also adapted from the questionnaire developed by Breslow (2005: online).

(ii) Smoking

The questions asked were adapted from the questionnaire (Appendix A) used in the 2002 SA YRBS (Reddy et al., 2002: online).

3.6.3.5 Knowledge, attitude and practices (KAP)

Participants completed a questionnaire during the structured interview to determine their knowledge, attitude and practices regarding nutrition. The questionnaire included questions testing their knowledge regarding selection of food items, ways in which foods are handled and methods in which foods are prepared. Their attitude towards obesity; knowledge about the causes of obesity and knowledge regarding the relationship between obesity and health, were also assessed.

The KAP questionnaire (Appendix E) was adapted for Lesotho adolescents from the KAP questionnaire used in the Assuring Health for All (AHA) study conducted in the Free State, SA (not yet published) which in turn was adapted from the KAP questionnaire used in the 1998 SA Health and Demographic Survey (2003: Online).

3.7 Reliability and validity

Validity and reliability are of great importance in nutritional assessments. Validity refers to the extent to which a measure actually measures what it is meant to measure (Burns and Grove, 2001: 226). Reliability refers to the degree of similarity of the information obtained when collecting data; or whether the same value is arrived at every time the measurement is taken; or whether the values vary a lot on repeated administration (Walsh and Joubert, 2007:24).

Validity in this study was ensured by including all questions related to the aim of the study, as based on a comprehensive overview of the literature.

The names on each RHC of each participant was validated to ensure that the chart is really that of the participant and all charts were photocopied or photographed for later reference to ensure the reliability of the data. During structured interviews reliability was improved by explaining the questionnaire and its procedures to the participants in their language of choice (English or Sesotho) before the interview. The researcher used probing questions in order to help subjects recall food items they usually eat and specifics regarding their lifestyles and habits. Local household utensils and food models were used to help subjects estimate the amounts they consume daily. As it is very difficult to validate usual intakes of individuals, a FFQ was used to cross check dietary information to ensure that data collected in the adapted 24-hour recall, were reliable. According to Bailey (1998) quoted by Gibson (2005: 149), relative validity can be achieved by comparing the test method with another method performed on the same sample.

The same questionnaire was also repeated on 10% of the sample a month after conducting the main data collection. If more than 20% of the answers to the questions differed between the two interviews, these questions were regarded as unreliable and disregarded.

To ensure reliability of the anthropometrical measurements, standardised techniques performed by a single trained researcher were used.

3.8 Pilot study

A pilot study was undertaken in November 2009 with four Sesotho speaking students (two males and two females) in Lesotho, aged 16, who and were in Form4. Participants were randomly selected from a school not included in the study sample. The same techniques as for the main study were employed.

The purpose of the pilot study was to ensure that respondents understood the questions in the language they were written in; to ensure that all the relevant food items in the FFQ were included; to determine how long it will take to complete the questionnaire and perform the anthropometric measurements and to identify and address any logistical problems before attempting the actual study.

3.9 Study procedure

The researcher completed questionnaires and conducted interviews at lunch and after school on Mondays to Fridays. Anthropometric measurements were taken on all participants. A usual 24-hour recall, a short FFQ, socio-demographic questionnaire, physical activity questionnaire, and questionnaires on lifestyle factors, and KAP in nutrition were completed.

Step 1

Approval to conduct the study was obtained from the Ethics Committee of the University of the Free State.

Permission to perform the study in Maseru High Schools was obtained from the Ministry of Education in Lesotho (Appendix F^1).

Permission was obtained from the Headmasters of the schools included in the pilot study (Appendix F^2).

Step 2

The researcher conducted a meeting with students to participate in the pilot study by visiting their school and informing them regarding the study. It was during these meetings that interviews were scheduled. Participants were informed to bring their RHC when coming for an interview.

The pilot study was conducted on four (two males and two females) Sesotho speaking students aged 16 who were in Form 4 in Lesotho during November 2009.

Parents/guardians of participants in the pilot study completed consent forms (Appendix G^1) with an information document attached to it (Appendix H).

Participants completed assent forms (Appendix G2) which had an information document attached to them (AppendixH)).

The pilot study was used to make revisions to the questionnaires.

Step 3

Consent was obtained from the Headmasters of the schools where the main study was conducted (Appendix F^3).

The researcher conducted a meeting with students who were selected to participate in the main study by visiting their schools and informing them regarding the study. It was during these meetings that interviews were scheduled.

Participants were informed to bring their RHC when coming for an interview.

Parents/guardians of participants completed consent forms (Appendix G^1) with an information document attached to it (AppendixH).

Participants selected completed assent forms (Appendix G^2) with an information document attached to it (Appendix H).

Step 4

Interviews took place at school during the time scheduled by the Head of the school.

At least six interviews were conducted per day, but as the interviews progressed, the researcher was able to conduct eight interviews per day.

A structured interview was conducted to determine the dietary intake, using the adapted 24-hour recall (Appendix B) and FFQ (Appendices B and C).

Anthropometric measurements, lifestyle factors and knowledge, attitude and practices questionnaire were completed (Appendix A).

Step 5

The reliability interviews of every 10^{th} participant were conducted one month after the initial interview.

Step 6

The reliability analysis and the statistical analysis of the data were performed by the Department of Biostatics, of the University of the Free State.

3.10 Statistical analysis

The analysis was performed by the Department of Biostatistics at the University of the Free State. Statistical analysis involved a descriptive analysis rendering frequencies and

percentages for categorical variables and means and standard deviations or medians and percentiles for continuous variables per group, where data was summarised in tables. Values were rounded off to one decimal place.

Associations between variables were analysed with the appropriate inferential statistics. Reliability analysis was conducted on the repeat data that were gathered from 10% sub-sample of the respondents, one month after the initial collection of data. Items found not reliably measured were excluded in the analysis.

3.11 Summary

A cross-sectional descriptive study was conducted to determine the prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru, Lesotho. A sample size of 251 students (125 boys and 126 girls) aged 16 years and in Form 4 was randomly selected from the 20 schools in urban area of the Maseru district. The final study population was 221 students.

Approval to undertake the study was obtained from the Ethics Committee of the Faculty of Health Sciences at the University of the Free State. Permission was also required from the Chief Inspector in the Ministry of Education and Training and the Heads of the selected schools. Signed informed consent and assent was obtained from the parents and the learners, respectively.

Structured interviews were conducted on the school premises, using a questionnaire. Reliability interviews of 10% of the sample were conducted one month after the initial interview. Data collected were described as means and standard deviations and percentages. Pearson correlation analyses were performed to evaluate associations between parameters. The analysis was performed be the Department of Biostatistics at the University of the Free State.

4 RESULTS

4.1 Introduction

In this chapter, the results include demographic information, anthropometricmeasurements, dietary intake, lifestyle factors, physical activity, and knowledge, attitude and practices regarding nutrition.

There were 2602 students enrolled in Form 4 in 2010 in schools in Maseru, and a representative sample of 251 students was selected. Finally, 221 students participated in the study. The collected questionnaires represented a response rate of 88% (221 of 251). The reasons for 30 students not participating in the study were that 7 students did not get consent from parents, 15 were not present due to unpaid school fees and 8 reported that they were too busy with their daily school work and unable to come for the interview.

4.2 Demographic information

Figures 4.1, 4.2 and 4.3 reflect the demographic data of the respondents regarding gender, place of residence (home/hostel) and type of school (single gender / co-ed) participants attended.

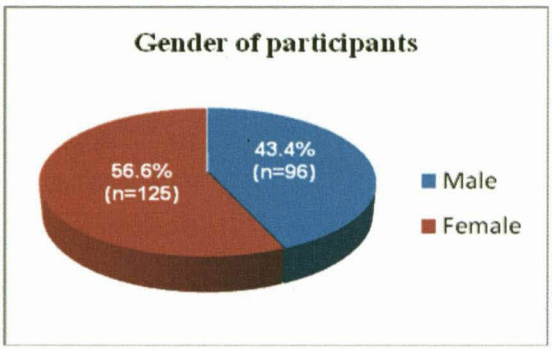

Figure 4-1: Gender of participants

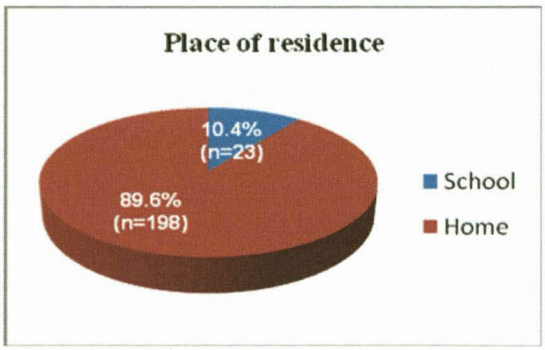

Figure 4-2: Place of residence

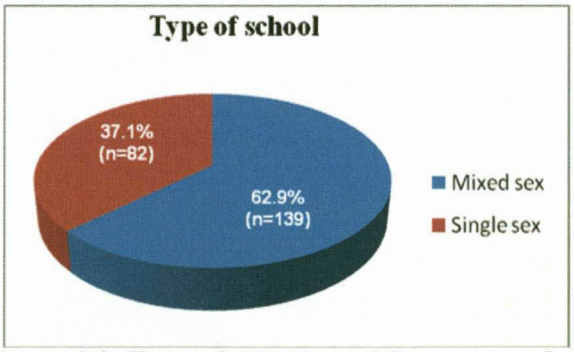

Figure 4-3: Type of school participants attended

Figure 4.1 indicates that more females (56.6%) than males (43.4%) participated in the study, while Figure 4.2 indicates that the majority (89.7%) of participants lived at home. The majority (62.9%) of participants attended school of mixed gender (co-ed) as indicated in Figure 4.3.

4.3 Anthropometric information

Anthropometric information included the current BMI and intrauterine growth adequacy (birth weight, birth height and weight and height history).

4.3.1 Current BMI

The current BMI of participants included in the study, was interpreted using Cole's age-specific cut-off-points adopted by the IOTF (Cole et al., 2000: 1), is shown in Table 4.1 where for 16-year olds, overweight refers to a BMI that falls between 23.30 to 28.88 kg/m^2 for boys and 24.37 to 29.11 kg/m^2 for girls, while obesity refers to BMIs greater than 28.88 for boys and 29.11 kg/m^2 for girls.

Table 4-1: Current BMI of participants

	Males (n=96)		Females (n=125)	
Sets of BMI cut-off points	**Overweight**	**Obese**	**Overweight**	**Obese**
IOTF age-specific cut off-points	2.1% (n=2)	0.0% (n=0)	11.3% (n=14)	1.6% (n=2)
CDC-growth standards	3.1% (n=3)	3.1% (n=3)	16.0% (n=20)	5.6% (n=7)
WHO growth standards	4.1% (n=4)	3.1% (n=3)	20.0% (n=25)	7.2% (n=9)

According to Table 4.1 the WHO growth standards identified more overweight males (4.1%) and females (20.0%) than CDC growth standards which identified 3.1% males and 16% females. The IOTF-adopted standards identified the least number of overweight males (2.1%) and females (11.3%). No obese males were identified using the IOTF-adopted standards, while the CDC and WHO cut-off-points identified the same number (3.1%) of obese males. In relation to prevalence of obesity in females, the WHO growth standards

identified more females (7.2%) than the CDC growth standards (5.6%) and the IOTF-adopted standards (1.6%).

4.3.2 Intrauterine growth adequacy

4.3.2.1 Birth weight

Of the 221 students interviewed, only 60 students produced their RHCs. The birth weights were recorded from these charts.

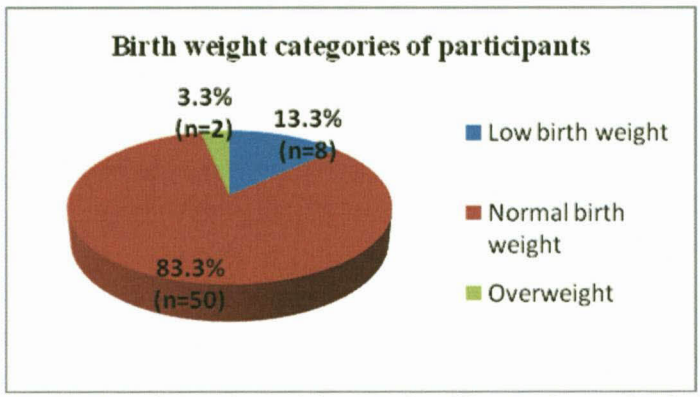

Figure 4-4: Birth weight of participants (n=60) who brought their RHCs (Sallout and Walker, 2003: 556)

As summarised in Figure 4.4, 13.3% (n=8) of the participants who produced their RHC (n=60) had a low birth weight (<2500g), 83.3% (n=50) had a normal birth weight (2500-4000g), while 3.3% (n=2) were born overweight (>4000g) (Sallout and Walker, 2003: 556).

4.3.2.2 Birth length

The birth lengths were not available in the RHCs so no data was collected for birth length.

4.4 Dietary intake

Dietary intake was determined using a usual 24-hour recall and FFQ.

4.4.1 Usual 24-hour recall

Participants were asked to recall all the foods eaten on a regular day, also stating the frequency with which different food types are consumed, in order to assess the actual dietary intake of the individual. The usual food intake was evaluated according to the recommendations of the FGP (USDA, 1992). The findings are summarised in Table 4.2.

Table 4-2: Evaluation of daily dietary intake from different food groups according to the recommendations of the FGP (USDA, 1992)

Food group	Daily intake category	n	Percentage (%)
Grains and starchy vegetables (n=221)	Below (<6 servings)	2	0.9
	Within (6-11 servings)	54	24.4
	Above (>11 servings)	165	74.7
Meat and meat substitutes (n=221)	Below (<2 servings)	83	37.6
	Within (2-3 servings)	45	20.4
	Above (>3 servings)	93	42.1
Fruit (n=221)	Below (<2 servings)	191	86.4
	Within (2-4 servings)	30	13.6
	Above (>4 servings)	0	0.0
Vegetables (n=221)	Below (<3 servings)	202	91.4
	Within (3-5 servings)	18	8.1
	Above (>5 servings)	1	0.5
Milk and milk products	Below (<3 servings)	201	91.0
	Within (2-3 servings)	20	9.0
	Above (>3 servings)	0	0.0
Fat and sugar (n=221)	Below (0 servings)	0	0.0
	Within (<3 servings)	21	9.5
	Above (>servings)	200	90.5

Table 4.2 shows that the majority (74.7%) of students' daily intake from the bread, cereal, rice and pasta group was above the recommended 6-11 servings. Similarly, almost half of the students (42.1%) consumed more than the recommended numbers of servings from the meat and meat substitute group, while nine in ten (90.5%) consumed more than three servings of fat and sugar combined per day. However, the majority of students consumed fewer than the recommended numbers of serving from the fruit (86.4%), vegetables (91.4%), and milk groups (91.0%).

4.4.2 Energy and macronutrient intake

The energy and macronutrients were quantified from the data collected in the usual 24-hour recall. Macronutrient intake refers to the total intake in grams (g) of carbohydrates, proteins and fats, while energy refers to the total intake in kJ as indicated in Table 4.3.

Macronutrients intakes were further expressed as percentages (%) of total energy intake, as indicated in Table 4.3.

Table 4-3: Minimum, maximum and mean intakes of total energy and macronutrients

Variable	Minimum	Maximum	Mean
Total energy (kJ)	3300	26662	6838.2
Carbohydrate (g)	137	455	267.6
Protein (g)	32	107	65.1
Fat (g)	3	93	35.5

Table 4.3 indicates that the mean intakes of carbohydrates, protein, fat and total energy were 267.6g, 65.1g, 35.5g and 6 838.2kJ. The high intake (26 662 kJ) is twice the recommended intake (13 238 kJ) of males due to a high consumption of alcohol by one participant, while the low intake (3 300 kJ) was eight times lower due to a participant who reported an insufficient supply of food in the household.

Table 4-4: Interpretation of macro-nutrient intake expressed as percentage of total energy intake (% x TE) compared to recommended ranges (Whitney and Rolfes, 2005:180)

Variable	Category (compared to recommended range)	n	Percentage (%)
Carbohydrates (g) (non-sugar)	Low (<45%)	29	13.1
	Within (45-65%)	151	68.3
	High (>65%)	41	18.6
Protein (g)	Low (<10%)	2	0.9
	Within (10-15%)	91	41.2
	High (>15%)	128	57.9
Fat (g)	Low (<20%)	117	52.9
	Within (20-35%)	102	46.2
	High (>35%)	2	0.9
Sugar (g)	Within (<25%)	212	95.9
	High (>25%)	9	4.1

Table 4.4 shows that most participants consumed the recommended amounts of carbohydrates (68.3%) and sugar (95.9%), respectively. Just more than half of the participants (57.9%) consumed more than the recommended amounts of protein per day, while the majority (99.1%) reported fat consumption below or within the recommended range.

4.4.3 Variety of foods consumed

A food frequency questionnaire was used to assess the intake and frequency of food and drinks to determine food items that are frequently consumed. Table 4.5 illustrates the results of this survey.

Table 4-5: Frequency of consumption of breads, cereals, rice, and pasta

Food type (Breads, cereals, rice, and pasta)	Frequency	n	Percentage (%)
Maize meal (pap)	Never	3	1.4
	Everyday	124	56.1
	Weekly	93	42.1
	Monthly	1	0.5
	Seasonally	1	0.5
Bread Brown/White	Never	2	0.9
	Everyday	141	63.8
	Weekly	76	34.4
	Monthly	2	0.9
	Seasonally	0	0
Cereal	Never	65	29.4
	Everyday	23	10.4
	Weekly	45	20.4
	Monthly	37	16.7
	Seasonally	1	0.5
Rice/Mealie rice	Never	21	9.5
	Everyday	2	0.9
	Weekly	177	80.1
	Monthly	21	9.5
	Seasonally	0	0

Samp	Never	43	19.5
	Everyday	2	0.9
	Weekly	106	48.0
	Monthly	66	29.9
	Seasonally	4	1.8
Cakes/Muffins/Scones/Pudding	Never	68	30.7
	Everyday	11	5.0
	Weekly	81	36.7
	Monthly	58	26.2
	Seasonally	3	1.4
Popcorn	Never	77	34.8
	Everyday	4	1.8
	Weekly	80	36.2
	Monthly	59	26.7
	Seasonally	1	0.5
Poone (mealies)	Never	34	15.4
	Everyday	1	0.5
	Weekly	8	3.6
	Monthly	9	4.1
	Seasonally	169	85.5
Pasta	Never	82	37.1
	Everyday	1	0.5
	Weekly	84	38.0
	Monthly	52	23.5
	Seasonally	2	0.9
Motoho	Never	101	45.7
	Everyday	3	1.4
	Weekly	21	9.5
	Monthly	73	33.0
	Seasonally	23	10.4
Lesheleshele	Never	110	49.8
	Everyday	11	5.0
	Weekly	53	24.0
	Monthly	41	18.6
	Seasonally	6	2.7

TABLE 4-5 CONTINUED

Table 4.5 indicates that the most commonly (63.8%) starch food item eaten on a daily basis, is bread, followed by Papa (56.1%), while the starch items least (0.9%) likely to be eaten on a daily basis, are rice and samp.

Table 4-6: Frequency of consumption of vegetables

Food type (Vegetables)	Frequency	n	Percentage (%)
Vegetables fresh/frozen	Never	0	0
	Everyday	66	29.9
	Weekly	130	58.8
	Monthly	9	4.1
	Seasonally	16	7.2
Wild vegetables	Never	138	62.4
	Everyday	0	0
	Weekly	15	6.8
	Monthly	10	4.5
	Seasonally	29	13.1
Lepu (pumpkin leaves)	Never	85	38.5
	Everyday	0	0
	Weekly	0	0
	Monthly	0	0
	Seasonally	136	61.5

As indicated in Table 4.6 very few participants (29.9%) ate vegetables daily and 62.4% (n=138) of participants never ate wild vegetables except for pumpkin leaves where 61.5% (n=136) ate them when in season.

Of the 251 participants, only a third (29.9%; n=66) ate vegetables daily, while only a quarter (25.3%; n=56) ate fruits daily. Vegetables commonly eaten were cabbage, spinach, and sepaile. Lepu (pumpkin leaves) and wild vegetables are consumed seasonally. The majority of participants (62.4%) never ate wild vegetables, while 61.5% (n=136) of participants eat lepu when in season. Vegetables which form part of the diet but are eaten on Sundays or special occasions, include onion, green pepper, carrots, beetroot and pumpkin. Vegetables such as egg plant, mushrooms, broccoli, and cauliflower were not commonly eaten by participants of this study.

Table 4-7: Frequency of consumption of fruits

Food type (Fruit)	Frequency	n	Percentage (%)
Fruit Fresh/Frozen	Never	0	0.0
	Everyday	56	25.3
	Weekly	118	53.4
	Monthly	35	15.8
	Seasonally	12	5.4
Wild fruits	Never	185	83.7
	Everyday	1	0.5
	Weekly	4	1.8
	Monthly	6	2.7
	Seasonally	25	11.3
Fruit juice	Never	0	0
	Everyday	19	8.6
	Weekly	104	47.1
	Monthly	95	43.0
	Seasonally	3	1.4

The majority (74.6%) of participants did not report consuming fruit on a daily basis as is recommended (Figure 2.3). As indicated in Table 4.7, 83.7% (n=185) of participants never eat wild fruits. Very few (8.6%) participants drink fruit juice daily.

Fruits that were commonly eaten included apples, bananas, oranges and peaches when in season. Peaches are the most common fruits and are affordable. Wild fruits such as berries, prickly pear and liponaponana were not commonly included. Prickly pear is found in the country side and is not commonly eaten in the urban area.

Table 4-8: Frequency of consumption of milk and milk products

Food type (Milk, yoghurt and cheese)	Frequency	n	Percentage
Milk	Never	33	14.9
	Everyday	35	19.0
	Weekly	111	50.2
	Monthly	42	15.8
	Seasonally	0	0

TABLE 4-8 CONTINUED

Mafi (sour milk)	Never	80	36.2
	Everyday	0	0
	Weekly	75	33.9
	Monthly	62	28.0
	Seasonally	4	1.8
Cheese	Never	109	49.3
	Everyday	6	2.7
	Weekly	56	25.3
	Monthly	47	21.3
	Seasonally	0	0
Yoghurt	Never	70	31.7
	Everyday	6	2.7
	Weekly	69	31.2
	Monthly	74	33.5
	Seasonally	2	0.9

Table 4.8 indicate that the milk and milk products are not commonly consumed daily as recommended. Only 19% of participants reported that they consume fresh milk daily, while the majority (50.2%) consume it weekly. Sour milk was even less popular than fresh milk with no participants who consume it daily. Cheese (2.7%) and yoghurt (2.7%) were also not commonly consumed on a daily basis.

Table 0-9: Frequency of consumption of meat, poultry, fish, beans, eggs, nuts

Food type (Meat, poultry, fish, dry beans, eggs, and nuts)	Frequency	N	Percentage (%)
Chicken	Never	1	0.5
	Everyday	2	0.9
	Weekly	173	78.3
	Monthly	46	20.8
	Seasonally	0	0

TABLE 4-9 CONTINUED

Bacon/Polony/Vienna/Ham/Russian	Never	43	19.5
	Everyday	38	17.1
	Weekly	108	48.9
	Monthly	32	14.5
	Seasonally	0	0
Eggs	Never	34	15.4
	Everyday	12	5.4
	Weekly	140	63.3
	Monthly	35	15.8
	Seasonally	0	0
Peanuts/Nuts	Never	74	33.5
	Everyday	6	2.7
	Weekly	72	32.6
	Monthly	67	30.3
	Seasonally	2	0.9
Peas/Beans/Lentils/Soy beans	Never	27	12.2
	Everyday	1	0.5
	Weekly	139	62.9
	Monthly	54	24.4
	Seasonally	0	0
Red meat	Never	14	6.3
	Everyday	2	0.9
	Weekly	144	65.2
	Monthly	60	27.1
	Seasonally	1	0.5
Fish	Never	54	24.4
	Everyday	0	0
	Weekly	95	43.0
	Monthly	71	32.1
	Seasonally	1	0.5

Likahare	Never	71	32.1
	Everyday	0	0
	Weekly	51	23.1
	Monthly	88	39.8
	Seasonally	11	5.0

Meat and meat substitutes were consumed by most participants only on a weekly and sometimes even less frequent. The only meat items that were consumed daily (17.1%), is the bacon, polony, vienna, ham, or Russians. Pulses were consumed only on a weekly basis by 62.9% (n= 139) participants as indicated in Table 4.9.

The commonly eaten food on daily basis in this food group was bacon/polony/Vienna/ham/Russian, however, this food was also commonly (48.9%) eaten on a monthly basis. Chicken was commonly consumed (78.3%) on weekly basis. Likahare (offals), which is supposed to be traditionally common for Basotho, was considered seasonal by a few (5.0%).

Table 4-10: Frequency of consumption of fats, oils, and sugar

Food type (Fats, oils, added sugar)	Frequency	n	Percentage (%)
Peanut butter	Never	79	35.7
	Everyday	11	5.0
	Weekly	87	39.4
	Monthly	41	18.6
	Seasonally	3	1.4
Salad dressing/Mayonnaise	Never	38	17.2
	Everyday	8	3.6
	Weekly	126	57.0
	Monthly	47	21.3
	Seasonally	2	0.9
Coffee creamer	Never	126	57.0
	Everyday	18	8.1
	Weekly	45	20.4
	Monthly	24	10.9
	Seasonally	8	3.6
	Never	4	1.8

TABLE 4-10 CONTINUED

Butter/Margarine/Oil	Everyday	182	82.3
	Weekly	28	12.7
	Monthly	5	2.3
	Seasonally	2	0.9
Sweets/Chocolates	Never	39	17.6
	Everyday	57	25.8
	Weekly	102	46.2
	Monthly	23	10.4
	Seasonally	0	0
Sugar	Never	8	3.6
	Everyday	164	74.2
	Weekly	40	18.1
	Monthly	4	1.8
	Seasonally	5	2.3
Jam	Never	102	46.2
	Everyday	8	3.6
	Weekly	60	27.1
	Monthly	44	19.9
	Seasonally	7	3.2
Cold drink eg Oros	Never	24	10.9
	Everyday	79	35.7
	Weekly	88	39.8
	Monthly	30	13.6
	Seasonally	0	0
Fizzy drinks	Never	26	11.7
	Everyday	12	5.4
	Weekly	93	42.1
	Monthly	71	32.1
	Seasonally	79	35.7
Ice cream	Never	72	35.6
	Everyday	0	0.0
	Weekly	36	16.3
	Monthly	31	14.0
	Seasonally	82	37.1

Margarine, oil and butter are a commonly (82.3%) eaten type of fat. The majority of participants (74.2%) reported adding the sugar to either their tea or coffee. According to Table 4.10, few (25.8%) participants reported that they consume sweets daily. The table further indicates that a majority (42.1%, 32.1%, 35.7%) of participants consumed fizzy drinks either weekly, monthly or seasonally i.e on special occasions; and that only 11.7% (n = 26) never have fizzy drinks.

Table 4-11: Frequency of consumption of other food items

Food type (other)	Frequency	n	Percentage (%)
Supplements	Never	200	90.5
	Everyday	9	4.1
	Weekly	5	2.3
	Monthly	2	0.9
	Seasonally	5	2.3
Salt	Never	12	5.4
	Everyday	191	86.4
	Weekly	14	6.3
	Monthly	2	0.9
	Seasonally	2	0.9
Lunch box	Never	113	51.1
	Everyday	13	5.9
	Weekly	91	41.1
	Monthly	4	1.8
	Seasonally	0	0
Fast foods/Tuck shop	Never	37	16.7
	Everyday	41	18.6
	Weekly	120	54.3
	Monthly	22	10.0
	Seasonally	1	0.5
Traditional dishes	Never	167	75.6
	Everyday	0	0
	Weekly	9	4.1
	Monthly	31	14.0
	Seasonally	14	6.3
	Never	171	77.4

TABLE 4-11 CONTINUED

Beer/Wine/Liqour/cider	Everyday	0	0
	Weekly	18	8.1
	Monthly	17	7.7
	Seasonally	15	6.8
Dry packet chips (eg simba chips)	Never	20	9.0
	Everyday	45	20.4
	Weekly	134	60.6
	Monthly	21	9.5
	Seasonally	1	0.5

The majority (90.5%) reported that they do not consume mineral or vitamin supplements. Most commonly participants (86.4%) use salt as an addition to food. Majority of participants (51.1%) reported that they never took a lunch box to school, but only 41 (18.6%) of participants buy from the tuck-shop every day. Table 4.11 further indicates that the majority of participants never ate traditional dishes (75.6%) nor consume alcohol (77%).

4.5 Physical activity

Physical activity refers to all movements made in everyday life including work, recreation, exercise and sporting activities. The levels of physical activity are summarised in Table 4.12.

Table 4-12: Physical activity levels

Levels of activity	n	% of participants
Vigorously active Learners who participated in at least 20 minutes of activity that would make them sweat and breathe harder than normal on at least 3 days the 7 days preceding the survey.	56	25.3%
Moderately physicallyactive Learners who participated in at least 30 minutes of activity that would make them sweat or breathe hard on at least 5 days the 7 days preceding the survey	115	52.1%
Insufficiently active Learner who participated in some physical activity during the past 7 days preceding the survey, but did not reach the above levels of activity.	20	9.1%
Inactive Learners who did not report any participation in physical activity during the 7 days before survey	30	13.6%

As indicated in Table 4.12, more than 1 in 5 participants (22.7%) were insufficiently active or inactive, while only 1 in 4 (25.3%) reported being vigorously active.

4.6 TV-watching and computer-usage

Participants were required to indicate the number of hours they spend watching TV and their usage of a computer outside of school. Tables 4.13 and 4.14 indicate the number of hours spend on TV and computer respectively.

Table 4-13: Daily TV watching [outside school] (n=154)

Number of hours spent watching TV	n	% of participants
1	36	23.4
2	50	32.5
3	34	22.1
4	24	15.6
5+	10	6.5

The majority 154 (61.4%) of participants reported watching TV, with 1 in 5 (22.1%) watching for 4 hours or more per day.

Table 4-14: Daily computer usage [outside school] (n=34)

Number of hours spent in front of a computer	n	% of participants
0	1	2.9
1	12	35.3
2	10	29.4
3	4	11.8
4	3	8.8
5	3	8.8
7+	1	2.9

As indicated in Table 4.14, only 34 (13.6%) of participants reported computer usage outside school hours. Of these participants, majority (67.6%) used the computer for 2 hours or less in a day.

4.7 Lifestyle factors

The lifestyle factors that were determined were alcohol consumption, and the use of cigarette and snuff (smokeless tobacco). Figures 4.5, 4.6 and 4.7 indicate the usage of these substances.

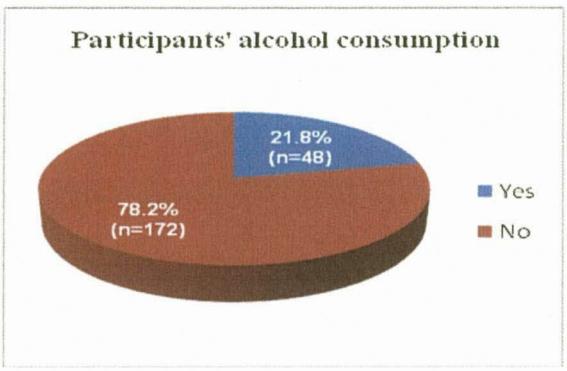

Figure 4-5: Consumption of alcohol

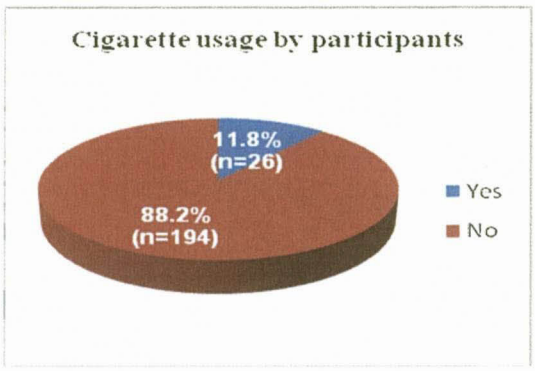

Figure 4-6: Cigarette usage

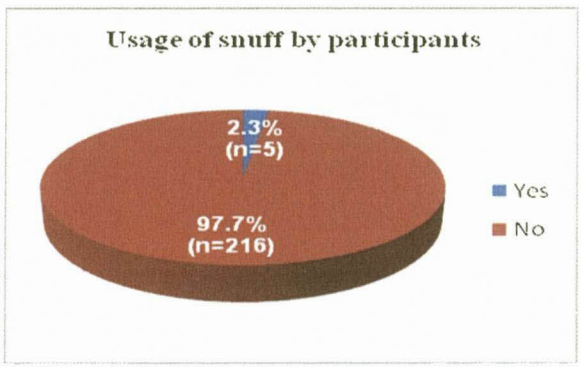

Figure 4-7: Snuff usage

About a fifth (21.8%) of participants reported drinking alcohol while 11.8% smoked cigarettes and very few (2.3%) used snuff.

Figures 4.8 reflect categories of alcohol consumers, while Figure 4.9 reflects the type of alcohol that participants (21.8%) consumed 30 days prior to the study.

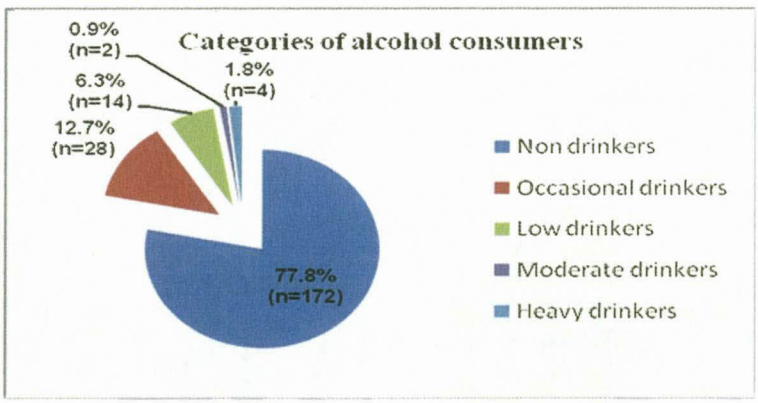

Figure 4-8: Categories of alcohol consumers

The majority (77.8%) of participants were non drinkers. Almost 13% reported occasional drinking, while only1.8% reported heavy drinking (Figure 4.8).

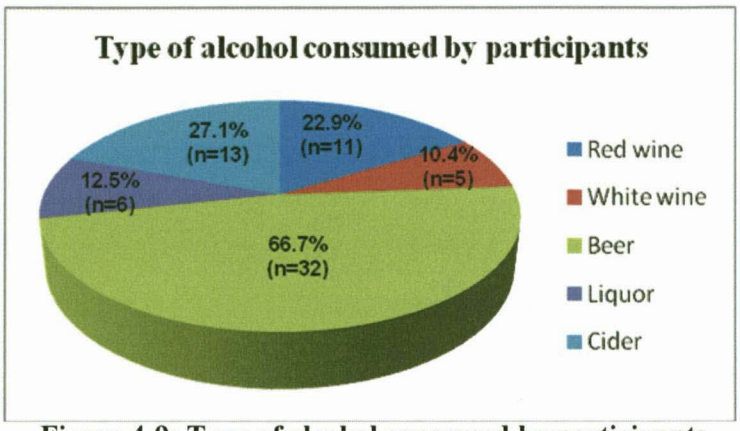

Figure 4-9: Type of alcohol consumed by participants

Figure 4.9 indicate that the commonly used alcohol was beer. The majority (66.7%) of participants who used alcohol drank beer. White wine was the least (12.5%) consumed type of alcohol.

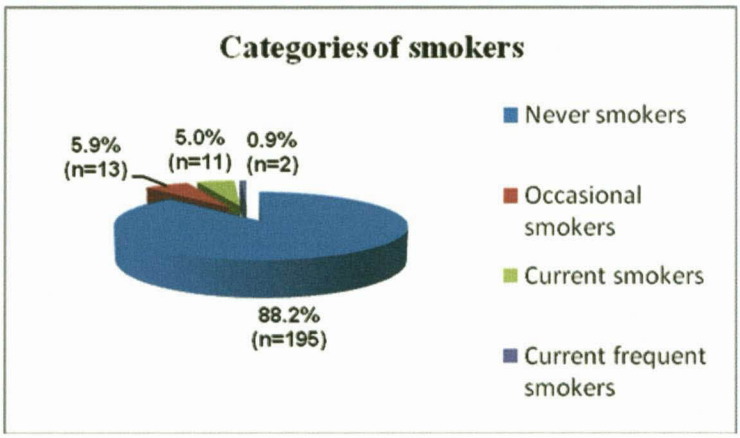

Figure 4-10: Categories of smokers

Figure 4.10 indicates that 88.2% (n=195) of participants were never smokers. Only 0.9% (n=2) were categorised as current frequent smokers.

4.8 Knowledge, attitude and practices (KAP) regarding nutrition

Participants were tested to determine their knowledge of nutrition, as well as their attitude and practices regarding nutrition. Table 4.15 illustrates the results of the KAP survey.

Table 4-15: Participants responses regarding their knowledge, attitude and practices in nutrition

Statements / Questions	Response	n	% of participants
Knowledge in nutrition (N=221)			
Most nutrients are lost during the cooking.	True#	192	86.9
	False	20	9.1
	Do not know	9	4.1
Nutrient losses from fruits and vegetables can occur as a result of long storage.	True#	142	64.3
	False	49	22.2
	Do not know	30	13.6
Maize porridge is a good source of vitamins and minerals.	True	91	41.2
	False#	97	43.9
	Do not know	33	14.9
Healthy foods help protect against illness.	True#	216	97.4
	False	5	2.3
	Do not know	0	0.0
Eating lots of different kinds of foods is healthier than eating a few kinds.	True#	170	76.9
	False	37	16.7
	Do not know	14	6.3
You should eat a lot of sugar to have energy.	True	68	30.8
	False#	137	62.0
	Do not know	16	7.2
Your body needs a little bit of salt a day to be healthy.	True	152	68.8
	False#	30	13.6
	Do not know	39	17.7
Sugar contains vitamins and minerals.	True	66	29.9
	False#	109	49.3
	Do not know	39	20.8
Dry beans, peas, lentils are a healthy choice to eat in place of meat.	True#	180	81.5
	False	26	11.8
	Do not know	15	6.8
Soya mince is as healthy as meat.	True#	122	55.2
	False	57	25.8
	Do not know	42	19.0
It is not healthy for pregnant women to drink alcohol.	True#	204	92.3
	False	16	7.2
	Do not know	1	0.5
Drinking a lot of beer and wine can make you put on weight.	True#	82	37.1
	False	111	50.2
	Do not know	28	12.6
Eat at least three meals a day.	True#	213	96.4
	False	5	2.3
	Do not know	3	1.4
Eating breakfast every morning is healthy	True#	210	95.0
	False	7	3.2
	Do not know	4	1.8
Attitude of participants regarding nutrition (N=221)			
I only buy food that is good for my body.	Agree	124	56.1
	Disagree	85	38.5
	Do not know	12	5.4
I eat what I like, and do not care if it is healthy or not.	Agree	95	43.0
	Disagree	124	56.1
	Do not know	2	0.9
I have a right to buy foods that are healthy for my body.	Agree	216	97.7
	Disagree	5	2.3
	Do not know	0	0.0

I only buy food that I can afford.	Agree	187	84.6
	Disagree	32	14.5
	Do not know	2	0.9
I do not need to care about eating healthy to keep my weight constant.	Agree	28	12.7
	Disagree	187	84.6
	Do not know	6	2.7
I believe that the food I eat now will affect my health in future.	Agree	137	62.0
	Disagree	57	25.8
	Do not know	27	12.2
I just do not have the time to think about food and nutrition.	Agree	67	30.3
	Disagree	141	63.8
	Do not know	13	5.9
I do not have to care about food unless the doctor or nurse talks about it.	Agree	36	16.3
	Disagree	181	81.9
	Do not know	4	1.8
Practices of participants regarding nutrition (N=221)			
Do you eat five vegetables and fruits a day?	Regularly	25	11.3
	Occasionally	128	57.9
	Never	68	30.8
Do you eat dry beans, split peas, lentils, soya twice or more/ week?	Regularly	72	32.6
	Occasionally	109	49.3
	Never	40	18.1
Do you drink water in between meals?	Regularly	156	70.6
	Occasionally	44	19.9
	Never	21	9.5
Do you drink cold drinks/ fizzy drinks every day?	Regularly	41	18.6
	Occasionally	130	58.8
	Never	50	22.6
Do you eat cake, pastries or biscuits in between meals everyday?	Regularly	17	7.7
	Occasionally	101	45.7
	Never	103	46.6
Do you add salt to your food at table?	Regularly	76	34.4
	Occasionally	81	36.7
	Never	64	29.0
Do you like to add sugar to vegetables in the cooking process?	Regularly	25	11.3
	Occasionally	54	24.4
	Never	142	64.3
Do you like to add butter to cooked vegetables?	Regularly	12	5.4
	Occasionally	43	19.5
	Never	166	75.1
Do you often buy take-away foods?	Regularly	15	6.8
	Occasionally	88	39.8
	Never	118	53.4
Attitude of participants towards obesity (N=221)			
Fat people have more friends.	True	25	11.3
	False	118	53.4
	Do not know	78	35.3
Children do not like their mothers to be fat.	True	122	55.2
	False	54	24.4
	Do not know	45	20.4
Fat people cannot work hard.	True	152	68.8
	False	57	25.8
	Do not know	12	5.4
Men prefer fat women.	True	41	18.6
	False	117	52.9
	Do not know	63	28.5

Fat people feel unhappy.	True	88	39.8
	False	64	29.0
	Do not know	68	30.8
People who eat healthy food are thin.	True	41	18.6
	False	155	70.1
	Do not know	25	11.3
If one exercises daily, one feels healthy.	True	203	91.9
	False	9	4.1
	Do not know	9	4.1
I enjoy bodily exercise.	True	187	84.6
	False	29	13.1
	Do not know	5	2.3
It is difficult to lose weight.	True	98	44.3
	False	98	44.3
	Do not know	25	11.3
If one looses weight, one looks unattractive with loose skin.	True	74	33.5
	False	107	48.4
	Do not know	40	18.1
Participants' knowledge in the causes of obesity (N=221)			
If one eats late in the evening, one is likely to get fatter.	True	60	27.1
	False	116	52.5
	Do not know	45	20.4
Fat on meat does not make one fatter.	True	64	29.0
	False	126	57.0
	Do not know	31	14.0
Lots of sugar in tea makes one fatter.	True	71	32.1
	False	113	51.1
	Do not know	37	16.7
Lots of oil and fat in food make one fatter.	True	173	78.3
	False	36	16.3
	Do not know	12	5.4
When one drinks a lot of water, one eats less.	True	107	48.4
	False	81	36.7
	Do not know	33	14.9
Participants knowledge in the relationship between obesity and health (N=221)			
Thin people get more sugar diabetes than fat people.	True	21	9.5
	False#	151	68.3
	Do not know	49	22.2
More fat people than thin people suffer from high blood pressure.	True#	177	80.1
	False	21	9.5
	Do not know	23	10.4
Thin people get tired easier than fat people.	True	7	3.2
	False#	205	92.8
	Do not know	9	4.1
When one eats a lot of fat in food, one feels comfortable.	True	58	26.4
	False#	129	58.4
	Do not know	34	15.4
Fat people with sugar diabetes become healthier when they lose weight.	True#	110	49.8
	False	47	21.3
	Do not know	64	29.0
Thin women do not get pregnant easily.	True	16	7.2
	False	156	70.6
	Do not know	49	22.2

 # the expected response

According to Table 4.15, the majority of participants had knowledge on nutrition, the causes of obesity and the relationship between obesity and health. The table further indicates that the participants reported a negative attitude towards obesity.

Regarding attitude towards nutrition, the majority of participants cared about their health; buy food that is healthy for their body; buy food they can afford; are conscious about their weight; and believe that what they eat now will affect their health in future.

Table 4.15 also indicates that the majority of participants do not regularly eat five vegetables and fruits a day; nor eat dry legumes 2 or more times per week which supports the findings of the 24-hour recall and FFQ; Most participants also reported that they regularly drink water in between meals; occasionally have cold drinks/fizzy drinks; never eat cakes, do not consume pastries or biscuits between meals everyday; and occasionally/never add salt, sugar and butter to cooked vegetables, nor regularly buy take-away foods.

4.9 Association between BMI and the variables discussed above (birth weight; energy, CHO, protein and fat intake; and TV and computer hours.

Simple statistics and the Pearson correlation coefficients were used to determine if any relationships exist between the participants' BMI and the risk factors for overweight and obesity which were tested. Table 4.16 shows the results.

Table 4-16: Pearson correlation coefficients of BMI with known risk factors of overweight and obesity

Variable	Correlation (r-value)	Significance(p)
Weight birth (n=60)	-0.1	0.53
Energy intake (N=221)	0.2	0.01
Carbohydrate (N=221)	0.3	0.00
Protein (N=221)	0.1	0.09
Fat (N=221)	0.1	0.14
Vigorous physical activity *(n=81)*	-0.2	0.03
Moderate physical activity *(n=52)*	-0.1	0.10
TV hours (n=154)	-0.0	0.81
Computer usage (n=34)	-0.0	0.80
Alcohol consumption (n=16)	-0.1	0.75
Smoking (n=20)	-0.4	0.12

As summarised in Table 4.16, there was a moderate association between vigorous physical activity and a weak relationship between energy intake and carbohydrates consumed, but no relationship of BMI with protein and fat intake, TV hours, computer usage, alcohol consumption and smoking.

4.10 Limitations of the study

The following problems were encountered during data collection:

- Some participants declined to participate in the study because their parents felt they will be victimised even though it was clearly stated in the consent form that the study procedures involved no risks or harm to participants.
- The majority of the participants did not have their RHCs, and those RHCs that were brought in were not completed up to 5 years. Mothers seemed to stop taking their children to the clinic once they were fully immunised at 18 months of age.
- Birth lengths were not plotted on the RHCs.
- Due to the small number of subjects who brought their RHCs it was not possible to confirm the association between LBW and LBL, with
- The possibility of misreporting smoking and drinking habits in this study for fear of retribution, cannot be totally excluded.

5 DISCUSION OF RESULTS

The main objective of this study was to determine the prevalence and known risk factors for overweight and obesity among adolescents in urban Maseru. The results of this study will be discussed according to current anthropometry (BMI), intrauterine growth, known risk factors of childhood and adolescent obesity, and associations between the above.

5.1 Demographic information

The demographic data provides information about the participants' gender, place of stay during school days and the type of school they attended.

Figures 4.1, 4.2 and 4.3 indicate that most participants in this study were female (56.6%), living at home (89.6%) and attended schools of mixed gender (co-ed) (62.9%).

5.2 Anthropometric information

Anthropometric data in this study referred to the current BMI and intrauterine growth of participants.

5.2.1 Current anthropometry

The current BMI and the prevalence of overweight and obesity of participants will be discussed in this section.

5.2.1.1 Comparing different growth standards

Three sets of BMI reference cut-off-points were used to interpret the current BMI of participants, namely the IOTF-adopted age-specific cut-off points, the CDC growth standards and the WHO growth standards. The prevalence estimate for combined overweight/obesity category was higher (34.4%) for both males and females when based on the WHO cut-off-points compared with the CDC (27.8%) or IOTF (15.0%) cut-off-points.

Estimates of the prevalence of obesity are similar for males based on WHO and CDC cut-off-points (3.1%), but lower for IOTF (0.0%), which did not identify any male as being obese. Regarding females, the WHO growth standards identified more females (7.2%) as being obese compared with CDC (5.6%) or IOTF (1.6%) cut-off-points (Table 4.1).

This finding is similar to that of Shields and Trembley (2010: 1) in a study to determine obesity in Canadian children and adolescents using the three sets. The 2004 prevalence estimate for the combined overweight/obesity category in Canadian children (2 to 17 years) was higher (35.0%) when based on the WHO cut-off-points compared with the IOTF (26.0%) or CDC (28.0%) cut-off-points. Estimates of the prevalence of obesity were similar based on WHO and CDC cut-off-points (13.0%), but lower when based on IOTF cut-off-points (8.0%).

The three BMI reference cut-off-points were generated using different data sets (as discussed in chapters 2 and 3) and smoothing methods and the approach of setting the cut-off-points was different, thus a variation in results when applied to the same data set is expected (Zimmermann et al., 2004:527).Whereas the original CDC growth chart was based on cross-sectional data of a sample consisting of mainly white, mostly formula-fed children between birth and 18 years of age, from a middle income American population (Kuczmarski et al., 2000: 1), the more recent WHO growth standards were based on longitudinal data following the same exclusively breast-fed children from six multi-centers across the world, representing different cultures and incomes, from birth over time (de Onis et al., 2007: 660). Africa (represented by Ghana) was included as one of the six centers.

The findings of the current study are similar to other studies, indicating a higher prevalence of overweight and obesity when based on WHO cut-off-points than previous standards, indicating that the WHO-standards are more sensitive to identify overweight and obesity in adolescents.

As the WHO growth charts are the first standards based on actual longitudinal growth of children under ideal conditions, the goal of WHO was that by 2010, most countries will base prevalence estimates of overweight and obesity on these cut-off-points. In line with this vision, the SA Department of Health has recently adopted the WHO growth charts.

5.2.1.2 Prevalence of overweight and obesity in Lesotho

The results (Table 4.1) indicated a prevalence of 2.1% to 4.1% for overweight and 0% to 3.1% for obesity among males aged 16 years in urban Maseru, while 16-year old females had a prevalence of 11.3% to 20% for overweight, and 1.6% to7.2% for obesity.

Independent of which growth standards and cut-offs (WHO, CDC or IOTF cut-off-points) were used, the prevalence of overweight (11.3% to 20%) and obesity (1.6% to 7.2%) was high among 16-year old Sesotho females living in urban Maseru. As treatment of overweight and obesity is often unsuccessful, and weight problems track into adulthood causing premature morbidity and mortality (Zimmermann et al, 2004; 528), preventive health measures need to be put into place in Lesotho to curb this problem. Lesotho like other developing countries is experiencing a transition from under-nutrition to over-nutrition, as well as a double burden of both malnutrition and obesity existing in the same communities. Though the prevalence of underweight was not determined in this study, a prevalence of underweight was found to be higher in males (7.2%) than in females (2.7%) in adolescents in the current study using the CDC growth standards.

Data from the current study show that the prevalence of overweight and obesity is still lower in Maseru than in SA, which surrounds Lesotho. The prevalence of overweight in SA, according to the SA YRBS (2002) performed on adolescents aged 15 to 24 years, and using the CDC growth standards, was 1.6 times higher (21.0%) than the prevalence found for Maseru (13.4%) in the current study, while that of obesity was 2.5 times higher (4.0%) in SA than in Maseru (1.6%). On the other hand though in the Thusa Bana Study (Kruger et al., 2006: 355), performed in the North West Province of SA, the overweight and obesity combined was only half (7.1%) as prevalent as in the Maseru adolescents (15.0%). This could however be related to the fact that the Thusa Bana Study was conducted on a younger age group between 10 and 15 years (Kruger et al., 2006: 351). According to Meko et al. (2009: 149), in a study performed on 13 to 15 year old adolescents in Magaung, Free State (which is geographically close to Lesotho and is populated by mainly Sesotho people) the prevalence of overweight was 1.3times lower than the prevalence of Maseru, while obesity was 3.4 times higher.

Compared to other African populations, however, a higher prevalence of overweight (19.1%) was recorded in the current study for Lesotho adolescents, than by Akinpelu et al. (2007: 13) for Nigerian adolescents (1.3%) of the same age when using the CDC cut-off-points. Using the IOTF-adopted age-specific cut-off-points, a higher prevalence of overweight was also identified in Lesotho (13.4%) than in the Nigerian (2.5%) study (Akinpelu et al., 2007: 13). Similarly, both the CDC and the IOTF cut-off-points, respectively, identified fewer obese adolescents in the Nigerian study (1.9%, 1.3%) than in

the current Lesotho study (8.7%, 1.6%). These differences in the Nigerian and Lesotho prevalence rates may be related to the nutrition transition in Lesotho. Steyn et al. (2006: 13) reviewed the fact that SA, due to rapid urbanisation, is challenged with a transition to a westernised diet and low physical activity, which leads to an increase in the prevalence of overweight and obesity. Lesotho, a developing country, is facing similar nutrition and lifestyle challenges as SA. The current data may indicate that Lesotho is possibly further down the path of nutrition transition than Nigeria, but has not yet caught up with SA. Concurrently, compared to other affluent and developed countries like Switzerland, both SA and Lesotho have lower adolescent overweight and obesity rates.

5.2.1.3 Prevalence according to gender

Similarly to the trends identified for the whole study group, when stratified according to gender, the WHO growth standards identified the largest number of overweight and obese participants, followed by the CDC growth standards. The IOTF-adopted age-specific cut-off points identified the least number of overweight and obese cases among these Maseru adolescents.

Results of the study indicate a higher prevalence of overweight and obesity respectively among females (11.3%, 1.6%) compared to males (2.1%, 0%) in the current study. Almost 1 in 8 (12.9%) of 16 year old females in this study had above normal body weights, although this was still lower than SA girls of same age according to the 2003 SADHS (20%).

Many studies confirm the trend of higher levels of overweight and obesity among females than males – even in adolescents. Similar results were for example observed in the 2002 SAYRBS and 2003 SADHS, as well as in a study conducted by Meko et al. (2009: 149). During sexual maturation body fat accumulation is initially stimulated in both boys and girls, but then it ceases in boys and continues in girls throughout adolescence. Thus girls accumulate more fat than boys (2003 SADHS; Lobstein et al.,2004: 79; Okeyo: in publication).

5.3 Intrauterine growth adequacy

It has been hypothesised that children who suffer growth failure and under-nutrition *in utero* and during the early years of life, tend to become overweight or obese when sufficient

food becomes available, probably related to metabolic and endocrine adaptations (Barker et al., 2009: 457).

5.3.1.1 Birth weight

The association between LBW and adult obesity was first published by Ravelli et al. (2001: 1797) who observed that obesity occurred more frequently among men born during the World War II. A substantial body of epidemiological evidence now supports an association between LBW and stunting in childhood, which later translates into adult obesity (Corvalan et al., 2007: online; Evenssen, 2009: 240; Wolf and Phil, 2003: 176; Sawaya et al., 2003: 171).

Due to the small number of participants presenting their RHCs it was not possible to investigate the association between LBW (only 8 participants) and body weight in these adolescents at 16 years of age.

5.3.1.2 Birth length

Low birth length (LBL) and stunting in early childhood, is hypothesised to also be associated with adult obesity. Stunting in childhood predisposes children to become overweight or obese when sufficient food comes available. Furthermore, stunting on its own, poses a threat for an emergence of chronic disease risk factors, when stunted children become obese adults (Steyn et al., 2006: 20).

As the birth lengths were not available in the RHCs, no data was collected for birth length. This was similar for SA children in a study conducted by Steyn et al. (2006: 20).

5.4 Dietary intake

The adequacy and quality of food intake will be discussed according to the intakes of total energy (kJ) and macronutrients (g), namely protein, carbohydrates and fat.

5.4.1 Total energy

Energy is defined as "the capacity to do work." Humans obtain the energy by consuming plants and the flesh of animals and releasing the energy from proteins, carbohydrates and fats through cellular processes (Frary and Johnson, 2008: 23; Stang, 2008:

250). Estimated energy requirements vary greatly among males and females because of variation in growth rate, body composition and physical activity levels (Stang, 2008: 250).

The recommended energy intake for adolescent males was 13 238kJ/day and 9 946 kJ/day for females. According to the findings of this current study, the minimum intake was far below, while the maximum was twice the recommended intake. The participant with the low intake reported an inadequate food supply when the study was being conducted. The high intake however was due to a high consumption of alcohol. This participant reported drinking every weekend. According to the literature reviewed, more males than females consume high amounts of alcohol (Reddy et al., 2002: online).

Weight gain results from taking in more energy than what the body uses. This imbalance causes an excessive accumulation of body fat (Galuska and Khan, 2001: 533). High energy intakes are achieved by active overeating which exposes people to higher portion sizes than recommended, increasing their energy intake. On the other hand, adolescents are being exposed to passive overeating, which refers to eating energy-dense foods, which may also cause excessive energy intake and weight gain, even though only moderate portions are consumed (Gee et al., 2008: 540). In this study a significant weak positive association was found between the current BMI and energy intake, thus supporting an increase in BMI when there is an increase in the amount of energy consumed.

5.4.2 Carbohydrate intake (non-added sugar)

CHO are manufactured by plants and are a major source of energy in the diet at a recommended level of 45% to 65% of total energy consumed (Gallagher, 2008: 42). According to the Food Guide Pyramid the majority of participants consumed above the recommended servings (6-11 servings) per day. Only two participants in this current study consumed servings less than the recommendation.

The carbohygrate requirement for adolescents is 130g/day (Gallagher, 2008:42). Adolescents who are very active and actively growing need additional CHO, whereas those that are inactive require fewer CHO (Stang, 2008: 251). The median intake of CHO in this study was 267.6g per day, which exceeded the DRI (130g/day) by 137.6g, while the minimum and maximum intakes were 137g and 455g respectively. When CHO were expressed as a percentage of total energy intake, the majority of participants (68.3%) consumed CHO within the recommended range (45% to 65%).

The recommended values of CHO are based on the minimum amount of glucose required by the brain, which can be exceeded to meet energy needs of the body (Lee and Nieman, 2010: 28). Complex CHO (starch, fibers) however, help maintain a healthy body weight or promote weight loss because they are low in fat and added sugar (Rolfes et al., 2009: 123).

The majority (74.7%) of participants consumed more than the recommended levels from the grains and starchy vegetables group per day. This high intake of starchy foods was mainly in the form of papa (stiff mealie meal porridge) and bread, which were consumed on a daily basis by more than half of the study group (51.6% and 63.8%, respectively). Foods which were commonly consumed only on a weekly basis were rice / mealie rice (which was commonly consumed on Sundays), samp, and pasta (commonly added in soups). Cakes/ muffins/scones/puddings were also commonly consumed on Sundays or during special occasions. Unlike in Lesotho, almost half of the Black participants (49.8%) in SA consumed cakes for four or more days in a week (Reddy et al., 2002: online),

5.4.3 Protein intake

The RDA for protein for adolescents is 0.8g/kg/day for girls and 1.0g/kg /day for boys (Gallagher, 2008: 62). To obtain this quantity of protein, the diet should provide approximately 10% to 15% of the total energy intake as protein. When protein was expressed as a percentage of total energy intake, the majority (57.9%) of participants in this study consumed more than the recommended level (>15%). However, this study found no association between the current BMI of participants and protein intake.

According to the FGP, 20.4% participants consumed the recommended number of servings (2-3 servings). An insufficient intake of protein in adolescents has a detrimental effect on growth and development (Stang, 2008: 250).

Protein makes a smaller contribution in the typical diet to the total energy intake than fat and CHO. However, there has been less research to determine the effect of protein on weight change than the other macronutrients. Furthermore, evidence from observational studies relating to the association of protein and obesity are also inconsistent (Jebb, 2007: 94) on this issue.

Overall very few participants in this study consumed protein foods on a daily basis. Seventeen per cent reported that they consume bacon/polony/vienna/ham or Russians that

they buy from the tuck-shop or from the vendors outside of school, daily. Chicken, red meat, eggs and peas were commonly consumed on a weekly rather than daily basis. Some participants reported that they only eat meat at school; in cases where the school provides lunch. Unlike in SA according to the YRBS, 60.7% of the participants consumed meat frequently (4 or more days/ week) (Reddy et al., 2003: online). Children begin to learn about food and nutrition at school and from their peers (Whitney & Rolfes, 2005: 568), so schools remain one of the best avenues for disseminating nutrition education programmes as they have the greatest access to the children. Foods sold by vendors and tuck-shops are minimally regulated for nutritional adequacy and they are often low in nutritional value (Kruger et al., 2006: 353; Steyn, 2006: 16). Probart et al. (2006: 245) state that the availability of these high carbohydrate and fatty foods on school premises can foster food preferences that increase the intake of these foods by children and adolescents, hence the need for them to be targeted to sell less fatty protein foods.

Even though pulses are low in fat, high in protein, fiber and micronutrients and phytochemicals, they are not commonly eaten by participants of this study. The KAP questionnaire, however indicated that the majority (81.5%) of participants had knowledge on the nutritive value of pulses. This behaviour may be attributed to their attitude towards the food item in question (Contendo, 2007: 60).

5.4.4 Fat intake

Currently there are no DRI values established for fat intake (Stang, 2008: 251) but saturated fats are associated with the development of chronic diseases (Corella et al., 2007: 12). It is however, recommended that fat intake should not exceed 35% of the total energy intake and that no more than 10% of energy should be contributed by saturated fatty acids. No RDA or AI has been established for fat since there is insufficient data available to determine the total fat requirements. Presently there is also no tolerable UL established for total fat because there is no level identified that is specifically associated with adverse effects (Lee and Nieman, 2010: 29).

Excessive accumulation of body fat is caused by an imbalance of energy intake and energy output. (Atterburn et al., 2008: 604). Most deposits of fat come from dietary triglycerides, which exist in food as saturated, monounsaturated and polyunsaturated fats. As these different types of fat have different metabolic effects, it is possible that this leads to

differences in the risk of weight gain. There is however limited research linking specific types of fat to weight gain (Pereira et al., 2005: 39).

In the current study, the median fat intake was 35.5g/day (minimum 3.0g; maximum 35.5g). The majority of participants (52.9%) had a low self reported fat intake (<20%), which would reduce their risk of overweight and obesity. Of the 251 participants, the majority (82.3%) consumed butter/margarine or oil daily. The oil was added to food during cooking. However, there may have been under-reporting due to the fact that some participants did not prepare the food, hence were unable to report the exact amount of oil added to the food.

5.4.5 Sugar intake

The increasing consumption of SSB, including soft drinks, is linked to childhood obesity. SSB is a very concentrated and energy dense form of dietary sugars which are consumed in large amounts. Excessive consumption of these beverages, that is 1 to 2 glasses per day, has been positively linked to weight gain, obesity, as well as metabolic disorders such as insulin resistance, type 2 diabetes, cardiovascular diseases, hypertension, gout and non-alcoholic fatty liver disease (van den Berg, 2010: 1).

The added sugar reported in the FFQ was added to tea and/coffee. Few participants (35.7%, 5.4%) consumed cold drinks and fizzy drinks respectively on a daily bases. The results can be attributed to underreporting (Lee and Nieman, 2010: 74). This was similar for adolescents in the Eastern Cape, where 39.4% reported to consume SSB daily as indicated in the SA YRBS (Reddy et al., 2003: online). Low sugar intake was also reported by the majority of participants (95.7%) when sugar intake was expressed as a percentage of total energy intake.

5.4.6 Food groups

The results on the frequency of consumption of food items are discussed in this section.

5.4.6.1 Breads, cereals, rice and pasta

On average, poor people in Lesotho grow less than 20% of the maize they need, and they buy 45 % and 60% of it. Food imports have been decreasing since 1998, but production does not seem to have increased (Ministry of Agriculture report, 2009). Traditionally, maize was ground using grinding stones, however, the practice is changing due to advanced milling facilities.

Maize meal is a commonly consumed food item in Lesotho and is available in almost all the households. The diet of the students in this current study was mainly based on maize meal porridge (papa). The majority consumed maize papa and brown bread on a daily basis (Table 4.5). According to 2003 SA YRBS, 64.7% of SA students had eaten maize in different forms (papa or porridge), with 67.1% being Black South Africans (Reddy et al., 2003: online). It is therefore evident that Maize meal is commonly consumed by Black Africans. Majority (80.1%) of participants consumed Cakes/Muffins/Scones/Puddings on weekly basis, with majority reporting to have eaten them two or three times a week, while in SA, 49.8% of Black South Africans conusumed cakes/biscuits 4 or more days a week (Reddy et al., 2003: online). This indicates that the adolescents in SA consume cakes/biscuits more frequently than Lesotho adolescents.

5.4.6.2 Fruits and vegetables

Fruits and vegetables contain nutrients, fibre, phytochemicals and antioxidants. Emerging evidence suggests that increasing the consumption of fruits and vegetables mayassist in dietary weight management strategies to prevent obesity (Atlantis et al., 2007: 343). Energy density is reduced by higher intakes of fruit and vegetables (Haslam and James, 2005: Abstract). Eating larger amounts of fruits and vegetables increase the feeling of satiety, displacing more energy dense foods (Tohill, 2005: 1). Therefore, incorporating more fruit and vegetable in the diet, can reduce the overall energy density of the diet, promote satiety and decrease the total energy intake and increase the quality of the diet (Rolls et al., 2005: 100; Ledikwe et al., 2006: 1362).

As indicated in Tables 4.6 and 4.7, fruits and vegetables were not commonly consumed by adolescents in Lesotho. This was similar for school children aged 10-15 years of age in SA (Kruger et al., 2006: 353), where a low and irregular intake of fruits of vegetables was reported. In a study by Meko et al. (2009: 193), the low intake of fruits and vegetables was attributed to problems with children's eating patterns based on the children's established habits while they are still toddlers and also at weaning. Modern weaning practices do not encourage children to learn to deal with foods which require substantial chewing before swallowing. This in turn leads to children avoiding foods which require a lot of chewing such as fruit and vegetables (Poskitt, 2005:).

5.4.6.3 Milk and milk products

The recommendation is that adolescents consume 2-3 servings of milk or milk products per day. However in this study, 91% of participants did not meet this level of intake, while only 19% consumed milk daily. Milk products such as mafi (sour milk), cheese and yoghurt were only consumed on special occasions by some. Only 2.7% (n=6) of participants reported consuming cheese and yoghurt daily. This low intake of this food group poses a risk for overweight (Dehghan et al., 2005: 26).

This finding supports the trend that the westernised diet is replacing milk with sugar sweetened beverages (SSB) or juices. Adolescents usually drink SSBs instead of milk. There is growing evidence suggesting that an increase in dairy intake by about two servings per day could reduce the risk of overweight by up to 70%; and that higher calcium intake and more dairy servings per day are associated with reduced adiposity in children (Dehghan et al., 2005: 25), lower peak bone mass which results in osteoporosis later in life (Smolin and Grosvenor, 2008: 441).

5.4.6.4 Meat, poultry, fish, beans, eggs and nuts

The FGP recommends that 2-3 servings of this food group be eaten daily. As indicated in Table 4.5, only 20.4% participants were able to meet this requirement. The majority (42.1%) consumed servings above the requirements.

Kruger et al. (2006: 353) reported that milk, eggs and meat were consumed in small amounts just sufficient to meet protein needs and not satisfy other micronutrient needs. In this study as indicated in Table 4.5, shows a low intake of this food group.

In Lesotho, according to this study, the majority of participants consume processed meat than the other types of meat. Processed meat is high in fat and salt. According to the 24hr-recall, most students bought sliced polony for lunch from the vendors. This sliced polony is affordable to most studentsl, the reason Table 4.2 indicates most participants consuming more servings than required.

5.4.6.5 Fats, oils and sugar

It is recommended that this food group be used sparingly by consumers (Gibney and Vorster, 2001: 48). As indicated in the FFQ, butter/margarine/oil (82.3%) and sugar (74.2%)

were commonly consumed by participants on daily basis. Fizzy drinks were commonly consumed (32.1%) on monthly basis compared to the other forms of sugar. The findings of this study did not pick up high consumption of sugar like in other studies in SA (Meko et al., 2009: 192). This can be attributed to poor reporting.

Recent recommendations emphasises more on the type of fat used rather than on the total fat consumed. Consumption of saturated fats (fats from animal source) predisposes one to numerous risks such as cholesterol, CVDs, cancers and obesity. The unsaturated fats such as fats from nuts, olive oil and fish seem to be protective of health risks associated with high fat diets (Smolin and Grosvenor, 2008: 159; Rolfes et al., 2009: 157). Very few (5.0%) participants consume nuts on daily basis.

5.4.6.6 Other food items

Numerous food items were listed for participants to indicate how often theywere consumed. According to the results in the FFQ

(i) Lunch box

Slightly more than half (51.1%) of participants reported that they never take a lunch box to school, whereas 18.6% reported eating from the tuck-shop or vendors. This is an indication that the majority of schools offer lunch.

(ii) Fast foods/Tuck shop

Few participants (18.6%) buy from the tuck-shop on daily basis, while the majority (54.3%) buy on weekly basis. Most schools do not have Tuck-shops, so the majority of students buy from the vendors outside the school premises.

(ii) Traditional dishes

The expectation in this regard would be to identify a high percentage of participants consuming traditional dishes since they are high in fiber, low in added sugar. The results of this current study, a large number (75.6%) of participants reported never eating traditional dishes. This was similar for Steyn et al. (2006: 13) who identified a trend of shifting from high fiber, low fat and sugar diets to highly refined ones due to urbanisation.

(iv) Beer/wine/liquor/cider

The majority (77.4%) of participants reported not to consume alcohol. However, the lifestyle factor questionnaire indicated a slightly higher number of participants (78.3%), an indication that there is a possibility of underreporting (Lee and Nieman, 2010: 77). None of the participants consume alcohol on daily basis. It is recommended that alcohol should be consumed in moderation (Smolin and Grosvenor, 2008: 40). The results of this study indicate a few (1.8%) participants to be at risk of consuming high amounts of alcohol. High intakes during adolescence may cause permanent damage in learning and memory, and can alter the storage, metabolism, and excretion of other vitamins and minerals (Smolin and Grosvenor, 2008: 203).

Beer is the commonly (66.7%) consumed type of alcohol type of alcohol and the white wine is the least (10.4%) consumed.

(v) Dry packet chips (crisps)

Crips are a highly energy dense type of food and children and adolescents usually eat them as snack. Participants need to be empowered on nutrition and health issues for them to be able to opt for foods that are beneficial to their health. Street vendors as well contribute to the availability of these foods, so they should also be empowered on nutrition and health issues. Table 4.2 indicate a high consumption of fat and sugar group. It is evident that the cakes and crisps that are consumed almost everyday, contributed to these high intakes.

5.5 Physical activity

Physical activity refers to any activity on a regular basis such as riding a bike, skipping or doing household chores (Whitney and Rolfes, 2005: 565). A decline in PA is associated to an increase in body weight (Lazaro and Soteriades, 2010: 75; Dehghan, 2005: 25). Current recommendations advise 1 hour (30 minutes) of moderately intense physical activity a day (Goedecke et al., 2006: 142; Lucas and Feucht, 2008: 222).

Of the 221 participants in this study, 22.7% (mostly female) were insufficiently active or inactive, putting them at risk for overweight/obesity and chronic diseases of lifestyle. Only 25.3% were vigorously active and of these, more were males than females in a ratio just below 2:1. According to the researcher's observation, in Lesotho, the majority of schools do not offer physical education at present, compared to SA where the SAYBR Study (2002)

reported that the percentage of adolescents in SA who received no physical education at school was 29%. Introducing compulsory physical education at school levels could contribute to increased physical activity levels of adolescents (Dehghan et al., 2005: 25)

Physical activity is not just important to prevent overweight and obesity, but is also vital for the management of obesity. Although studies show that if physical activity is used as the sole intervention, only a small reduction of weight is achieved, but is beneficial in controlling appetite and increases the metabolic rate, thus supports a continued weight loss or maintenance (Rolfes et al., 2008: 301).

5.6 TV watching and computer usage

Time spent watching television can be considered a potential marker of sedentary behaviour and inactivity amongst children and adolescents since it decreases opportunities for physical activity (Strauss, 1999). There are, however, no clear data to date linking viewing of interactive videos, or using computers or other electronic media with the development of obesity (Batch & Baur, 2005: 132).

According to the SAYBR (2002: online) study, 25% of children in SA watched more than 3 hours of TV per day, while the results of this study revealed that of the 154 Lesotho participants who had access to TV, 44.2% watched TV for more than 3 hours per day and 22.1% for more than 4 hours per day, increasing their risk for overweight or obesity. Lazaro and Soteriades (2010: 70-77) observed that adolescents who spent more than 4 hours watching TV, were three times more likely to be overweight or obese. As indicated in Table 4.16 there was however no apparent association between current BMI and TV watching.

With regard to computer usage out of school; the results indicated that only a few participants (n=34) had access to computers out of school and of these 32.3% (n=11) spent more than 3 hours per day using the computer either for homework, playing games, communicating with friends and/or watching movies. The small sample size of participants who watched TV, could not determine an association between TV watching and BMI.

5.7 Lifestyle factors

Lifestyle factors determined in this study were alcohol consumption and smoking. The results are discussed below.

5.7.1 Alcohol consumption

Alcohol may contribute to weight gain because energy in the form of liquid kilojoules has less satiety value and drinking may stimulate appetite, promoting consumption of other additional energy sources (Smolin and Grosvenor, 2008: 205; Yeomans, 2010: 84). Alcohol energy contributes up to 50% of total energy in heavy drinkers (Bowman and Russell, 2001: 497).

Most participants (77.8%) in this study were non-drinkers.The 22.2% reported to consume alcohol, were light and moderate drinkers. Only 1.8% were heavy drinkers (n=4, all males). The consumption of alcohol among adolescents was thus lower than what has been reported in some studies in SA. In a study at high schools in the Pietersburg area in SA, Madu and Matla (2002: 121) for example found that 39.1% of adolescents drank alcohol. However, the possibility of misreporting drinking habits in this study for fear of retribution, cannot be totally excluded. Alcohol usage in the current study was also more common among males than females, as was the case in the study by Madu and Matla (2002: 130).

Since the sample of participants who drank alcohol was small, it was not possible to determine an association with the current BMI.

5.7.2 Smoking

As weight loss is a concern for adolescents, some start smoking in order to suppress appetite. As smoking is associated with lower body weights in adult women, adolescents may believe that it will help them stay thin or lose weight (Smolin and Grosvenor, 2008: 626).

Very few (11.8%) participants in this current study smoked cigarette and only 0.9% (n=2) were current frequent smokers. The prevalence of smoking among the participants in the current study was much lower than what has been reported in SA (Reddy, 2002: 121) where 35.2% of adolescents were found to be smoking at the age of 16 years. This may indicate that the Lesotho youth is currently less at risk for smoking-related health consequences including heart disease and lung cancer, than SA youth.

5.8 Knowledge, attitude and practices (KAP) regarding nutrition

The fact that many chronic diseases are to a large extent the result of individual and social patterns of behavior means that knowledge plays a major role in determining these lifestyle related diseases including obesity (Contendo, 2007: 2). Contento (2007: 60) further

states that if people acquire knowledge in nutrition and other health areas, their attitude is expected to change. Changes in attitude will therefore result to changes in behaviour or practices.

According to the results of this study the majority of adolescents had sufficient knowledge on nutrition, but did not put their knowledge into practice. Their choice of foods was based more on affordability, than the quality of the food even though they were aware of the consequences. It was of great concern to discover that most adolescents were not aware of the importance of water in the body. This was reflected in the 24-hour recall where the majority reported drinking water when thirsty. Those who drank water daily drank less than a litre.

5.9 Summary

The prevalences of overweight and obesity in Lesotho seem to be lower than in SA, but higher than in Nigeria. Females are at a higher risk of overweight and obesity than males as indicated. The results of the study indicate that the WHO growth standard are more sensitive in picking up overweight and obesity in adolescents, indicating that they are a better tool to use in growth monitoring as well as in conducting research studies.

Quantification of the 24-hour recalls indicated low intakes of vegetables, fruits, milk, proteins. The energy intake was lower than the recommended DRI except in the case where alcohol was consumed in large amount. However, the energy from alcohol is not beneficial to the body.

Physical inactivity and maybe the energy intakes are the factors associated to overweight and obesity in this study. In interventions designed to reduce paediatric obesity, emphasis should be on these two factors that indicated an association with an increase in body weight.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

In this study the prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru were determined. The conclusionsas well as the recommendations based on these conclusions are summarised in this chapter.

6.1.1 Prevalence of overweight and obesity

The prevalences of overweight and obesity are higher among 16-year old females (11.3% to 20%) than among males (2.1% to 4.1%) in urban Maseru. This finding is consistent with findings in SA where 2002 SA YRBS, 2003 SADHS and Meko et al. (2009) indicated a higher prevalence of overweight and obesity among females than in males.

The WHO cut-off-points identified a higher percentage of overweight and obese adolescents than the previous standards (IOTF-adopted age-specific cut-off points and CDC growth standards). As the WHO growth standards are based on actual growth patterns of children under ideal circumstances, these should be the growth standard of choice when evaluating adolescent weight. Lesotho currently has not fully adopted the WHO growth standards. In line with the vision of the WHO, the Lesotho Department of Health should adopt the WHO BMI percentiles, to assess the weight of adolescents. Personnel at Health facilities in Lesotho have recently been trained on the new WHO growth standards, but in practice, the results are interpreted as percentiles since the growth charts in the RHC are still in percentiles. The old version (RHC), which has similar growth charts for boys and girls, is still in use.

This high prevalence of overweight in Lesotho adolescents gives cause for serious concern because of the increased risk of chronic diseases among adults in Lesotho. The management of these incurable diseases incurs large direct and indirect expenses for governments. Indirect costs are incurred by for example workdays lost, while impaired quality of life and pre-mature mortality, in turn also leads to poor performance of personnel, poor productivity and loss in economic growth of the country.

6.1.2 Dietary intake

Daily milk and milk products (dairy products) intake was reported low by most adolescents. The low intake places these children at an increased risk of being overweight and obese. In a study conducted by Louie et al. (2011: e582), the results of their study indicated a protective effect of dairy food consumption on weight status. An increase in consumption of dairy products reduced weight. Few studies though, are in agreement about the effects of dietary intake on the progression of overweight and obesity in children. In Lesotho there is a lack of studies that investigated the link between dairy product intake and weight status, particularly amongst children. This study did not investigate the link.

Total energy intake was low as reported by most of the adolescents and most had a normal to high fat intake. Few adolescents's risk of developing obesity is further increased by high energy and fat intakes. Studies have shown that a restriction in the consumption of daily calories results in a decrease in weight gain. It is conclusive that energy intake is a risk factor for overweight and obesity. The results of this study indicate an association between energy intake and the current BMI.

All of the schools reported having a tuck shop and/or informal sellers in or around the school premises. Energy-dense, nutrient poor foods were sold in these schools and very few healthy options were available at the school shops and informal sellers. Pupil's food preferences influence the types of foods sold at tuck- shops and vendors, such that similar food items were sold at schools. Health and nutrition are not a priority for adolescents (Probart *et al.*, 2006).

6.1.3 Physical activity

The adolescents in this study were mostly moderately and vigorously active during the five work days (Monday to Friday). Very few participated in informal sporting activities. Of the 221 adolescents, 25.3% are vigorously active and 52.1% moderately active.

In SAYRBS more (44.6%) children in that study were found to be vigorously active than moderately active (33.5%) while in Lesotho according to the findings of this study, more (52.1%) adolescents are moderately active than vigorously active (25.3%). The girls were less active than the boys in this study.

Adolescents who are vigorously active are at a lesser risk of overweight and obesity because the results in this study indicated a negative association between vigorous activity and current BMI. Epidemiological studies have observed a relationship between little or no physical activity and increased prevalence of disease (Wildman and Miller, 2004: 74).

6.1.4 TV-watching and computer-usage

The majorityof participants watched TV for more than three hours per day. This was similar for SA where the SAYBR (2002) study indicated a high number of students. TV watching is another form of sedentary behaviour, therefore this behaviour (TV watching) further increases the risk of overweight and obesity.

6.1.5 Lifestyle factors

A majority of participants (77.8%) in this study were non-drinkers; and only 1.8% (n=4) were heavy drinkers. Heavy drinkers were all males. Alcohol is considered to contribute to weight gain because liquid kilojoules have less satiety value. Alcohols stimulate appetite, promoting high consumption of other additional energy sources (Smolin and Grosvenor, 2008: 205; Yeomans, 2010: 84). Majority of adolescents in this study are at a reduced risk of overweight and obesity as well other diseases caused by high and frequent consumption of alcohol. Beer was commonly consumed.

Very few (11.8%) adolescents smoked cigarettes, with 0.9% of adolescents being current frequent smokers, a group which is more exposed to being underweight.Smoking leads to weight loss by increasing the metabolic rate, decreasing metabolic efficiency, or reduction in appetite (Chiolero et al., 2008: 803), but this does not justify the use of cigarrette in reducing weight as there are other risk factors related to smoking such as cardiovascular diseases. Smoking therefore is not a risk factor for overweight and obesity.

6.1.6 Knowledge, attitude and practices (KAP) regarding nutrition

It is conclusive from the results of this study and literature reviewed that maintenance of normal weight or weight reduction requires a combination of regular vigorous activity and reduction in energy intake. It needs to be recognized that no intervention can be made in isolation. Policy makers need to recognise that malnutrition, both under-and overnutrition are prevalent in Lesotho and that a poor diet together with other unhealthy behaviours lead to the development of a substantial burden of chronic diseases. Secondly, it needs to be recognised

that many children and adolescents in urban Maseru and most probably Lesotho lead an unhealthy lifestyle.

To address the problem of overweight and obesity, an environment that is conducive and supportive for a multi-sectoral approach is required. The approach should include changes in policies aimed at creating a change in lifestyle behaviours of children and adolescents at schools in order to prevent overweight and obesity in children, who are likely to become obese adults.

6.2 Recommendations

Overweight and obesity are preventable. It is recognised that prevention is the most feasible option for curbing childhood obesity epidemic since current treatment practices are largely aimed at bringing the problem under control rather than affecting a cure. The goal in fighting childhood obesity is to achieve an energy balance which can be maintained throughout the individual's life span. The promotion of healthy diets and regular adequate physical activity are major factors in fighting childhood obesity.

Since schools have most access to children, they should be the area of focus in implementing intervention programmes aimed at preventing overweight and obesity. It is recommended that ministries of education and training (MOET), health and social welfare (MOHSW), and agriculture and food security (MOAFS) provide schools with health education regarding the importance of good nutrition, physical activity, and maintenance of a healthy body weight in order to avoid chronic diseases of lifestyle. Emphasis of good nutrition should focus on the importance of good eating habits, balanced meals, and eating of a variety of foods especially fruits and vegetables, legumes, whole grains and nuts. The community must also be encouraged to eat according to the recommendations, and to eat foods in season in order to achieve greater variety in the diet.

The MOHSW in collaboration with the MOET should re-introduce physical education as part of the school curriculum. This will help ensure that activity levels, especially of those children who are not engaging in any form of physical activity are increased, thus assisting in helping to reduce the risk of overweight and obesity in children. Promotion of physical activity should also be more aggressive amongst girls due to their increased risk of being sedentary as well as their increased risk of developing overweight and obesity as compared to boys.

Further research is required using the same study design on a larger sample size including adolescents from the rural areas. The study should include issues such as factors affecting the lifestyle (physical activity, eating habits) of Lesotho adolescents; number of meals eaten per day; their socio-economic status; their sources of information; and assess the consequences of overweight and obesity in the Lesotho adolescents.

Few studies are in agreement about the effects of dietary intake on the progression of overweight and obesity in children. In Lesotho there is a lack of studies that investigate the link between dietary intake and weight status, particularly amongst children. If successful intervention programmes are to be planned, further studies are needed that will determine the effects of dietary habits on weight status. It remains difficult to obtain accurate data about the dietary intakes of children and innovative methods will be necessary to assess the dietary intakes of adolescents.

In conclusion, since there has not been any study conducted in Lesotho regarding the prevalence and known risk factors for overweight and obesity, this study has provided a baseline from which other studies can be conducted. The study provides valuable information that will be useful for policy makers in the fields of health and nutrition. The study has discovered that Lesotho adolescents are at a risk of overweight and obesity. The study has further indicated a high prevalence using the WHO cut-off points. It is evident from the results of the study that a typical nutrition transition is characterised by low intakes of fibre; fruit and vegetables; variety of plant foods and calcium rich foods; but high intakes of fat and sugar, and low physical activity.

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8 APPENDICES

Appendix A	Socio-demographic data, growth history and anthropometry Questionnaire
Appendix B	Usual 24-hour dietary intake recall questionnaire
Appendix C	Food Frequency questionnaire
Appendix D	Physical Activity questionnaire
Appensix E	Knowledge, Attitude and Practices questionnaire
Appendix F[1]	Letter to Ministry of Education
Appendix F[2]	Letter for the Principal
Appendix G[1]	Consent form
Appendix G[2]	Assent form
Appendix H[1]	Information document (parent or guardian)
Appendix H[2]	Information document (participant)
Appendix I	2000 CDC percentile charts for BMI for boys
Appendix J	2000 CDC percentile charts for BMI for girlss
Appendix K	WHO percentile charts for BMI in boys
Appendix L	WHO percentile charts for BMI in girls

QUESTIONNAIRE

For Office use

ocio-demographic data, growth history questionnaire and anthropometry questionnaire

[ ][ ][ ] 1-3
[ ][ ][ ][ ][ ][ ] 4-9

. **Subject number** _____

. Date_____

[ ] 10

. Where do you stay? _____

1	School
2	Home

Anthropometric measurements

Intrauterine growth adequacy

All information in this section will be checked from the Road-to-Health record (RHC)

[ ][ ][ ][ ] 11-14

4. Birth weight _____**g**

[ ][ ][ ] 15-17

5. Birth height _____cm

[ ] 18

6.Weight history during the first 5 years of life _____

1	No malnutrition
2	Mild malnutrition
3	Moderate malnutrition
4	Severe malnutrition

[ ] 19

7. Height history during the first 5 years of life _____

1	No malnutrition
2	Mild malnutrition
3	Moderate malnutrition
4	Severe malnutrition

Current measurements

[ ][ ][ ] 20-22

8. Weight _____**kg**

[ ][ ][ ] 23-25

9. Height _____cm

Lifestyle factors questionnaire

Alcohol consumption

10. Do you drink alcohol? _____ ☐ 26

1	Yes
2	No

11. What kind of alcohol do you drink?

1	2	
Red wine _____	Yes	No	☐ 27
White wine _____	Yes	No	☐ 28
Beer _____	Yes	No	☐ 29
Liquor _____	Yes	No	☐ 30
Other, please specify_____			☐ 31

12. During the past 7 days, how many drinks of alcohol did you have of (specified in units)?

Red wine _____ ☐☐ 32-33
White wine _____ ☐☐ 34-35
Beer _____ ☐☐ 36-37
Liquor _____ ☐☐ 38-39
Other, please specify_____ ☐☐ 40-41

13. How many days per week do you drink alcohol?

_____ ☐ 42

Smoking

13. Have you ever tried smoking cigarette before? _____ ☐ 43

1	Yes
2	No

14. During the past 30 days, how many days did you smoke cigarettes?

_____ ☐☐ 44-45

Appendix B

Usual 24-hour dietary intake recall questionnaire

Please indicate quantity of intakes; time food was eaten; and method of preparation as well as any additions

Food and drinks and amounts – preparation method, additions and time consumed	Breads, cereal & legumes	Meats & meat alter-natives	Milk & Milk products	Fruit	Vegetables	Fats	Sweets & sugar
Total							

Evaluation of dietary intake:

		Interpretation of number of exchanges compared to FGP* recommendations			
Food Groups	**Nr of exchanges**	**Below (1)**	**Within (2)**	**Above (3)**	
Bread, cereal & legumes					1
Meat and alternatives					2
Milk and milk products					3
Fruit					4
Vegetables					5
Fats and sweets					6

*FGP: USDA Food Guide Pyramid

Serving recommendations according to the Food Guide Pyramid (USDA, 1992)

FOOD GROUP	NUMBER OF SERVINGS
Bread, cereal & legumes	6 – 11
Meat and alternatives	2 – 3
Milk and milk products	2 – 3
Fruit	2 – 4
Vegetables	3 – 5
Fats and sweets	Use sparingly (< 3 servings)

Calculation of energy and macronutrient intakes:

Food Groups	Nr of exchanges	Energy	Carbohydrate	Protein	Fat
Bread, cereal & legumes		**285**	**15**	**3**	
Meat and alternatives		**315**		**7**	**5**
Milk and milk products: Full cream		**640**	**12**	**8**	**8**
Milk and milk products: Low fat (1.5-2%)		**530**	**12**	**8**	**5**
Milk and milk products: Skimmed		**340**	**12**	**8**	**-**
Fruit		**285**	**15**	**-**	**-**
B Vegetables		**150**	**7**	**2**	**-**
A Vegetables		**-**	**-**	**-**	**-**
Fats		**190**	**-**	**-**	**5**
Sweets / sugar		**170**	**10**	**-**	**-**
Alcohol	(ml)	**29kJ/ml**			

Estimated total values calculated above:

Carbohydrate (g) _____

Protein (g) _____

Fat (g) _____

Energy (kJ) _____

	8 -10
	11-13
	14-16
	17-21

Food Frequency Questionnaire
Instructions:

In this questionnaire please indicate only one option (per day / per week / per month / per season).

Food	/day	/week	/month	/season	
Chicken					24 - 31
Bacon/ polony/ vienna/ ham					32 - 39
Eggs					40 - 47
Cheese					48 - 55
Peas, beans, lentils, soya beans					56 - 63
Full cream milk					64 - 71
Yoghurt					72 - 79
Ice cream					1 - 8
Fruit fresh/ dried					9 - 16
Fruit juice					17 - 24
Fresh/ frozen vegetables					25 - 32
Cereal					33 - 40
Cakes/ muffins/ scones/ puddings					41 - 48
Brown/ white bread					49 - 56
Maize meal pap					57 - 64
Rice/ mealie rice					65 - 72
Samp					73 - 80
Fast foods/ tuckshop					1 - 8
Simba chips					9 - 16
Peanuts/ nuts					17 - 24
Butter/ margarine/ oil					25 - 32
Salad dressing/ mayonnaise					33 - 40
Sugar					41 - 48
Sweets/ chocolates					49 - 56
Coffee creamer					57 - 64
Fizzy drinks					65 - 72
Cold drinks eg. Oros					73 - 80
Beer/ wine					1 – 8
Supplements (specify)					9 - 16
Water					17 - 24
Chips					25 - 32
Coffee creamer					33 - 40
Jam					41 - 48
Low fat milk/ skim					49 - 56
Peanut butter					57 - 64
Fish					65 - 72
Red meat					73 - 80
Pasta					1 - 8
Salt					9 - 16
Motoho					17 - 24
Poone					25 - 32
Theepe					33 - 40
Lesheleshele					41 - 48

Likahare					49 - 56
Mafi					57 - 64
Lepu					65 - 72
Moroho					73 - 80
Poone					1 - 8
Theepe					9 - 16
Serue					17 - 24
Bobatsi					25 - 32
Wild veg (please specify)					33 - 40
Wild fruits (please specify)					41 - 48
Traditional beer (please specify)					49 - 56
Traditional dishes (please specify)					57 - 64
Pop corn					65 - 72
Lunch box					73 - 80

Remarks:

NOTE: For this part, participants will state what foods they buy at fast-foods shops and/or tuck-shops; what foods they take in the lunch-box; and supplements they are using if there are any.

Physical activity questionnaire

In this questionnaire the researcher is interested in finding out about the kinds of physical activities the participants do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days.** Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at school, as part of your house and yard work; to get from place to place; and in your spare time for recreation, exercise or sport.

Think all about the **vigorous** and **moderate** activities that you did in the **last 7 days. Vigorous** physical activities refer to activities that take hard physical effort and make you breath much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

NOTE: Fill in the answers in the spaces provided.

For Office Use

1. During the past 7 days, on how many days did you do vigorous physical activities (that made you breathe hard and sweat) such as soccer, netball, basketball, volleyball and running, for at least 20 minutes at a time? _____ | ☐ 1

2. During the past 7 days, on how many days did you do moderate physical activities (that did not make you breathe hard and sweat) such as walking, slow bicycling, pushing a lawn mower, mopping, polishing or sweeping the floor, for at least 30 minutes at a time? _____ | ☐☐ 2-3

3. How many hours do you watch TV a day? _____ | ☐☐ 4-5

4. How many hours do you play video or computer games or use a computer? (Include activities such as play station, computer games and the internet) _____ | ☐☐ 6-7

Appendix E

Knowledge, Attitude and Practices Questionnaire
NOTE: Fill in the answers in the space provided.
Questions below determine knowledge of participants in nutrition. To answer, participants will give the following responses: 1 = True, 2 = False, 3 = Do not know

1. Most nutrients are lost during the cooking. _____ | | 1
2. Nutrient losses from fruits and vegetables can occur as a result of long storage. _____ | | 2
3. Maize porridge is a very good source of vitamins and minerals. _____ | | 3
4. Healthy foods help to protect the body against illness. _____ | | 4
5. Eating a lot of different kinds of food is healthier than eating only a few kinds of food. ___ | | 5
6. You should eat a lot of sugar to have energy. _____ | | 6
7. Your body only needs a little bit of salt a day to be healthy. _____ | | 7
8. Sugar contains vitamins and minerals. _____ | | 8
9. Dry beans, peas and lentils are a healthy choice to eat in place of meat. _____ | | 9
10. Soya mince is as healthy as meat. _____ | | 10
11. It is not healthy for pregnant women to drink alcohol. _____ | | 11
12. Drinking a lot of beer and wine can make you put on weight. _____ | | 12
13. Eat at least three meals a day. _____ | | 13
14. Eating breakfast every morning is healthy. _____ | | 14

b) Questions below determine attitude of participants regarding nutrition. To answer, participants will give the following responses: 1 = Agree, 2 = Disagree, 3 = Do not know

15. I only buy food that is good for my body. _____ | | 15
16. I eat what I like, and do not really care if it is healthy or not. _____ | | 16
17. I have a right to buy foods that are healthy for my body. _____ | | 17
18. I only buy food that I can afford. _____ | | 18
19. I do not need to care about eating healthy food if I keep my body weight constant. _____ | | 19
20. I believe that the food I eat now will affect my health in future. _____ | | 20
21. I just do not have the time to think about food and nutrition. _____ | | 21
22. I do not have to care about food unless the doctor/ nursing sister talks about it. _____ | | 22

c) Questions below determine practices of participants regarding nutrition. To answer, participants will give the following responses: 1=Regularly, 2=Occasionally, 3=Never

23. Do you eat five vegetables and fruits a day? _____ | | 23
24. Do you eat dry beans, split peas, lentils, soya products 2 or more times a week? _____ | | 24
25. Do you drink water in between meals? _____ | | 25
26. Do you drink cold drink or fizzy drinks every day? _____ | | 26
27. Do you eat cake, pastries or biscuits in between meals every day? _____ | | 27
28. Do you add salt to your food at table? _____ | | 28
29. Do you like to add sugar to vegetables in the cooking process? _____ | | 29
30. Do you like to add butter to cooked vegetables? _____ | | 30
31. Do you often buy take-away foods (every week)? _____ | | 31

d) Questions below determine attitude towards obesity. To answer, participants will give the following responses: 1 = True, 2 = False, 3 = Do not know

32. Fat people have more friends. _____ 32
33. Children do not like their mothers to be fat. _____ 33
34. Fat people cannot work hard. _____ 34
35. Men prefer fat women. _____ 35
36. Fat people feel unhappy. _____ 36
37. People who eat healthy food are thin. _____ 37
38. If one exercises daily, one feels healthy. _____ 38
39. I enjoy bodily exercise. _____ 39
40. It is difficult to lose weight. _____ 40
41. If one looses weight, one looks unattractive with loose skin. _____ 41

e) Questions below test if participants have knowledge in the causes of obesity. To answer, participants will give the following responses: 1 = True, 2 = False, 3 = Do not know

42.If one eats late in the evening, one is likely to get fatter. _____ 42
43. Fat on meat does not make fatter. _____ 43
44. Lots of sugar in tea makes one fatter. _____ 44
45. Lots of oil and fat in food make one fatter. _____ 45
46. When one drinks a lot of water, one eats less. _____ 46

f) Questions below test if participants have knowledge in the relationship between obesity and health. To answer, participants will give the following responses: 1 = True, 2 = False, 3 = Do not know

47. Thin people get more sugar diabetes than fat people. _____ 47
48. More fat people than thin people suffer from high blood pressure. _____ 48
49. Thin people get tired easier than fat people. _____ 49
50. When one eats a lot of fat in food, one feels comfortable. _____ 50
51. Fat people with sugar diabetes become healthier when they lose weight. _____ 51
52. Thin women do not get pregnant easily. _____ 52

Appendix F[1]

Date
The Chief Inspector
Ministry of Education
P.O. Box 547
Maseru.

Dear Sir/Madam,

Re: Permission to perform a research study at secondary/ high schools in urban Maseru

I am currently a student registered for Masters Degree in Nutrition in the Department of Human Nutrition at the University of the Free State. I hereby apply for permission to undertake a study at secondary and or high schools in the urban Maseru area titled **"Prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru".**

The purpose of this study is to determine the prevalence of overweight and obesity and the known risk factors that contribute to both overweight and obesity in adolescents. The parents, adolescents, Ministry of Education and the Ministry of Health will benefit from the findings generated from this study since it will be used to plan relevant intervention programs.

The evaluation will involve the following:

1. An interview will be conducted with only the selected students. Three questionnaires will be completed regarding diet history, lifestyle, and knowledge, attitude and practices in nutrition.
2. Body weight and height will be measured.
3. Participants will be asked to bring their Road-to-Health Charts.

The study will be submitted for approval to an Evaluation Committee of the faculty of Health Sciences as well as the Ethics Committee of the faculty of Health Sciences at the University of the Free State. All information will be kept strictly confidential, and no information will be used for purposes other than the research project. The respondent's decision to participate is voluntary and they are allowed to withdraw from the study at any time.

Sincerely,

_____

Lisemelo Seheri (2006113811)
M Nutrition student

Appendix F[2]

Date
The Principal
Dear Sir/Madam,

Re: Permission to perform a research study at your school

I am currently a student registered for Masters Degree in Nutrition in the Department of Nutrition and Dietetics at the University of the Free State. I wish to apply for permission to undertake a study at your school titled **"Prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru".**

The purpose of this study is to determine the prevalence of overweight and obesity, the known risk factors that contribute to overweight and obesity in adolescents. The parents, adolescents, parents, Ministry of Education and the Ministry of Health will benefit from the findings generated from this study since it will be used to plan relevant intervention programs.

The evaluation will involve the following:

1. A face-to-face interview will be conducted with only the selected students. Three questionnaires will be completed regarding dietary intake, lifestyle and knowledge, attitude and practices in nutrition.
2. Body weight and height will be measured.
3. Participants will be asked to bring their Road-to-Health Charts (RHC).

The research study will be submitted for approval to an Evaluation Committee as well as the Ethics Committee of the faculty of Health Sciences at the University of the Free State. All information will be kept strictly confidential, and no information will be used for purposes other than the research project. The respondent's decision to participate is voluntary and they are allowed to withdraw from the study at any time. No compensation will be given to participants, but participants who remember to bring their RHC will receive an incentive (peanuts and raisins and a small box of juice).

There will be one contact session with each student when administering the questionnaire. Reliability interviews will be conducted one month after the initial interview.

Sincerely,

Lisemelo Seheri (2006113811)
M Nutrition student

Appendix G[1]

CONSENT TO PARTICIPATE IN THE RESEARCH

Informed Consent Respondent number_____

Research: Prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru

The purpose of this study is to determine the prevalence of overweight and obesity, and known risk factors that contribute to overweight and obesity in adolescents. The parents, adolescents, Ministry of Education and the Ministry of Health will benefit from the findings generated from this study since it will be used to plan relevant intervention programs.

The Ethics Committee of the Faculty of Health Sciences has approved the study and its procedures. The procedures involved will not expose you to any physical or psychological harm, nor will you be subjected to unusual stress, embarrassment or lose self- esteem.

The procedure will include the following:

1. Three questionnaires regarding dietary intake, lifestyle and knowledge, attitude and practices in nutrition will be completed.
2. Body weight and height will be measured.
3. Participants will be asked to bring their Road-to Health Charts

Above measurements will require you to empty your bladder and wear light clothes. An interview with each participant will take approximately 1 hour.

Data will be collected by the researcher and stored in a secure place and will not be shared with any person without your permission.

Your participation in this study is voluntary and you have the right to withdraw at any time. There is no compensation for participating in this study, but participants who remember to bring their RHC will receive an incentive (peanuts and raisins and a small box of juice). Should any health problem be identified, you will be referred to the relevant health care professional.

Your identity will not be revealed to anyone while the study is being conducted or when the study is reported or published. Questions regarding the study may be directed to the investigator at any time to the following numbers: +27 730237656 or +266 63013639.

I have read this consent form and voluntarily consent to participate in this study.

Subject's signature_____ Date_____

Parent's signature_____ Date_____

Witness's signature_____ Date_____

Appendix G[2]

ASSENT TO PARTICIPATE IN THE RESEARCH

Respondent number_____

Dear Participant,

Research: Prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru

You are kindly invited to participate in this study. You have been informed about the study by Lisemelo Seheri, a student at the University of the Free State (UFS).

The Evaluation committee of the school of Allied professionals and the Ethics Committee of the Faculty of Health Sciences has approved the study and its procedures. The procedures involved will not expose you to any physical or psychological harm, nor will you be subjected to unusual stress, embarrassment or loss of self- esteem.

The procedure will include the following:

1. An interview during which questionnaires regarding socio demographic data, lifestyle factors, dietary intake, physical activity and knowledge, attitude and practices in nutrition will be completed.
2. Body weight and height will be measured.
3. Participants will be asked to bring their Road-to Health Charts (RHC) to assess their growth history.

Above measurements will require you to empty your bladder and wear light clothes. An interview with each participant will take approximately 1 hour. Data will be collected by the researcher and stored in a secure place and will not be shared with any person without your permission.

Your participation in this study is voluntary and you have the right to withdraw at any time without any penalties. There is no compensation for participating in this study, but participants who remember to bring their RHC will receive an incentive (peanuts and raisins and a small box of juice). There are no costs required from you for participating in the study. Should any health problem be identified, you will be referred to the relevant health care professional.

Your identity will not be revealed to anyone while the study is being conducted or when the study is reported or published. Questions regarding the study may be directed to the investigator at any time to the following numbers: +27 730237656 or +266 63013639.

The research study, including the above information has been verbally described to me. I understand my involvement in the study and voluntarily agree to participate.

Subject's signature_____ Date_____

Witness's signature_____ Date_____

INFORMATION DOCUMENT

Study title: Prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru

Dear Parent/Guardian,

I, Lisemelo Seheri a student at the University of the Free State, is pursuing a Masters Degree in Nutrition in the Department of Nutrition and Dietetics. I am doing a research on the study title stated above. The purpose of this study is to identify the prevalence of overweight and obesity and the known risk factors among adolescents in urban Maseru. The findings of this study will provide baseline data that could be used by individuals, health care teams and/or the Government of Lesotho to design programmes to address the identified problems.

A descriptive study will be conducted from January 2010 to April 2010. There will be 251 participants in all, selected from 10 schools in urban Maseru. There are four (2 boys and 2 girls) Sesotho speaking students who will participate in the pilot study from the school excluded in the main study in November 2009. Adolescents participating in the study are adolescents aged 16 years and are in Form 4. The standard procedures involve a structured interview in private with the trained researcher. A reliability interview will be conducted a month after conducting the main data collection with 10% of the same sample.

I am inviting your child to participate in a research study. The procedure will include the following:

1. An interview during which questionnaires regarding socio demographic data, dietary intake, lifestyle factors, physical activity and knowledge, attitude and practices in nutrition will be completed.
2. Body weight and height will be measured.
3. Participants will be asked to bring their Road-to Health Charts (RHC) to assess their growth history.

An interview with each participant will take approximately 1 hour. These interviews will be conducted during school hours but will not interfere with the school's daily activities. The researcher will schedule times for interviews with the Principal.

The study procedures involve no foreseeable risks or harm to participants. Participation is voluntary and refusal to participate will involve no penalty. Participants have the right to withdraw from the study at any time and without any penalties. No compensation will be given to participants, but participants who remember to bring their RHC will receive an incentive (peanuts and raisins and a small box of juice).

Efforts will be made to keep personal information confidential. Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law.

The results may be published but the participant will remain anonymous.

Questions regarding the study may be directed to the researcher at any time at the following numbers +27 730237656 or +266 63013639 and/or the Secretariat of the Ethics Committee of the Faculty of Health Sciences, UFS, Ms Strauss +2751 4052812.

Appendix H[2]

INFORMATION DOCUMENT

Study title: Prevalence and known risk factors for overweight and obesity in adolescents in urban Maseru

Dear Participant,

I, Lisemelo Seheri a student at the University of the Free State, is pursuing a Masters Degree in Nutrition in the department of Nutrition and Dietetics are doing a research on the study title stated above. The purpose of this study is to identify the prevalence of overweight and obesity and the known risk factors among adolescents in urban Maseru. The findings of this study will provide baseline data that could be used by individuals, health care teams and/or the Government of Lesotho to design programmes to address the identified problems.

A descriptive study will be conducted from January 2010 to April 2010. There will be 251 participants, selected from 10 schools in urban Maseru. There are four (2 boys and 2 girls) Sesotho speaking students who will participate in the pilot study from the school excluded in the main study in November 2009. Adolescents participating in the study are aged 16 years and in Form 4. The standard procedures involve a structured interview in private with the trained researcher, where you will be expected to answer questions set and your body measurements will be assessed. You are expected to be in the study until July 2010 when it will be submitted for evaluation. A reliability interview will be conducted a month after conducting the main data collection with 10% of the same sample.

I am inviting you to participate in a research study. The procedure will include the following:

1. An interview during which questionnaires regarding socio demographic data, dietary intake, lifestyle factors, physical activity and knowledge, attitude and practices in nutrition will be completed.
2. Body weight and height will be measured.
3. Participants will be asked to bring their Road-to Health Charts (RHC) to assess their growth history.

An interview with each participant will take approximately 1 hour. These interviews will be conducted during school hours but will not interfere with the school's daily activities. The researcher will schedule times for interviews with the Principal.

The study procedures involve no foreseeable risks or harm to participants. Participation is voluntary and refusal to participate will involve no penalty. Participants have the right to withdraw from the study at any time and without any penalties. No compensation will be given to participants, but participants who remember to bring their RHC will receive an incentive (peanuts and raisins and a small box of juice).

As a participant you will be given relevant information on the study while involved in the project and after the results are available. There will be no personal results issued since efforts will be made to keep personal information confidential.

Efforts will be made to keep personal information confidential. Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law.

The results may be published but the participant will remain anonymous.

Questions regarding the study may be directed to the researcher at any time at the following numbers +27 730237656 or +266 63013639 and/or the Secretariat of the Ethics Committee of the Faculty of Health Sciences, UFS, Ms Strauss +2751 4052812.

Appendix F[1a]

Letsatsi: _____

Mohlahlobi e moholo oa likolo

Lekala la Thuto

P.O. Box 547

Maseru

Monghali/ Mofumahali,

Tumello ea ho etsa liphuputso likolong teropong ea Maseru

Ke ntse ke ithutela lengolo la Master's Degree fapheng la Phepo e Nepahetseng le Melaoana ea Lijo (Nutrition and Dietetics) Unifesithing ea Foreistata (University of the Free State) 'me ke kopa ho fuoa tumello ea ho fuputsa har'a barutuoa ba likolo tse phahameng (High schools) toropong ea Maseru. Sehlooho sa litaba ke: **Ngatafalo ha bacha ba nang le mononohali le botenya bo makatsang le mabaka a tsejoang a bakang boemo bona har'a bacha toropong ea Maseru.**

Sepheo sa liphuphutso tsena, ke ho fumana ho ata ha bacha ba nang le bothata bona; le mabaka a tsejoang a bakang mononohali le botenyahali bo sa tloaelehang. Manollo ea tsena e tla thusa batsoali, Lekala la Thuto le la Bophelo hobane sepheto sa liphuputso se tla thusa makala ana ho ntlafatatsa meralo moo ho nang le sekheo mabapi le phepo.

Ho seka-seka litaba tsa barutuoa ba khethiloeng:

1. Ho tla ba le puisano le barutuoa ba khethiloeng 'me ba tla botsoa lipotso tse mekhahelo e meraro (3). Lipotso tsena li reretsoe ho bonts'a nalana ea lijo, tloaelo, tsebo, litsekamelo le tseo tloaetseng ho li etsa mabapi le phepo.
2. Boima le bolele ba barutuoa ba khethiloeng bo tla nkuoa.
3. Barutuoa bana ba tla koptjoa ho tla le libukana tsa bophelo (Road-to-heath Charts)

Sepheo sa phuputso se tla isoa ho Komiti e seka-sekang ts'ebetso ea baithuti kapa ea lihlahlobo (Evaluation Committee) ea Lefapha la tsa Bophelo le Mahlale (Health Sciences) esitana le Komiti ea Melao le Melaoana ea Batho (Ethics committee) ea lefapha la Bophelo le Mahlale (Health Sciences). Tsohle tsa litaba tse amanang le barutuoa ba botsitsoeng lipotso e tla ba lekunutu. Ha ho le e 'ngoe ea litaba tsena e ka sebelisoang ka thoko ntle le tsa phuputso ena (research). Morutuoa o ikhethela ho emisa ha a rata. Ha ho letho leo barutuoa ba le fuoang. Hona ke ho bolela hore ha ho limpho tseo ba tlang ho li fuoa.

Ho tla ba le puisano le morutuoa ka 'ngoe ho botsa lipotso. Ho tla boela ho e-ba le puisano ka mor'a khoeli. Sepheo e tla ba ho nonya bonnete ba taba tseo ba faneng ka tsona sethatong; empa hona ho tla etsahala karolong e itseng ea baithuti e seng ho bona kaofela.

Ka boikokobetso,

Lisemelo Seheri (2006113811)

Moithuti oa tsa Phepo e Nepahetseng

Khomeletso ea F[2a]

Letsatsi: _____

Mosuoe-hooho

Monghali/ Mofumahali,

Tumello ho etsa phuputso sekolong sa hao

Ha joale Ke ntse ke ithutela lengolo la Master's Degree fapheng la Phepo e Nepahetseng le Melaoana ea Lijo (Nutrition and Dietetics) Unifesithing ea Foreistata (University of the Free State) 'me ke kopa ho fuoa tumello ea ho fuputsa har'a barutuoa ba likolo tse phahameng (High schools) toropong ea Maseru. Sehlooho sa litaba ke: **Ngatafalo ha bacha ba nang le mononohali le botenya bo makatsang le mabaka a tsejoang a bakang boemo bona har'a bacha toropong ea Maseru.**

Sepheo sa liphuphutso tsena, ke ho fumana ho ata ha bacha ba nang le bothata bona; le mabaka a tsejoang a bakang mononohali le botenyahali bo sa tloaelehang. Manollo ea tsena e tla thusa batsoali, Lekala la Thuto le la Bophelo hobane sepheto sa liphuputso se tla thusa makala ana ho ntlafatatsa meralo moo ho nang le sekheo mabapi le phepo.

Ho seka-seka litaba tsa barutuoa ba khethiloeng:

4. Ho tla ba le puisano le barutuoa ba khethiloeng 'me ba tla botsoa lipotso tse mekhahelo e meraro (3). Lipotso tsena li reretsoe ho bonts'a nalana ea lijo, tloaelo, tsebo, litsekamelo le tseo tloaetseng ho li etsa mabapi le phepo.
5. Boima le bolele ba barutuoa ba khethiloeng bo tla nkuoa.
6. Barutuoa bana ba tla koptjoa ho tla le libukana tsa bophelo (Road-to-heath Charts)

Sepheo sa phuputso se tla isoa ho Komiti e seka-sekang ts'ebetso ea baithuti kapa ea lihlahlobo (Evaluation Committee) ea Lefapha la tsa Bophelo le Mahlale (Health Sciences) esitana le Komiti ea Melao le Melaoana ea Batho (Ethics committee) ea lefapha la Bophelo le Mahlale (Health Sciences). Tsohle tsa litaba tse amanang le barutuoa ba botsitsoeng lipotso e tla ba lekunutu. Ha ho le e 'ngoe ea litaba tsena e ka sebelisoang ka thoko ntle le tsa phuputso ena (research). Morutuoa o ikhethela ho emisa ha a rata. Ha ho letho leo barutuoa ba le fuoang. Hona ke ho bolela hore ha ho limpho tseo ba tlang ho li fuoa.Barutoana ba tla tla le libukana tsa bophelo, ba tla lebouoa ka senoamapholi le makotomane.

Ho tla ba le puisano le morutuoa ka 'ngoe ho botsa lipotso. Ho tla boela ho e-ba le puisano ka mor'a khoeli. Sepheo e tla ba ho nonya bonnete ba taba tseo ba faneng ka tsona sethatong; empa hona ho tla etsahala karolong e itseng ea baithuti e seng ho bona kaofela.

Ka boikokobetso,

Lisemelo Seheri (2006113811)

Moithuti oa tsa Phepo e Nepahetseng

Khomeletso ea G[2a]

Nomoro ea moithaopi: _____

Foromo ea tumelo

Sehlooho: **Ho ngatafala le mabaka a tsejoang a bakang mononohali le botenyahali har'a bacha toropong ea Maseru.**

Sepheo sa phuphutso (research) ena ke ho fumana bongata ba bacha ba nang le bothata ba mononohali le botenya. Batsoali, bacha, Lekala la Thuto le la Bophelo ba tla fumana molemo ho sephetho sa phuphutso ena hobane ho ka raloa tse tlang ho thibela le ho loants'a bothata ba 'mele o moholohali o atileng lefats'eng ka bophara.

Komiti ea melaoana ea Botho (Ethics committee) ea Lefapha la Bophelo le Mahlale (Faculty of Health Sciences) le fane ka tumello ea hore phuphutso e tsoele pele. Ha ho le joalo ts'ebetso ena e keke ea tlisa khatello ea letho 'mellng esitana le kelellong. E ke ke ea sithabetsa maikutlo, ea tlisa ho itsaba le ho tlosa seriti sa motho.

Tsebetso e tla latela methati ena:

1. Lipotso li tla ba karolo li tharo (3) tse amanang le lijo, tloaelo, tsebo le ts'ekamelo etsoang mabapi le phepo.
2. Ho tla fumanoa boima le bolele ba barutuoa ba khethiloeng.
3. Barutuoa ba ts'oanela ho tla le libukana tsa Bophelo (road-to-heath /charts

Ntlha ea boima le bolele e hloka hore pele ho ts'ebetso ena, motho a etse ts'ets'e/ lesoe (empty the bladder), a apare phahlo tse bobebe. Puisano e tla nka nako e etsang hora e le 'ngoe le motho ka 'ngoe. Motho o na le bolokolohi ho botsa potso efe kapa efe ha feela e amana le phuphutso'me he, motho a ka letsetsa Mofumahatsana Seheri nomorong ena: 63013639 neng kapa neng.

Pampiri tsa taba tsa moithaopi ka mong, li tla phuthoa le ho bolokoa ke mofupotsi (researcher). Pampiri tsena li tla bolokoa ka hloko 'me ha ho motho ea ka li baling ntle le mofupotsi.

Ho Kenya letsoho ts'ebetsong ke boikhethelo ba motho. Motho a ka itokolla haeba a khetha joalo. Limpho/ lipabi ha li eo ho hang. Haeba ho fumaneha motho a na le bothata bo itseng ba bophelo, o tla fetisetsoa ho lingaka tse ka fanang ka pheko/ kapa a fumantsoa thuso ho bo-maphepo. Barutoana ba tla tla le libukana tsa bophelo, ba tla lebouoa ka senoamapholi le makotomane.

Mabitso a ke ke a bonts'oa kapa a phatlalatsoa ha phuputso e ntse e tsoela pele kapa ha sephetho se hasitsoe. Lipotso tse amanang le sehlooho sa litaba (moko-taba) li ka lebisoa ho mofuputsi nomorong tse latelang: +27730237656 kapa +26663013639.

Ke balile litaba tsena 'me ke ikhethela ho Kenya letsoho tabeng ena ea phuputso.

Motekeno oa moithaopi _____ Letsatsi _____

Motekeno oa motsoali_____ Letsatsi_____

Motekeno oa paki _____ Letsatsi_____

Appendix H[1a]

TOKOMANE E HLALOSANG PHUPUTSO

Sehlooho: Ngatafalo ha bacha ba nang le mononohali le botenya bo makatsang le mabaka a tsejoang a bakang boemo bona har'a bacha toropong ea Maseru

Motsoali kapa Moikarabelli,

'Na, Lisemelo Seheri moithuti unifesithing ea Foreistata , ke ithutela Masters Degree ea phepo e nepahetseng fapheng la Phepo e Nepahetseng le Melaoana ea Lijo. Karolo ea thuto ena ke ho etsa phuputso ka sehlooho boletsoeng ka holimo ho taba tsena.

Phuputso ena e qala ka Pherekhong ho isa 'Mesa selemong sa 2010. Phuputso ena e tlo hlalosa ngatafalo ha bacha ba nang le mononohali le botenya bo makatsang le mabaka a tsejoang a bakang boemo bona har'a bacha toropong ea Maseru. Phuputso e tlo etsuoa holima baithuti ba 251 ba khethuoeng likolong tse leshome holima tse mashome a mabeli tse oelang teropong ea Maseru. Baithuti bana ba tlameha ho ba lilemo tse 16 'me ba kena sehlopheng sa bone (Form 4). Baithuti ba botosa lipotso ke mofutsi lekunutung. Ho tla botsoa moithuti ka mong. Mofuputsi o tla boela a nke boima le bolelele ba moithuti ka mong. Moithuti o tla kena phuputsong ena ho fihlela khoeling ea Phupu selemong sa 2010. Ho tla boetse ho e ba le puisano ka mora khoeli le baithuti ba leshome feela lekhong la lenane (10%). Sepheo e tla ba ho nonya bonnete ba taba tseo ba faneng ka tsona sethatong.

Ka hoo, ke memela ngoana ua hau ho tla nka karolo phuputsong ena. Ho seka-seka litaba tsa barutuoa ba khethiloeng:

1. Ho tla ba le puisano le barutuoa ba khethiloeng 'me ba tla botsoa lipotso tse mekhahelo e meraro (3). Lipotso tsena li reretsoe ho bonts'a nalana ea lijo, tloaelo, tsebo, litsekamelo le tseo tloaetseng ho li etsa mabapi le phepo.
2. Boima le bolele ba barutuoa ba khethiloeng bo tla nkuoa.
3. Barutuoa bana ba tla koptjoa ho tla le libukana tsa bophelo (Road-to-heath Charts) ho tla hlahloba kholo ea bona bongoaneng.
4.

Phuputso le moithuti ka mong e nka bonyane hora (1 hour). Phuputso ena e etsoa nakong ea sekolo 'me sena ha se bolele hore morutuoa o tla nts'uoa ka sekelong. Nako ea phuputso e tla lokisoa ke mosuoe-hlooho 'moho le mofuputsi ho netefatsa hore barutuoa ba bonoa ka nako eo bas eng ka sekolong. Litaba tsa phuputso ena lit la bolokoa ka mokhoa o bolokehileng ke mofuputsi oa litaba, 'me ha li na aroleloana le mang kapa mang, e tla ba lekunutu la mofuputsi.

Morutoana o bolokolohing ba ho lumela kapa ho hana ho ba karolo ea barutoana ba tla fuputsoa, 'me a ka itokolla nako eohle ho se kotlo ea letho. Phuputso ena ha e behe bophelo ba moithuti ofe kapa ofe kotsing.

Ha ho letho leo barutoana ba lebeletseng ho le patala ha ba nka karolo phuputsong ena. Hape ha ho letho leo ba tlang ho le fuoa, ntle la barutoana ba tla hoopla ho tla le libukana tsa bophelo; bona ba tla fuoa paketana ea makotomane le lero la litholoana (juice).

Moithuti ea ikhethetseng ho nka karolo, o tla fuoa tokomane e hlalosang phuputso ena. Ha ho na letho le amanang le moithuti ka mang leo tla le fuoa mabapi le tlitaba tsa phuputso. Litaba tsa phuputso ena e tla ba lekunutu la mofuputsi.

Liataba tsena li ka 'na tsa phatlalatsoa empa mabitso a baithaopi ba nkileng karolo a ke ke a phatlalatsoa.

Lipotso mabapi le phuputso ena li etsoe ho mofuputsi oa litaba nomorong tse latelang: +27 730237656 kapa +266 63013639 kapa ho Mofumahali Strauss ea fumanehang ofising ea melao le melaoana ea batho lefapheng la Bophelo le Mahlale, Unifesithing ea Foreistata nomorong e latelang +2751 4052812.

Appendix H^{2a}

TOKOMANE E HLALOSANG PHUPUTSO

Sehlooho: Ngatafalo ha bacha ba nang le mononohali le botenya bo makatsang le mabaka a tsejoang a bakang boemo bona har'a bacha toropong ea Maseru

Moithuti,

'Na, Lisemelo Seheri moithuti unifesithing ea Foreistata , ke ithutela Masters Degree ea phepo e nepahetseng fapheng la Phepo e Nepahetseng le Melaoana ea Lijo. Karolo ea thuto ena ke ho etsa phuputso ka sehlooho boletsoeng ka holimo ho taba tsena.

Phuputso ena e qala ka Pherekhong ho isa 'Mesa selemong sa 2010. Phuputso ena e tlo hlalosa ngatafalo ha bacha ba nang le mononohali le botenya bo makatsang le mabaka a tsejoang a bakang boemo bona har'a bacha toropong ea Maseru. Phuputso e tlo etsuoa holima baithuti ba 251 ba khethuoeng likolong tse leshome holima tse mashome a mabeli tse oelang teropong ea Maseru. Baithuti bana ba tlameha ho ba lilemo tse 16 'me ba kena sehlopheng sa bone (Form 4). Baithuti ba botosa lipotso ke mofutsi lekunutung. Ho tla botsoa moithuti ka mong. Mofuputsi o tla boela a nke boima le bolelele ba moithuti ka mong. Moithuti o tla kena phuputsong ena ho fihlela khoeling ea Phupu selemong sa 2010. Ho tla boetse ho e ba le puisano ka mora khoeli le baithuti ba leshome feela lekhong la lenane (10%). Sepheo e tla ba ho nonya bonnete ba taba tseo ba faneng ka tsona sethatong.

Ka hoo, ke memela ngoana ua hau ho tla nka karolo phuputsong ena. Ho seka-seka litaba tsa barutuoa ba khethiloeng:

1. Ho tla ba le puisano le barutuoa ba khethiloeng 'me ba tla botsoa lipotso tse mekhahelo e meraro (3). Lipotso tsena li reretsoe ho bonts'a nalana ea lijo, tloaelo, tsebo, litsekamelo le tseo tloaetseng ho li etsa mabapi le phepo.
2. Boima le bolele ba barutuoa ba khethiloeng bo tla nkuoa.
3. Barutuoa bana ba tla koptjoa ho tla le libukana tsa bophelo (Road-to-heath Charts) ho tla hlahloba kholo ea bona bongoaneng.

Phuputso le moithuti ka mong e nka bonyane hora (1 hour). Phuputso ena e etsoa nakong ea sekolo 'me sena ha se bolele hore morutuoa o tla nts'uoa ka sekelong. Nako ea phuputso e tla lokisoa ke mosuoe-hlooho 'moho le mofuputsi ho netefatsa hore barutuoa ba bonoa ka nako eo bas eng ka sekolong. Litaba tsa phuputso ena lit la bolokoa ka mokhoa o bolokehileng ke mofuputsi oa litaba, 'me ha li na aroleloana le mang kapa mang, e tla ba lekunutu la mofuputsi.

Morutoana o bolokolohing ba ho lumela kapa ho hana ho ba karolo ea barutoana ba tla fuputsoa, 'me a ka itokolla nako eohle ho se kotlo ea letho. Phuputso ena ha e behe bophelo ba moithuti ofe kapa ofe kotsing.

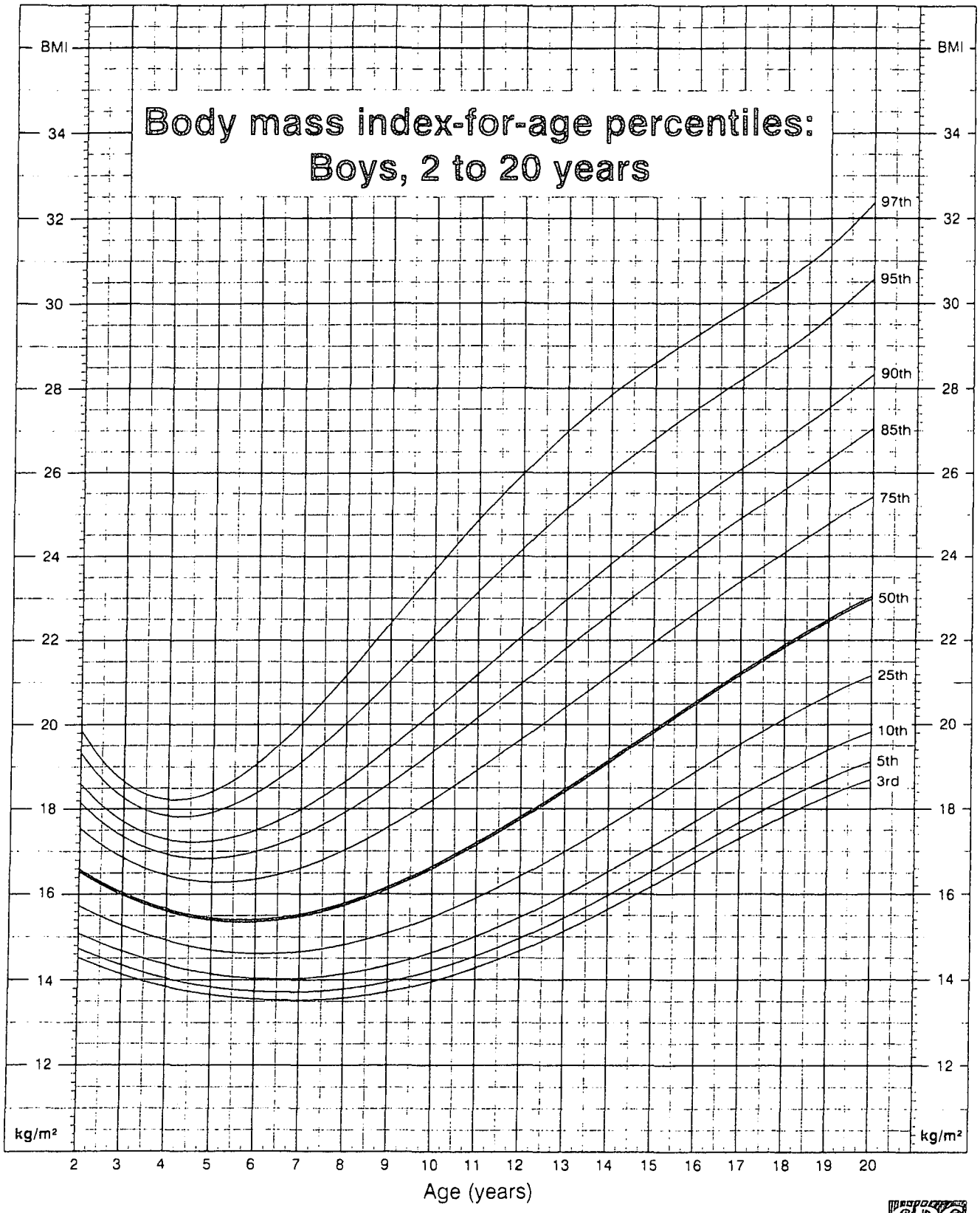
Ha ho letho leo barutoana ba lebeletseng ho le patala ha ba nka karolo phuputsong ena. Hape ha ho letho leo ba tlang ho le fuoa, ntle la barutoana ba tla hoopla ho tla le libukana tsa bophelo; bona ba tla fuoa paketana ea makotomane le lero la litholoana (juice).

Moithuti ea ikhethetseng ho nka karolo, o tla fuoa tokomane e hlalosang phuputso ena. Ha ho na letho le amanang le moithuti ka mang leo tla le fuoa mabapi le tlitaba tsa phuputso. Litaba tsa phuputso ena e tla ba lekunutu la mofuputsi.

Liataba tsena li ka 'na tsa phatlalatsoa empa mabitso a baithaopi ba nkileng karolo a ke ke a phatlalatsoa.

Lipotso mabapi le phuputso ena li etsoe ho mofuputsi oa litaba nomorong tse latelang: +27 730237656 kapa +266 63013639 kapa ho Mofumahali Strauss ea fumanehang ofising ea melao le melaoana ea batho lefapheng la Bophelo le Mahlale, Unifesithing ea Foreistata nomorong e latelang +2751 4052812.

CDC Growth Charts: United States



Published May 30, 2000.
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

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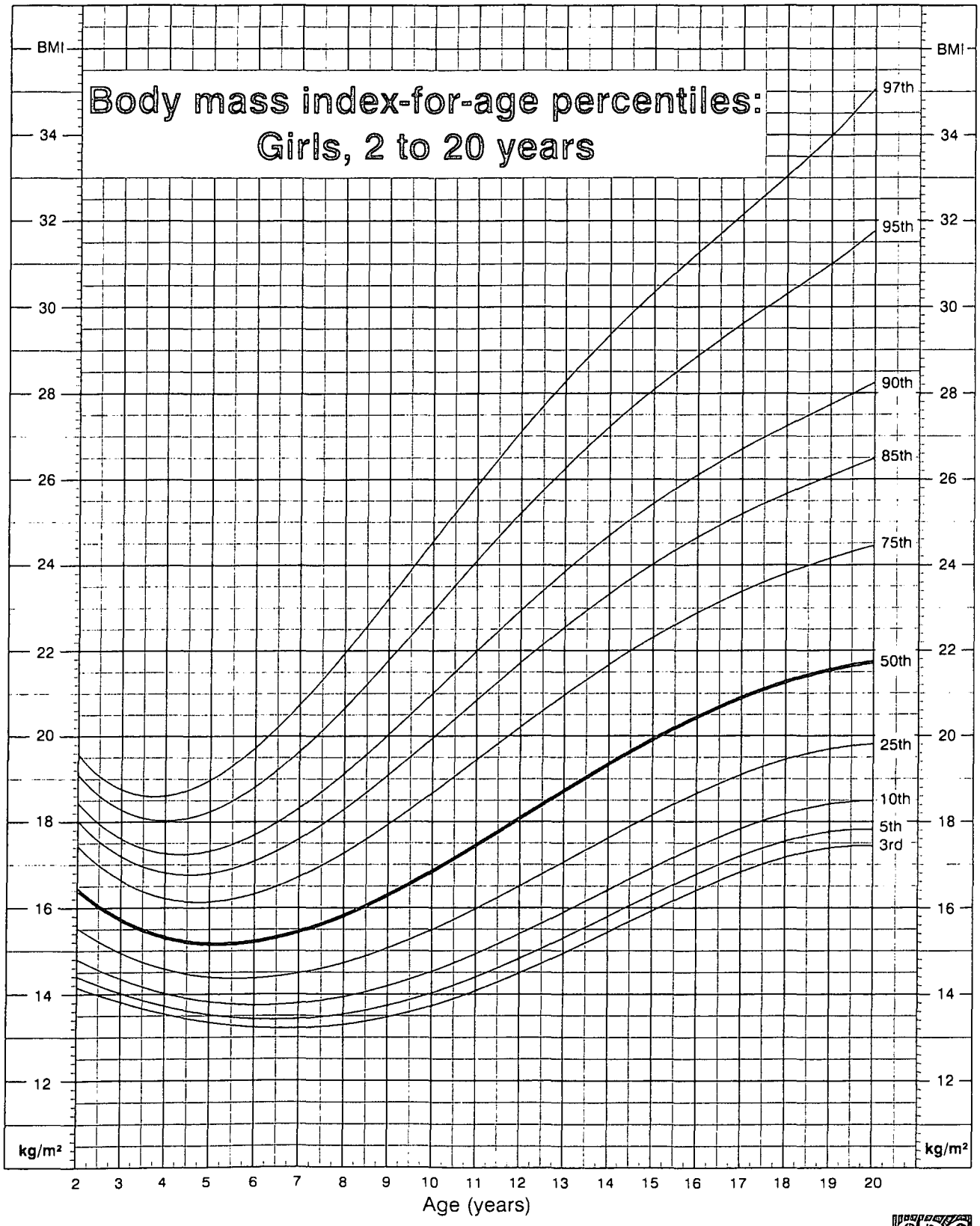
CDC Growth Charts: United States



Published May 30, 2000.
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

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BMI-for-age BOYS
5 to 19 years (percentiles)

World Health Organization

Year: Month	Months	3rd	15th	Median	85th	97th
15: 1	181	16.2	17.6	19.8	22.9	26.4
15: 2	182	16.3	17.7	19.9	23.0	26.5
15: 3	183	16.3	17.7	20.0	23.0	26.6
15: 4	184	16.4	17.8	20.0	23.1	26.7
15: 5	185	16.4	17.8	20.1	23.2	26.7
15: 6	186	16.4	17.9	20.1	23.2	26.8
15: 7	187	16.5	17.9	20.2	23.3	26.9
15: 8	188	16.5	18.0	20.3	23.4	27.0
15: 9	189	16.6	18.0	20.3	23.5	27.0
15: 10	190	16.6	18.1	20.4	23.5	27.1
15: 11	191	16.7	18.1	20.4	23.6	27.2
16: 0	192	16.7	18.2	20.5	23.7	27.3
16: 1	193	16.7	18.2	20.6	23.7	27.3
16: 2	194	16.8	18.3	20.6	23.8	27.4
16: 3	195	16.8	18.3	20.7	23.9	27.5
16: 4	196	16.8	18.4	20.7	23.9	27.5
16: 5	197	16.9	18.4	20.8	24.0	27.6
16: 6	198	16.9	18.5	20.8	24.0	27.7
16: 7	199	17.0	18.5	20.9	24.1	27.7
16: 8	200	17.0	18.5	20.9	24.2	27.8
16: 9	201	17.0	18.6	21.0	24.2	27.8
16: 10	202	17.1	18.6	21.0	24.3	27.9
16: 11	203	17.1	18.7	21.1	24.3	28.0
17: 0	204	17.1	18.7	21.1	24.4	28.0
17: 1	205	17.2	18.7	21.2	24.5	28.1
17: 2	206	17.2	18.8	21.2	24.5	28.1
17: 3	207	17.2	18.8	21.3	24.6	28.2
17: 4	208	17.3	18.9	21.3	24.6	28.2
17: 5	209	17.3	18.9	21.4	24.7	28.3
17: 6	210	17.3	18.9	21.4	24.7	28.4

BMI-for-age GIRLS
5 to 19 years (percentiles)

World Health Organization

Year: Month	Months	3rd	15th	Median	85th	97th
15: 1	181	16.1	17.7	20.3	23.7	27.6
15: 2	182	16.1	17.8	20.3	23.8	27.7
15: 3	183	16.2	17.8	20.4	23.8	27.7
15: 4	184	16.2	17.8	20.4	23.9	27.8
15: 5	185	16.2	17.9	20.4	23.9	27.9
15: 6	186	16.2	17.9	20.5	24.0	27.9
15: 7	187	16.3	17.9	20.5	24.0	28.0
15: 8	188	16.3	18.0	20.6	24.1	28.0
15: 9	189	16.3	18.0	20.6	24.1	28.1
15: 10	190	16.3	18.0	20.6	24.2	28.1
15: 11	191	16.4	18.0	20.7	24.2	28.2
16: 0	192	16.4	18.1	20.7	24.2	28.2
16: 1	193	16.4	18.1	20.7	24.3	28.2
16: 2	194	16.4	18.1	20.8	24.3	28.3
16: 3	195	16.4	18.1	20.8	24.4	28.3
16: 4	196	16.5	18.2	20.8	24.4	28.4
16: 5	197	16.5	18.2	20.9	24.4	28.4
16: 6	198	16.5	18.2	20.9	24.5	28.4
16: 7	199	16.5	18.2	20.9	24.5	28.5
16: 8	200	16.5	18.3	20.9	24.5	28.5
16: 9	201	16.5	18.3	21.0	24.6	28.5
16: 10	202	16.6	18.3	21.0	24.6	28.6
16: 11	203	16.6	18.3	21.0	24.6	28.6
17: 0	204	16.6	18.3	21.0	24.7	28.6
17: 1	205	16.6	18.3	21.1	24.7	28.6
17: 2	206	16.6	18.4	21.1	24.7	28.7
17: 3	207	16.6	18.4	21.1	24.7	28.7
17: 4	208	16.6	18.4	21.1	24.8	28.7
17: 5	209	16.6	18.4	21.1	24.8	28.7
17: 6	210	16.6	18.4	21.2	24.8	28.8