IMPACT OF A MULTIDIMENSIONAL WEIGHT-MANAGEMENT PROGRAMME ON THE WEIGHT STATUS AND ASSOCIATED FACTORS OF FIRST-YEAR FEMALE STUDENTS

by

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DECLARATION

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

SUMMARY

First-year female students (FYFS), studying at the University of Stellenbosch were previously identified as a high-risk group for gaining weight. A four-year follow-up of these female students indicated that a large percentage experience weight fluctuations throughout their university careers. The unique weight management needs of the FYFS were also identified in the longitudinal study. The integration of these results with an extensive search and assessment of the weight management literature led to the development of a multidimensional weight-management paradigm for application in the development of weight-management interventions for female students. Subsequently, a self-help weight-management manual, which follows the multidimensional approach proposed in the mentioned paradigm, was developed to address the unique weight-management needs of female students.

The aim of the current study was to evaluate the impact of the multidimensional self-help weight-management manual (the Manual) on the weight status and associated factors of FYFS at the University of Stellenbosch over an eight-month period. For this purpose a non-randomized quasi-experimental design was used, including purposively selected experimental and control groups. Data were obtained during February (Baseline), May (three months after baseline = Follow-up 1) and October 2002 (eight months after baseline = Follow-up 2). All students in the experimental group received the Manual at Baseline for use during the eight-month study period. Because this was a low-intensity intervention programme, no further contact was made with either group during the study period, except when Follow-up 1 data were obtained. Measures that were taken and instruments that were completed include the following: weight, height, triceps skinfold, mid-upper arm circumference, hip circumference, waist circumference, Adolescent Self-Concept Scale (self-concept), Body Shape Questionnaire (body shape concerns), Eating Attitudes Test (eating attitudes and behaviours), General Health Questionnaire (general psychological well-being), 90-item Semi-quantified Food Frequency Questionnaire (dietary intake from nine food groups), and the Baecke Questionnaire of Habitual Physical Activity (physical activity). Additional questions on weight related perceptions and practices, dissatisfaction with body parts, reasons for eating and socio-demographic factors were also included.

The Baseline characteristics of the FYFS involved in this study, which did not differ between the experimental and control groups for all key variables, identified them as a typical group of young female adults who are healthy but are not realistic about their weight status and who experience numerous problems related to their weight status.

The implementation of the Manual was found to be significantly effective in limiting weight gain among the FYFS in the experimental group. The control group experienced almost a full unit increase in BMI (0.93 kg/m^2), while the increase found for experimental group was 0.53 kg/m^2 ($p=0.004$). Although the weight of both groups increased initially the experimental group went on to lose weight, while the control group continued to gain weight during the last five months of the intervention. The impact of the Manual

is further illustrated by the fact that the FYFS in the experimental group who indicated that they did use the Manual extensively experienced a significantly lower rise in their weight (change in BMI over study period = 0.37 kg/m^2) than those in the experimental group who indicated that they did not use the Manual (change in BMI over study period = 0.89 kg/m^2). Factors that are possibly linked to the success attained with the Manual were identified and include more reasonable weight goals; the use of sound weight-reduction methods such as a balanced diet and physical activity; improvements in self-concept; maintenance of physical activity levels, especially during the first three months at university; improvement in general psychological well-being; decreased intake of foods from the "other" (includes mainly high fat, sugar based foods such as doughnuts, cookies, cake, tart), beverage and grains food groups; and possibly less concerns with body shape from the start. Factors for which no link with weight management success could be established include changes in body composition; perceptions of own weight; weight loss attempts; foods from the vegetables, fruit, milk and cheese, meat, fish and chicken, fats and fast foods food groups; physical activity over the total eight-month period; reasons for eating; eating attitudes and behaviour; dissatisfaction with body parts; and body shape concerns. It is recommended that the implementation of the Manual on the campus of the University of Stellenbosch to prevent weight gain of FYFS should be considered, bearing in mind some of the recommendations formulated by the FYFS in the experimental group.

OPSOMMING

Eerstejaar damestudente wat aan die Universiteit van Stellenbosch studeer is voorheen geïdentifiseer as 'n hoë risiko groep vir gewigstoename. 'n Vier-jaar opvolg van hierdie damestudente het aangedui dat 'n groot persentasie vir die duur van hul universiteitsloopbane gewigsfluktuasies ondervind. Die unieke gewigshanteringsbehoeftes van die eerstejaar damestudente is ook tydens die longitudinale studie geïdentifiseer. Die integrasie van hierdie resultate met 'n uitgebreide soektog en ontleding van die literatuur wat betrekking het op gewigshantering het aanleiding gegee tot die ontwikkeling van 'n multidimensionele gewigshanteringsparadigma wat gebruik kan word tydens die ontwikkeling van gewigshanteringsintervensies vir damestudente. As 'n volgende stap is 'n self-help gewigshanterings handleiding, wat die multidimensionele benadering voorgestel in die genoemde paradigma volg, ontwikkel om die unieke gewigshanteringsbehoeftes van damestudente aan te spreek.

Die doel van die huidige studie was om die impak van die multidimensionele self-help gewigshanteringshandleiding (die Handleiding) op die gewigstatus en geassosieerde faktore van eerstejaar damestudente aan die Universiteit van Stellenbosch oor 'n tydperk van agt maande, te evalueer. Vir hierdie doeleinde is 'n nie-gerandomiseerde kwasi-eksperimentele ontwerp gebruik, wat doelbewus geselekteerde eksperimentele en kontrole groepe ingesluit het. Data is gedurende Februarie (Basislyn), Mei (drie maande na basislyn = Opvolg-1) en Oktober (agt maande na basislyn = Opvolg-2) 2002 versamel. Alle studente in die eksperimentele group het die Handleiding tydens Basislyn ontvang vir gebruik tydens die agt maande studieperiode. Omdat dit 'n lae-intensiteit intervensie program was, is geen verdere kontak gedurende die studieperiode met beide die groepe gemaak nie, behalwe tydens die versameling van Opvolg-1 data. Metings wat geneem is en instrumente wat voltooi is, sluit die volgende in: gewig, lengte, triseps velvou, mid-bo-armomtrek, heupomtrek, middelomtrek, "Adolescent Self-Concept Scale" (self-konsep), "Body Shape Questionnaire" (besorgdheid oor liggaamsvorm), "Eating Attitudes Test" (eetgedrag en -houding), "General Health Questionnaire" (algemene sielkundige welstand), 90-item semi-gekwantifiseerde voedselfrekwensievraelys (dieetinname van nege voedselgroepe), en die "Baecke Questionnaire of Habitual Physical Activity" (fisieke aktiwiteit). Addisionele vrae aangaande gewigsverwante persepsies en praktyke, ontevredenheid met liggaamsdele, redes vir eet en sosio-demografiese faktore is ook ingesluit.

Die Basislyn eienskappe van die eerstejaar damesstudente wat aan hierdie studie deelgeneem het, het nie tussen die eksperimentele en kontrole groepe vir alle sleutelveranderlikes verskil nie. Hierdie inligting het ook daarop gedui dat die studente 'n tipiese groep jong vroulike volwassenes is wat gesond is maar, onrealisties is oor hul gewigstatus en baie gewigstatusverwante probleme ondervind.

Die resultate toon dat die implementering van die Handleiding beduidend effektief was om die gewigstoename by eerstejaar damestudente in die eksperimentele groep te beperk. Die gewig van die kontrole groep het byna 'n volle LMI eenheid (0.93 kg/m^2) toegeneem terwyl die toename vir die

eksperimentele groep 0.53 kg/m^2 was. Alhoewel die gewig van beide groepe aanvanklik toegeneem het, het die eksperimentele groep daarna gewig verloor terwyl die kontrole groep se gewig gedurende die laaste vyf maande van die intervensie verder toegeneem het. Die impak van die Handleiding word verder geïllustreer deur die feit dat die eerstejaar damesstudente in die eksperimentele groep wat aangedui het dat hul wel die Handleiding ekstensief gebruik het, 'n beduidend laer toename in gewig (LMI verandering gedurende studieperiode = 0.37 kg/m^2) ondervind het as die studente in die eksperimentele groep wat aangedui het dat hul nie die Handleiding gebruik het nie (LMI verandering gedurende studieperiode = 0.89 kg/m^2). Faktore wat moontlik gekoppel kan word aan die sukses verkry met die Handleiding is geïdentifiseer en sluit die volgende in: meer redelike gewigsdoelwitte; die gebruik van veilige gewigsverlies metodes soos 'n gebalanseerde dieet and fisieke aktiwiteit; verbetering van self-konsep; handhawing van fisieke aktiwiteitsvlakke, veral gedurende die eerste drie maande op universiteit; verbetering van algemene sielkundige welstand; verlaagde inname van voedsel van die "ander-" (sluit hoofsaaklik hoë vet, suiker gebasseerde voedsels soos oliebolle, koekies en tert in), drankies- en graan-voedselgroepe; en moontlik minder besorgdheid oor liggaamsvorm van die begin af. Faktore waarvoor geen verband met sukses met gewigshantering gevind is nie sluit die volgende in: liggaamsamestelling; persepsies van gewig; gewigsverliespogings; voedselinname uit die groente-, vrugte-, melk en kaas-, vleis, vis en hoender-, vette- en kitskosse-voedselgroepe; fisieke aktiwiteit gedurende die totale agt-maande periode; redes vir eet; eetgedrag en -houding; ontevredenheid met liggaamsdele; en besorgdheid oor liggaamsvorm. Dit word aanbeveel dat die implementasie van die Handleiding op die kampus van die Universiteit van Stellenbosch oorweeg word om gewigstoename van eerstejaar damesstudente te voorkom. Dit word ook aanbeveel dat die aanbevelings van die studente in die eksperimentele groep in hierdie verband, in ag geneem moet word.

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CHAPTER 1

INTRODUCTION

1.1 PROBLEM IDENTIFICATION AND MOTIVATION FOR THE STUDY

The World Health Organization (WHO) has described obesity as an "escalating epidemic" and "one of the greatest neglected public health problems of our time" (WHO, 1998). The prevalence of obesity is increasing at an alarming rate world-wide, affecting children and adults in both developed and developing countries, including South Africa (Pi-Sunyer, 1993; SAHR, 2002; WHO, 2003: 8, 61).

It is often written that the United States of America (USA), a typical example of a developed country, is in the midst of an obesity epidemic. The most comprehensive studies on the prevalence of obesity in the USA are data from the National Health (and Nutrition) Examination Surveys (NHES or NHANES). These indicate that the prevalence of overweight (BMI[1]≥25 and <30) has remained relatively constant since 1960, affecting between 30.5% and 32.0% of USA adults aged 20 to 74 years (Flegal *et al.*, 1998; Flegal *et al.*, 2002; Kuczmarski *et al.*, 1994). For the same age group data from NHES I (conducted from 1960 to 1962), NHANES I (conducted from 1971 to 1974) and NHANES II (conducted from 1976 to 1980) indicated that obesity (BMI≥30) prevalence also remained relatively constant at 12.8%, 14.1% and 14.5% respectively (Flegal *et al.*, 1998). However, since NHANES II a dramatic increase in obesity prevalence has occurred. NHANES III (conducted from 1988 to 1994) indicated that 22.5% of USA adults were obese (Flegal *et al.*, 1998), while the latest statistics obtained from 1999 to 2000 revealed that obesity prevalence has reached 30.5% (Flegal *et al.*, 2002). Similar figures and increases in obesity prevalence have also been reported for other developed countries such as those in Europe, England and Australia (WHO, 1998: 17-40).

In developing countries it is well known that the health of many citizens is compromized by undernutrition and starvation (WHO, 2003: 8). However, in many of these countries, especially in the economically advanced regions, the problem of undernutrition may co-exit with obesity (WHO, 1998: 17). This seems to be the situation in South Africa as statistics from the South African Vitamin A Consultative Group (SAVACG) and the National Food Consumption Survey (NFCS) indicate respectively that 9.3% and 10.3% of children between the ages of 6 months to 9 years are underweight, 23.8% and 21.6% are stunted, while 2.6% and 3.7% are wasted (Labadarios, 2000; SAHR, 2002; SAVACG, 1996). It was also found, however, that 6.0% of children between the ages 1-9 years are classified as overweight (Labadarios, 2000). Among adults, the first South African National Demographic and Health Survey (SADHS) indicates that 19.2% of adult South Africans older than 15 years (9.1% men and 29.4% women) are obese (BMI≥30) and a further 19.8% of men and 26.1% of women are overweight (BMI≥25 and <30) (SADHS, 1998; SAHR, 2002). Underweight in adults is, however, prevalent in 5.6% of females and 12.9% of males (SADHS, 1998). For women obesity is a problem across all races because obesity prevalence is 21.3% for Indian, 25.5% for White, 28.5% for mixed ancestry and 31.2% for Black females (SADHS, 1998; SAHR, 2002).

[1] BMI = Body Mass Index = Weight (kg)/ Height $(m)^2$ (Bastow, 1982).

Obesity also affects 9.6% of young women in South Africa between the ages of 15 to 24 years, while overweight and underweight account for 20.0% and 9.5% respectively (SADHS, 1998). Statistics for female student populations studying at tertiary institutions (e.g. colleges, technikons or universities) indicate that obesity prevalence is somewhat lower among female students than is indicated by national statistics. Studies done at two South African universities show that 18.2% of black first-year female students were overweight and 6.5% obese (Steyn *et al.*, 2000), while 6.7% of white first-year female students were overweight and 0.8% obese (Senekal, 1988b). A four-year follow-up of the white female students revealed that obesity prevalence changed to 1.6% after three months at university, 0.5% in their second year, 0.6% in their third year and 1.8 % in their fourth year (Senekal, 1994). For the same students more marked increases in the prevalence of overweight were observed. Three months after the initial measurements, overweight prevalence rose to 15.2% and then decreased to 11.9% in their second year, 11.5% in their third year and 9.9% in their fourth year (Senekal, 1994). In the USA and Europe the prevalence of overweight reported for different tertiary female student samples ranged from 7.9% to 20%, while obesity prevalence ranged from 1.0% to 6.0% (Bellisle *et al.*, 1995; DiGioacchino DeBate *et al.*, 2001; Douglas *et al.*, 1997; Sciacca *et al.*, 1991).

Health care professionals are concerned about the rising prevalence of obesity for several reasons. Obesity is associated with increased morbidity and mortality risk (Allison *et al.*, 1999) due to the increased risk of the development of comorbidities such as atherosclerosis, coronary heart disease, hypertension, stroke, non-insulin-dependent diabetes mellitus, insulin resistance, dyslipidemia, gallbladder disease, and some types of cancers (NIH 1998; WHO, 1998; Wadden *et al.*, 2002). These chronic and life-threatening diseases are often preceded by a range of other non-fatal but debilitating conditions such as infertility, skin problems, respiratory difficulties, osteoarthritis and gout, which affect the immediate quality of life (WHO, 1998). The risk of developing one or more of these comorbidities is especially linked to a BMI≥27 (Wolf & Colditz, 1998), visceral location of excess body fat (Despres, 1993) and weight gain after the age of 18 regardless of BMI (Colditz *et al.*, 1995; Hill *et al.*,2000: 442). As BMI increases, so the risk of the development of comorbidities increases simultaneously; however, this risk is higher in young adults than in those of an advanced age (Stevens *et al.*, 1998). Furthermore, becoming overweight or obese during early adulthood results in a greater increase in the mortality rate associated with increased weight than in later adulthood (Must *et al.*, 1999; Tayback, 1990). This phenomenon has been linked to the longer presence of the obese state in those who develop obesity early on (Must *et al.*, 1999; Tayback, 1990).

Concern has also been expressed about the cost of obesity and the related comorbidities to governments and the individual concerned. For developed countries it has been estimated that between 2% and 7% of the total health care expenditure is attributable to obesity (Wolf & Colditz, 1998; Allison *et al.*, 1999; HHS, 2001). The economic cost of obesity in developing countries is unknown, but agencies such as the WHO and World Bank have recognized that it may exceed the cost in developed countries, because a great deal of expensive equipment, medicines or other supplies necessary for treatment have to be imported at unfavourable exchange rates (WHO, 1998).

The obese must also contend with social stigmatization and discrimination in many societies. They are generally considered to be ugly, dirty and stupid people, who are less successful in work as well as being weak-willed (Stunkard & Sobal, 1995: 417-418; Whitney *et al.*, 2002: 276). Obese women are particularly liable to have completed fewer years of schooling, to marry less frequently and to have lower earnings compared to non-obese women (Gortmaker *et al.*, 1993). These and other factors contribute to the psychological consequences of obesity, which include the development and progression of a low self-esteem, body image problems, binge eating (Stunkard & Sobal, 1995: 418-419), loss of self-confidence, depression and lower levels of happiness (summarized by Franz, 1998).

Because of these negative consequences associated with obesity, treatment or management has been receiving increased attention. However, despite the fact that it has been shown that small weight losses of five to ten percent of initial weight are associated with clear health benefits (Dwyer, 1996; Laquatra, 2000: 496) and despite all the efforts to address the problem, the prevalence of obesity is still increasing world-wide. This situation indicates that treatment has thus far been relatively unsuccessful, which is confirmed by numerous studies which indicate that current treatments for obesity and overweight, including weight loss diets, behavioural therapy, exercise, medication, surgeries as separate or combined approaches, are largely ineffective (Glenny *et al.*, 1997; NIH, 1998). The IOM (2003: 126) and a comprehensive review by Glenny *et al.* (1997) indicate that initial weight-loss is often experienced, but long-term weight maintenance is not easily achieved.

Unsuccessful weight reduction attempts or the inability to maintain weight after initial weight loss could be the starting point of a never-ending cycle of weight gain and dieting, which may further contribute negatively to health, although more research in this area is necessary. Weight cycling in itself has been associated with subsequent large weight gains (Kroke *et al.*, 2002), an increase in the waist-to-hip ratio in women (Rodin *et al.*, 1990), an increased risk of coronary heart disease (French *et al.*, 1997; Hamm *et al.*, 1989; Lee & Paffenbarger, 1992; Lissner *et al.*, 1991), hypertension (Guagnano *et al.*, 2000) and all-cause mortality (Despres, 1993; Lee & Paffenbarger 1992; Lissner *et al.*, 1991).

St Jeor (1997) states that because obesity is a chronic condition or disease, the only way to induce long-term weight maintenance is by changing certain lifestyle habits permanently. This type of change requires the implementation of a continuing care model of therapy for adequate management, similar to the treatment models for cardiovascular disease or diabetes mellitus (Coulston, 1998).

Bearing this scenario in mind, more emphasis is currently being placed on the development of strategies or programmes **to prevent** the development of overweight and obesity in the first place (Müller *et al.*, 2001). It is suggested that, to be effective, prevention strategies should address the root causes of obesity. However, because obesity is a heterogeneous disorder with multiple causes which could include any combination of genetic, metabolic, biochemical, psychological, physiological and environmental factors, the development of appropriate prevention programmes is not a simple task (ADA, 2002).

Childhood obesity has been hailed by some as the starting point of adult obesity (Eriksson *et al.*, 2003; Laitinen *et al.*, 2001; Whitaker *et al.*, 1997). Many authors therefore suggest that prevention programmes should focus primarily on children (Lindsay *et al.*, 2002; Moore, 2002). However, research indicates that childhood obesity accounts for adult obesity in less than a third of women (Braddon *et al.*, 1986; Dietz, 1994; IOM, 2003: 58) and only a tenth of men (Braddon *et al.*, 1986), while the main cause of the development of obesity seems rather to be gradual weight gain during adulthood (IOM, 2003: 58). This possibility is supported by information provided by large prospective cohort studies, which indicate that unwanted weight gain most commonly occurs between the ages of 18 to 34 years in both men and women (Braddon *et al.*, 1986; Burke *et al.*, 1996; Rothacker & Blackburn, 2000; Williamson *et al.*, 1990). Research completed in the 1980s and early 1990s indicates that continuous weight gain after the age of 18 years leads to increases in obesity prevalence, which eventually peaks after the age of 35 years (Braddon *et al.*, 1986; Williamson *et al.*, 1990). However, more recent research indicates that the peak prevalence for becoming obese may now be sooner, affecting adults younger than 30 years of age (Rothacker & Blackburn, 2000). Furthermore, women tend to be approximately twice more likely than men to experience unwanted weight gain, with overweight women between 24 to 44 years of age being the most susceptible (Williamson *et al.*, 1990). A further trend that is evident is that women are less likely than men to maintain their weight within one BMI unit over a ten-year period (Williamson *et al.*, 1990). This notion is supported by the work of Rothacker and Blackburn (2000), who found that more than half of normal weight women gained weight and consequently became overweight or obese over a five year period. Many overweight women in the study either remained overweight or became obese, while all those who were obese to begin with remained obese and gained a further mean of 7.5 kg (Rothacker & Blackburn, 2000).

Unwanted weight gain has also been reported for young women in tertiary institutions. A retrospective study executed at the University of Stellenbosch indicated that 58.8% of non-first-year female students (n=922) felt that they had gained weight ranging from 1 to 25 kg during their first year (Senekal *et al.*, 1988a). A prospective study at the same university found that 72.8% of the first-year female students (FYFS) (n=316) had gained between 2 to 12.2 kg during their first three months at university (Senekal, 1988b). Follow-up of these students over a four-year period revealed that only a fifth were able to maintain their weight, 31.5% gained weight continuously, 29.7% were unable to maintain a stable weight, and 18% were clear weight cyclers (Senekal, 1994). Similar trends have been found in the USA. During 1983 Squire (in Hesse-Biber & Marino, 1991) already wrote about the "Freshman 10", which refers to the 10 pounds (4.5 kg) a freshman (first-year student in the USA) is expected to gain during her first year at a tertiary institution. This soon became "Freshman 15", which refers to an average weight gain of 15 pounds (6.8 kg) during their first year (Hodge *et al.*, 1993). Evidence for this notion comes from the work of Anderson *et al.* (2003b), Graham and Jones (2002), Hodge *et al.* (1993), Hovell *et al.* (1985), Megel *et al.* (1994) and Striegel-Moore *et al.* (1989), who all reported problems with first-year weight gain amongst tertiary female student populations, although not necessarily always in the range of 15 pounds.

The above information strongly points to the fact that early adulthood is a crucial time for the prevention of obesity. Several authors suggest that all persons in their twenties should be the primary target group for obesity prevention efforts, irrespective of BMI (Coulston, 1998; Senekal *et al.*, 1988a; Senekal, 1994; Williamson *et al.*, 1990) as many of those who become obese in later life are not overweight in early adulthood (Braddon *et al.* 1986; Rothacker & Blackburn, 2000). Furthermore, the change from high school to a tertiary institution seems to be a trigger for weight gain and FYFS are classified as a high-risk group for weight gain and the development of obesity (Senekal, 1994). Despite the clear need for prevention in this age group, specifically in female student populations, appropriate programmes for weight maintenance and prevention of weight gain seem to be scarce. The importance of the development, implementation and evaluation of appropriate weight management programmes aimed at female student populations is therefore evident.

Workers like Wooley (1995: 75) have, however, warned that it is very important that the messages in weight management interventions should be formulated very carefully so that the emphasis on the need to maintain or reduce weight does not contribute to the development of other weight-management-related problems such as disordered eating and ultimately eating disorders. It is well known that most women are already inclined to set physiologically unacceptable weight targets, based on the Western beauty ideal, which has been found to be 13 to 19% below expected weight (Wiseman *et al.*, 1992). This is supported by the fact that female students are inclined to select an underweight body silhouette as the body size they wanted most and the size they thought women should comply with (Schulken *et al.*, 1997). Many researchers have also confirmed that the weight goals, the definition of an ideal body weight (Anderson *et al.*, 2003a; Crawford & Campbell, 1999; Paxton *et al.*, 1994; Ziebland *et al.*, 1996) and the average perceived overweight BMI of especially young women are significantly lower than that of men (Crawford & Campbell, 1999). This is further illustrated by the fact that more than half of female students are typically dissatisfied with their weight (Georgiou *et al.*, 1997; O'Dea, 1999; Page & Fox, 1998; Senekal, 1994) and that many are inclined to perceive themselves as overweight when their actual weight falls within the normal BMI range (Adame *et al.*, 1990; Anderson *et al.*, 2003a; Sciacca *et al.* 1991; Senekal *et al.*, 1988b, 1994; Stephens *et al.*, 1999).

Overestimation of body size and the desire to achieve an 'ideal' weight "has spawned a proliferation of weight loss techniques, books, programs and aids as well as chronic caloric restriction or dieting to promote weight loss" (Polivy & Herman, 1995: 83; Wadden *et al.*, 1996). Brownell *et al.* (1992) maintain that dieting becomes part of a woman's life during adolescence and most women engage in life-long weight management practices to achieve their idealized weight. This is supported by the fact that many students have established dieting behaviours before entering a tertiary institution (Cogan *et al.*, 1996; Page & Fox, 1998; Senekal 1988b; Senekal *et al.*, 2001; Striegel-Moore *et al.*, 1989), while for others dieting begins soon after entering such an institution (Senekal, 1994; Striegel-Moore *et al.*, 1989). Evidence shows that dieting is rife among female student populations, despite the fact that the mean BMI of first-year students falls well within the normal BMI range (Akan & Grilo, 1995; Cogan *et al.*, 1996; Rosen *et al.*, 1996; Schulken *et al.*, 1997; Senekal 1988; Sherward, 1995).

Unnecessary and unsuccessful dieting could cause further weight gain or weight fluctuations and consequently contribute to the development or exacerbation of negative perceptions of body image, psychological problems, disordered eating, chronic dieting (Crawford & Campbell, 1999; St Jeor *et al.*, 1993) and ultimately eating disorders (Polivy & Herman, 1995). This phenomenon is also prevalent among students as Toray and Cooley (1997) found that female students who experience weight fluctuations exhibit higher levels of dissatisfaction with their bodies, a stronger desire to be thin, uncertainty about their own emotions and an increased incidence of bulimic behaviours when compared to a weight-stable group of students. Nelson *et al.* (1999) also reported that female students who are problem eaters viewed themselves less positively, had lower self-concepts and were more psychologically distressed than non-problem eaters. Eating problems and anorexic-like attitudes and behaviours are common among female students and prevalence studies have reported that up to one in five female students have disordered eating attitudes and behaviours (Brookings & Wilson, 1994; Hesse-Biber, 1992; Nelson *et al.*, 1999; Prouty *et al.*, 2002; Stephens *et al.*, 1999). Hesse-Biber (1992) reported on a two-year follow-up of female college students and maintains that the majority of female students' eating problems are chronic. Over and above these problems, the methods used to lose weight are often unhealthy and unsound, and could contribute to the development of further health problems. Dieting methods used by female students include self-induced vomiting, laxatives, diuretics, overactivity/ exercise, diet pills, fasting for more than 24 hours, skipping meals and going on crash diets (Douglas *et al.*, 1997; Hendricks & Herbold, 1998; Kurtzman *et al.*, 1989; Page & Fox, 1998; Striegel-Moore *et al.*, 1989). Wilson (1995: 87) very aptly summarized the effect of dieting as follows: "dieting is more likely to make people gain rather than lose weight, make them sicker rather than healthier, and make them unhappier rather than happier".

It is clear that any weigh-management programme aiming to empower an individual to manage his or her weight effectively and to prevent unnecessary weight gain should address a variety of factors which all influence weight management within a particular context. It is therefore very important that the very specific needs of the target group (in this research FYFS) are considered. Beside the above-mentioned weight-related behaviours common to women and female students, the transition from high school to a tertiary institution is associated with its own specific consequences. With this transition FYFS are exposed to many changes in their new social, academic and psychological environment in which they are now suddenly free to make their own decisions. Research indicates that this transition may be accompanied by a decrease in self-concept (Hesse-Biber & Marino, 1991) and an increase in psychological distress (Page & Fox, 1998; Sax, 1997). The reported prevalence of increased psychological distress among first-year female students ranges form 28% to 57% (Adlaf *et al.*, 2001; Humphris *et al.*, 2002; Ko *et al.*, 1999; Martinez *et al.*, 1999; Roberts *et al.*, 1999), which is significantly higher than rates among the general population (Adlaf *et al.*, 2001; Roberts *et al.*, 1999). Decreases in self-concept and increases in psychological stress have been related to the development or worsening of eating problems (Hesse-Biber & Marino, 1991) as well as dissatisfaction with weight (Cohen *et al.*, 2002).

The traditional unidimensional approach to weight management using reduction of energy intake through dieting and/or increasing energy expenditure has been found to be largely ineffective and not acceptable in the general population (Popkess-Vawter *et al.*, 1998). The same will hold true for female student populations. Researchers should therefore focus on the development of weight-management programmes using a multidimensional approach, as was suggested by Senekal *et al.* (1999), bearing in mind specific characteristics of the target group.

Because female students are such a high-risk group for gaining weight and developing eating disorder-related problems, a multidimensional weight-management programme in the form of a self-help manual aimed at this target group was developed (Senekal, 2002). The programme followed the suggested multidimensional approach (Senekal *et al.*, 1999) and was based on the results of a four-year longitudinal follow-up of a group of FYFS (Senekal 1988b; Senekal, 1994) which aimed to identify specific factors contributing to ineffective weight management in this target group. The final step in the development of this programme is to determine its impact on the weight status of FYFS.

1.2 AIM

The aim of this study therefore was to evaluate the impact of the multidimensional weight-management programme on the weight status and associated factors of first-year female students at the University of Stellenbosch.

1.3 OBJECTIVES

The following objectives were formulated to realize this aim:

1.3.1 Primary objective

- To determine the impact of the multidimensional weight-management programme on the weight status (BMI) of FYFS over an eight-month period.

1.3.2 Secondary objectives

- To determine baseline characteristics of the FYFS and their association with weight status;
- To determine the changes that occurred in the factors associated with the weight status of the FYFS over an eight-month period.

1.4 DESCRIPTION OF KEY CONCEPTS

1.4.1 First-year female student (FYFS)

In 2002 there were 21 000 students registered at the University of Stellenbosch (US), of whom 3593 were first-year students (male students = 1572 and female students = 2021). These first-year students could either be classified as newly registered first-year students (first ever registration at the US) or could include those who had changed their course and reregistered as first-year students for a new course or those who had failed their first year and reregistered for their first year. Of all the newly registered female students, 1033 resided in a residence on the university campus. Most of these residences are exclusively for female students (Personal communication, 2003, Ms I Walters, Administration, University of Stellenbosch).

For the purposes of this study a FYFS was defined as a female student who registered at the University of Stellenbosch for the first time ever in February 2002 and resided in one of the exclusively female residences. The mean age of these students was 18 years. Their home language was Afrikaans (79%) or English (17%) or they were bilingual (2%), and less than 2% had other home languages. The ethnic distribution of the FYFS during 2002 was 87% white, 10% of mixed ancestry (coloured), 2% black and less than 1% Indian (Personal communication, 2003, Ms I Walters, Administration, University of Stellenbosch).

1.4.2 Multidimensional weight-management programme

The multidimensional weight-management programme used in this study was a self-help weight-management manual, referred to as the Manual from this point forward. The development of the Manual was based on a multidimensional weight-management paradigm (Figure 1.1) developed by Senekal *et al.* (1999). The paradigm, which focuses on all aspects of the prevention, treatment and management of weight-related problems, was a step towards recognizing weight-management interventions as multidimensional approaches and a move away from the simplistic unidimensional weight-loss paradigm used in the past. The Manual was developed by Senekal (2002) to address the unique needs of female students as identified through previous longitudinal research on female students at the University of Stellenbosch (Senekal, 1988; Senekal, 1994). In this research it was found that students who were unable to maintain a stable weight over the four-year period were characterized by the following during their first year: higher levels of total energy intake; inclination to eat due to homesickness, frustration, boredom, stress, lack of self-discipline, just because others eat and social events; problems with adaptation to residence life; a better knowledge of nutrition and finally significant weight gain (Senekal, 1988b). Results of the total four-year period indicated that students who were unable to maintain a stable weight were also inclined to be less realistic about their body weight and size; to have abnormal eating attitudes, compromised psychological well-being and high scores for dietary restraint; to experience

problems with external and emotional eating and disinhibition; to perceive their eating attitudes as poor; to be more susceptible to factors that could have an adverse effect on eating habits; to be less able to handle small weight changes successfully, and to be less likely to be physically active (Senekal, 1994).

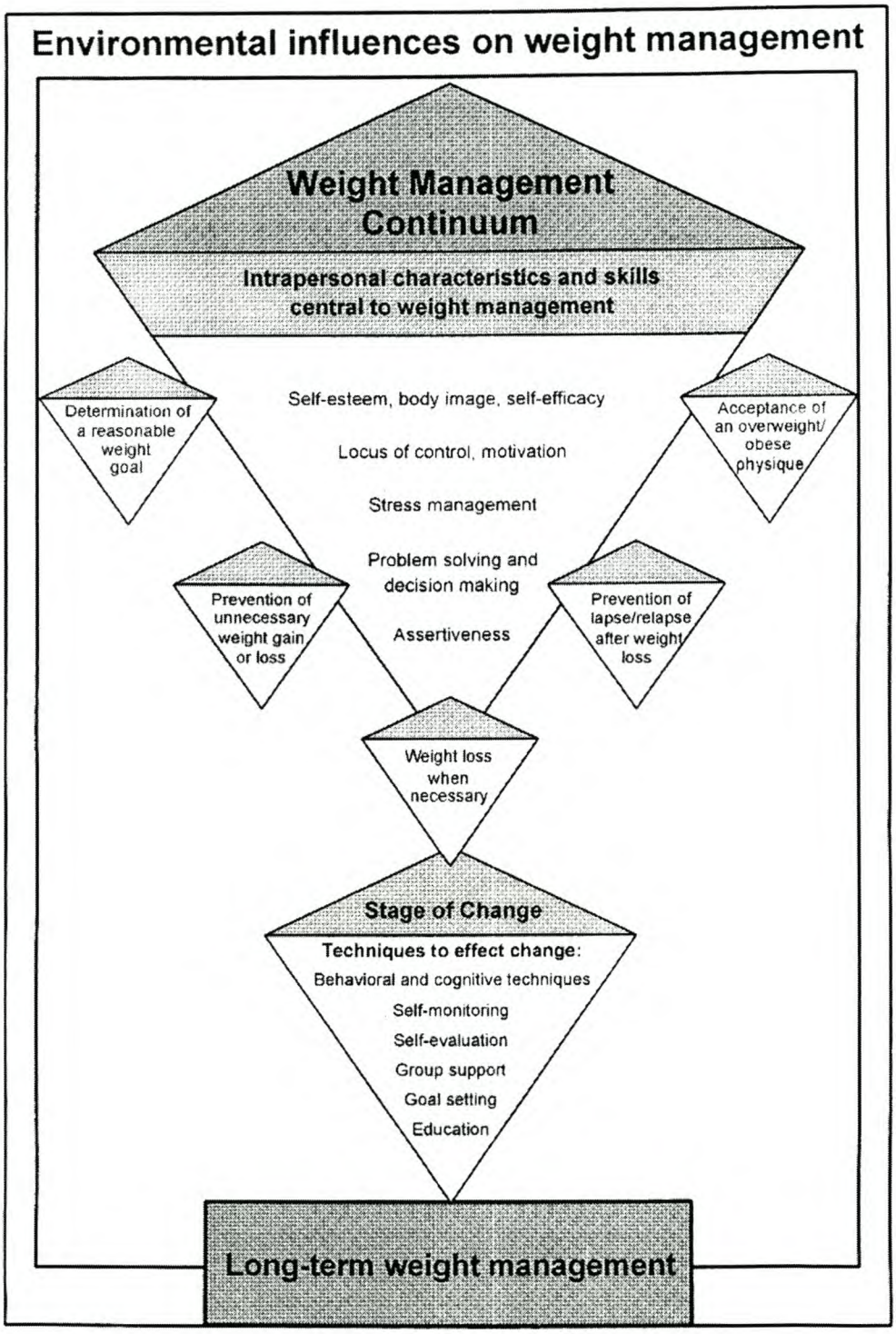

FIGURE 1.1: Multidimensional weight-management paradigm (Senekal *et al.*, 1999).

1.4.3 Weight status

The calculated Body Mass Index (BMI) of the FYFS is used as the primary indicator of weight status. BMI is calculated as the weight in kilograms divided by the square of the height in meters (kg/m^2) (Bastow, 1982). The cut-off points suggested by the WHO (1998: 9) and adopted by the Southern African Society for the Study of Obesity (SASSO, 2003: 4) were used to classify the students according to the level of obesity as indicated in Table 1.1.

TABLE 1.1: Weight status of adults classified according to BMI

BMI	Classification	Level of obesity
<18.5	Underweight	
18.5 – 24.9	Normal weight	
≥25.0	Overweight	
25.0 – 29.9	Pre-obese	
30.0 – 34.9	Obese	Class I
35.0 – 39.9	Obese	Class II
≥40.0	Obese	Class III

1.4.4 Factors associated with the weight status of FYFS

For the purposes of this study, factors associated with the weight status of FYFS were chosen to reflect aspects addressed in The Manual. The factors included the following:

- Other anthropometric measurements: triceps skinfold, mid-upper arm circumference, waist circumference, hip circumference, waist-hip-ratio;
- Healthful eating: dietary intake from food groups, reasons for eating;
- Physical activity: physical activity at work; physical activity from sport during leisure time; physical activity during leisure time, excluding sport;
- Psychological health: body shape, dissatisfaction with body parts, self-concept, general psychological well-being, eating attitudes and behaviours;
- Weight-related issues: perception of body weight, weight goals, weight reduction practices, weight reduction methods;
- Other health indicators[2]: prevalence of non-communicable diseases, use of medicine and supplements, smoking habits, blood pressure.

[2] Other health indicators were included to foster the perception that the study involved is a health survey for control group students.

1.5 OUTLINE OF THE THESIS

In Chapter 2 a review of the literature is presented which first focuses on the concepts "preventive intervention" and "weight management". This is followed by a discussion of the essential components of weight management interventions, the indicators of and factors related to success with weight management interventions and published prevention interventions. A final section addresses the issue of evaluation research. The first article, "The association between the BMI of first-year female university students and their weight related perception and practices, psychological health, dietary intake, physical activity and other physical health indicators", is presented in Chapter 3. In the methods and procedures section of this article a very detailed description of the different measures and instruments used is presented. The second article, "Impact of a multidimensional self-help weight-management manual on the weight status and associated factors of first year female students", is presented in Chapter 4. In the methods and procedures section of this article there is less detail regarding the measures and instruments used (the reader is referred to the first article) and more emphasis is placed on the study design and the intervention itself. Finally, a general discussion of the total study and final conclusions and recommendations are presented in Chapter 5.

The articles are aimed for publication in the *Journal of the American Dietetic Association.* The referencing system applied is therefore based on the system prescribed by the *Journal of the American Dietetic Association*, except that the references in the text are not indicated by numbers but rather by the authors' last names and the date of publication.

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CHAPTER 2

LITERATURE REVIEW

Weight management, weight-management programmes and programme evaluation are the central concepts discussed in this literature review. In the first section of this literature review the concepts of preventive intervention with specific reference to obesity are discussed. Following this the weight management concept is firstly described, after which a brief overview is given of the different components that should be included in a weight-management intervention. Different modes and techniques of intervention delivery as well as general guidelines or prerequisites for the implementation of weight-management interventions are also discussed. This is followed by a discussion of the success of weight-management interventions in general as well as with specific reference to published obesity-prevention interventions. Finally, an overview of considerations for programme evaluation research is presented.

2.1 PREVENTIVE INTERVENTION

2.1.1 Prevention terminology and classification

According to the Institutes of Medicine (IOM) in the United States of America (USA), there is some ambiguity of the terminology in the prevention literature (Mrazek & Haggerty, 1994: 19). In general terms it can be said that to prevent something implies taking an action to stop or prevent something from happening (Mrazek & Haggerty, 1994: 19). However, different ideas have been put forward as to what should actually be stopped or kept from happening to prevent a condition such as obesity. For example, it could refer to reducing the incidence of obesity as such, to the prevention of weight gain and progression of existing obesity, to the prevention of the development or progression of comorbidities or to the modification of an underlying risk condition or predisposition factor for obesity development (Thomas, 1995: 152-153). To address this problem, systems for the classification of the level of prevention of a disease were described in a report compiled by the IOM (Mrazek & Haggerty, 1994). The original (traditional) public health classification system of disease prevention was proposed in 1957 by the Commission on Chronic Illness in the USA and referred to primary, secondary and tertiary levels of prevention. When this classification system was introduced, diseases were viewed as an acute condition with a specific and unifactorial cause. Since then, research has shown that the etiology of many diseases is multifactorial, which created confusion in the application of the traditional prevention classification system (Mrazek & Haggerty, 1994: 20). Consequently, an alternative classification system has been developed by Gordon (1987). Both these classification systems are discussed in depth by the IOM in their report on "Reducing risks for mental disorders: frontiers for preventive intervention research" (Mrazek & Haggerty, 1994) and with more application to obesity in "Weighing the Option: Criteria for evaluating weight-management programmes" (Thomas, 1995).

2.1.2 Traditional classification of disease prevention

The different levels of the traditional classification of prevention of disease, namely primary, secondary and tertiary prevention and their relation to obesity, are summarized in Table 2.1.

TABLE 2.1: Traditional classification of disease prevention and implications for obesity prevention*.

Level of prevention	Goal	Implications for obesity prevention	
		Target group	Target action
Primary prevention	Decrease the number of new cases (incidence).	Normal weight, underweight and overweight† individuals	Prevent unnecessary weight gain and the consequent development of obesity
Secondary prevention	Lower the rate of established cases of the disorder in the population (prevalence)	Obese and overweight† individuals	Effective weight-loss interventions when necessary and maintenance of weight loss thereafter.
Tertiary prevention	Stabilize or decrease the level of disability associated with an existing disorder.	Obese and overweight individuals	Decrease the progression to more severe obesity† OR decrease the development or progression of associated comorbidities† OR prevent lapse and relapse after weight loss

†Ambiguities which arise due to the traditional classification system.

*Source: Mrazek & Haggerty (1994: 20); Thomas (1995: 153).

Although this classification system has been used in relation to obesity prevention, the WHO (1998: 167) and IOM (Mrazek & Haggerty, 1994: 20) indicate that it creates confusion and ambiguity among health care professionals. For instance, it is not clear whether primary obesity prevention refers to preventing overweight people from becoming obese or whether this should be seen as secondary prevention (indicated with † in Table 2.1). Similarly, it is also unclear what the target action of tertiary prevention should be (WHO, 1998: 167). An alternative classification system that addresses these issues, related to diseases with multifactorial causes, was clearly necessary.

2.1.3 Alternative classification of disease prevention

According to the alternative classification system, three different but complementary levels of prevention are identified, namely universal, selective and indicated/ targeted prevention (Thomas, 1995: 154; WHO, 1998: 167-169, Figure 2.1). These prevention categories represent a population group or the level of intervention rather than a target outcome, disorder or disease state (WHO, 1998: 167, Thomas, 1995: 154).

FIGURE 2.1: The alternative classification system for disease prevention (WHO, 1998: 168)

2.1.3.1 Universal prevention

Universal prevention interventions are designed for everyone in an eligible population or community, such as all children or elderly or pregnant women, regardless of their current level of risk (Mrazek & Haggerty, 1994: 20). This implies that the target population for intervention often includes individuals who are already obese (Thomas, 1995: 156). Universal preventions aimed at obesity prevention can be classified into the following two broad categories, according to the:

- Preventive education and skills targeted toward individuals: Programmes are employed in various settings and designed to enhance nutritional knowledge and increase physical activity, thereby informing the public about the nature of weight change, so that uninvolved and unaffected people can avoid negative or adverse consequences (Thomas, 1995: 156);
- Modification of social and economic policies: Programmes are employed in an attempt to reduce the population's exposure to the environmental causes of obesity. Examples of intervention at this level include mandated changes in food composition, regulation of food advertising and food labelling (Thomas, 1995: 156).

The aim of universal prevention programmes aimed at obesity prevention may be to stabilize the level of obesity, reduce the incidence of new cases and ultimately decrease the prevalence of obesity in the population (WHO, 1998: 168). The following outcome measures could thus be used when evaluating such programmes (Thomas, 1995: 156):

- Reduction in the prevalence of obesity in the general target population;
- An overall reduction in the mean weight or mean BMI of the target population;.
- Improvements in nutritional intake, eating habits, exercise, and other health-related activities for the target population;
- Improved knowledge, attitudes and norms regarding nutrition weight, eating habits and exercise of the target population;
- Decreased rates of comorbidity related problems among the target population;

- Public policy and environmental change indices such as regulation of food labelling or advertising.

Universal prevention programmes aimed at obesity prevention may be family-based, school-based, work-site-based, community-wide or may include environmental-change programmes (Thomas, 1995: 157-159). With family-based prevention programmes the eating behaviour and risk of weight gain of the whole family can be addressed. These programmes could, for example, focus on food purchases, food presentation, food preparation and adult eating behaviours as a model for children (Thomas, 1995: 157). School-based programmes could be effective, especially in countries where the children who are enrolled in school eat one or two meals per day at school. These intervention strategies could include a section targeting the cafeteria at schools to increase available healthy food choices and decrease unhealthy choices on the menu (Donnelly *et al.* 1996) (Table 2.10[3], p 75). A nutrition education and a physical activity component can also be included in such programmes (Donnelly *et al.* 1996; Thomas, 1995: 157). Other examples of school-based programmes in which printed pamphlets and audiovisual aids were used to provide dietary information are reported by Simonetti (1986) (Table 2.10, p 75). After completing school, employed people spend more time at work than at any other activity. Therefore, work-site-based programmes provide access to large numbers of persons who can be reached at relatively low cost (Thomas, 1995: 158). In this case programmes could focus on promoting healthful eating and physical activity through behaviour change methods (Thomas, 1995: 158). Community-wide programmes focus on a specific community identified through geographical borders (Thomas, 1995: 158). These types of programmes also usually focus on promoting healthful eating and increasing physical activity through behaviour change (Thomas, 1995: 158). Examples of community-wide universal prevention programmes include the two Pound of Prevention studies published by Forster *et al.* (1988) and Jeffery & French (1999). Both these programmes applied a low-intensity intervention approach based on monthly newsletters containing messages aimed at helping readers to make small changes in their diet and exercise habits and to pay attention to weight (Table 2.10, p 75).

2.1.3.2 Selective prevention

Selective prevention interventions aimed at obesity prevention are directed to a subgroup of the population whose risk of developing obesity is above average or high (WHO, 1998: 169). High-risk groups are identified on the basis of biological, psychological or social/ cultural risk factors that are known to be associated with the onset of the disorder (Thomas, 1995: 159). Age, gender, occupation, family history (Thomas, 1995: 159), ethnicity, smoking cessation, excess alcohol intake, drug treatment, disease states, changes in social circumstances and other characteristics may distinguish high-risk subgroups (WHO, 1998: 142-146). The risk may be acute (for certain vulnerable life stages) or occur over a lifetime (genetic predisposition to weight gain) (WHO, 1998: 169, Thomas, 1995: 159). However, selective prevention interventions aimed at obesity prevention do not include persons who are already

[3] In Tables 2.9 to 2.11 (pp 74-77), all the weight-gain and obesity-prevention programmes that were identified are listed and critically discussed. Where information in the literature review is illustrated by one or more of these programmes, the reader is referred to these tables.

obese, but target only individuals who are at a high risk of developing obesity. Such programmes will thus focus on the development of lifetime behavioural patterns by high-risk non-obese individuals which will protect them from developing obesity. Early adulthood is classified by the WHO (1998: 144) as one of the vulnerable periods of life for the development of future obesity because this period is associated with a marked reduction in physical activity, which occurs for women at ages 15-19 years but for men usually in their early 30s.

Selective prevention aimed at obesity prevention is therefore concerned with improving the knowledge and skills of the target group to empower them to address the factors which put them at a high risk of developing obesity more effectively. The following are possible outcome measures associated with such interventions (Thomas, 1995: 160):

- Prevention of weight gain in high-risk individuals and groups;
- Decreased excessive dieting among dieters;
- Improved lifestyle patterns, e.g. better nutrition, more exercise and decreased eating disorders.

Selective prevention interventions may be initiated through schools, colleges, worksites, community centres, shopping outlets or through any appropriate setting which allows access to high-risk groups (WHO, 1998:169). Because it has been indicated that female students studying at a tertiary institution are a group at high risk of gaining large amounts of weight during their first year, an intervention targeting to reduce the weight gain among first-year female students would be an example of a selective prevention intervention. An example of a selective prevention intervention aimed at FYFS was conducted by Matvienko *et al.* (2001) (Tables 2.9 to 2.11, pp 74-77).

2.1.3.3 Indicated or Targeted prevention

Indicated or targeted prevention interventions are targeted at individuals who are not yet obese but who are already overweight, or to individuals who exhibit biological markers associated with excessive fat stores (indicating pre-disposition) (Thomas, 1995: 161). Risk factors to identify these individuals include a family history of obesity, a high risk of developing obesity related comorbidities, biological markers and the development of early symptoms of the disorder (Thomas, 1995: 161, WHO, 1998: 169). Although reliable biological markers for obesity are still not clearly identified, individuals who are already overweight or who have a sedentary lifestyle may be effectively targeted (Thomas, 1995: 161). A failure to intervene at this stage will result in many of these individuals becoming obese and suffering from the associated comorbidities (WHO, 1998: 169). Indicated interventions are designed for individuals and not for a total group, as in the case of selective prevention programmes, and will involve intensive individual or small-group preventive interventions (WHO, 1998: 169).

Indicated prevention aimed at obesity prevention is therefore concerned with the prevention of further weight gain and the reduction of the prevalence of co-morbidities among already overweight individuals (WHO, 1998: 169). The following are possible outcome measures for such interventions (Thomas, 1995: 161):

- Reductions in the number of obese people who go on to develop obesity-related comorbidities, e.g. reduce adult obesity among overweight children receiving intervention in childhood;
- Decrease the number of overweight or high-risk individuals who may develop obesity;
- Increase in the number of obese people who are successful in attaining and maintaining relatively small weight losses and a decrease in the number who gain a small amount of weight.

An example of an indicated prevention programme was published by Epstein *et al.*, (1994) who implemented a successful treatment programme for obese children to prevent adult obesity.

2.1.4 Preventive intervention research cycle

In order to establish successful preventive interventions the IOM recommends instituting a "preventive intervention research cycle" (Thomas, 1995: 154). This research cycle consists of the following three phases:

- Phase 1: Description of the interplay between risk and protective factors. High-risk and protective factors for the development of obesity must be identified, bearing in mind that the etiology of obesity is multifactorial;
- Phase 2: Identification of causal risk factors that may be alterable through interventions;
- Phase 3: Systematic, empirical and rigorous testing of the intervention, most often in preventive intervention trials. The development, implementation and evaluation of interventions must be based on the research done in Phases 1 and 2.

The IOM report indicated that in 1995 research to prevent obesity was mainly involved with the first two phases of the proposed research cycle (Thomas, 1995: 154). They recommend that researchers should continue to work in these two phases, but that pilot-testing of promising interventions should be done, after which funds should be allocated for large-scale community prevention trials (Phase 3). Currently research still continues in the first two phases of the cycle, but several programmes have been developed, implemented and evaluated. The progression of the "prevention intervention research cycle" to ensure effective weight management by FYFS at the University of Stellenbosch is summarized in Table 2.2.

TABLE 2.2: Progression of the preventive intervention research cycle for FYFS.

Phase	Goal	Research on FYFS
Phase 1	Identify high-risk and protective factors	Senekal (1988a, 1988b, 1994) indicated that FYFS are a high-risk group to gain substantial amounts of weight during their first year and to continue gaining weight or becoming weight cyclers in subsequent years. Factors related to specific weight-management patterns were identified.
Phase 2	Identify risk factors that can be changed by intervention	Senekal (1994) identified factors related to weight-management problems experienced by female students that may be alterable through interventions.
Phase 3	Testing of prevention interventions	A multidimensional weight-management programme for female students was developed based on these findings. Testing of the multidimensional programme in a systematic, empirical study is the aim of this study

2.2 DESCRIBING THE CONCEPT OF WEIGHT MANAGEMENT

In scientific literature the concept "weight management" is especially used in conjunction with overweight and obesity, and is usually equated with weight-loss programmes or the achievement and maintenance of weight-loss goals. However, the term could involve a much broader application, regardless of BMI classification and weight loss as a primary goal. This notion is supported in a report by the American Dietetic Association (ADA) in which it is emphasized that weight management should not be regarded as synonymous with weight loss or the achievement of slenderness (ADA, 2002). Rather, health professionals should teach people to achieve and accept a healthier weight and adopt and maintain healthier lifestyles that lead to reduced health risks (ADA, 2002; Kassirer & Angell, 1998). Bearing this in mind, effective weight management implies achieving the best weight possible in the context of overall health (ADA, 1997). According to the ADA (2002), this will require a life-long commitment to healthful lifestyle behaviours, with an emphasis on sustainable and enjoyable eating practices and daily physical activity. Ineffective weight-management strategies such as weight cycling due to unsuccessful and unnecessary dieting could have detrimental effects on a person's health, even if he/ she is not classified as overweight or obese.

According to Senekal *et al.* (1999), weight management can be regarded as a continuum on which the following five prominent points were identified: determination of a reasonable weight goal; prevention of unnecessary weight gain or loss; weight loss when necessary; prevention of lapse/ relapse after weight loss, and the acceptance of an overweight/ obese physique when necessary. This continuum of weight management is strongly influenced by interactions with the environment. Certain intrapersonal characteristics and skills such as self-esteem, body image, self-efficacy, locus of control, motivation, stress management, assertiveness, problem solving and decision making will influence a person's ability

to be an effective weight manager and therefore form an integral part of the continuum. Lastly, using specific methods and techniques to ensure change where necessary are required to achieve and maintain an optimal weight (Figure 1.1, p10). All these components on the weight management continuum need to be addressed in any weight-management programme aiming to establish effective long-term weight-management practices of participants, regardless of their initial BMI classification.

Authors such as Parham (1999) and Strain (1999) suggest that weight management exists on a continuum as far as the extent to which external weight-management practices are necessary and should be attempted to achieve a healthy weight. According to these authors, this continuum ranges from complete reliance on internal control, such as hunger and satiety signals, to increased external supports systems such as the prescription of diets, meal plans and exercise protocols. Non-dieting, normalized eating, or intuitive eating are seen as approaches based on internal control (ADA, 2002). The assumption underlying these approaches is that the body knows best and that a person should rely on internal signals of hunger and satiety to guide their food intake (ADA, 2002). Literature indicates that approaches emphasizing internal regulation of food intake are mostly targeted at individuals who aim to maintain their current weight while addressing other issues associated with their eating and weight. Improvements in self-esteem, body image and other variables associated with psychological well-being have been associated with these types of programmes (Lyons & Miller, 2000; McFarlane *et al.*, 1999), although long-term randomized controlled studies are needed to validate this approach (ADA, 2002).

However, the ADA (2002) maintains that the extent to which people are able to perceive and act upon internal signals varies considerably. It can therefore not be assumed that all participants in a weight-management programme will necessary react effectively to internal signals. Factors such as emotional associations with food and eating, psychological problems and environmental factors may also complicate internal guidance. Some participants will thus be more dependent on external methods to structure and guide them to become effective weight managers, while others may have less or no need for such methods. Those who are unable to rely on internal systems may require long-term interventions which will teach them to perceive internal signals of hunger and satiety and to develop trust in allowing these signals to guide food intake (ADA, 2002).

A more moderate or mixed approach allows for a combination of a focus on internal and external guidance or support systems (ADA, 2002). Such approaches would, for example, teach an individual how to make healthy food choices (external guidance) and then allow their internal control systems to determine portion sizes. These approaches often include advice on exercise, stress management, self-acceptance as well as awareness of amounts eaten and the sensations produced while eating (ADA, 2002), which is very much in line with the approach suggested by Senekal *et al.* (1999). Theoretically, such approaches should cause changes in eating and exercise habits that will promote weight management (ADA, 2002).

In a report on weight-management counselling in primary care settings by the American College of Preventive Medicine it was recommended that all adults, independent of weight or BMI, should consistently receive counselling about healthful dietary and physical activity patterns (Nawaz & Katz, 2001). These authors also recommend the periodical assessment of BMI of all adults, in order to intervene early at an early stage.

2.3 ESSENTIAL COMPONENTS OF WEIGHT-MANAGEMENT INTERVENTIONS

Any weight-management intervention should help a person to take responsibility for making permanent lifestyle changes, which include the acceptance, change and maintenance of healthy dietary intake and physical activity through the means of behavioural modification (Nawaz & Katz, 2001). From relevant literature the American Dietetic Association summarized the proposed goals of weight-management interventions as follows (ADA, 2002):

- The prevention of weight gain;
- The prevention of further weight gain in the individual who has been experiencing a steady increase in his or her weight;
- Improvements in physical and emotional health;
- Small maintainable weight losses or more extensive weight losses achieved through sensible and tolerable eating and exercise behaviours;
- Improvements in eating, exercise and other behaviours apart from any weight losses.

All weight-management interventions should therefore at the very least include training in lifestyle modification with the following goals (ADA, 1997):

- Gradual change to a healthful eating style with increased intake of whole grains, fruits, and vegetables;
- A non-restrictive approach to eating based on internal regulation of food (hunger and satiety);
- Gradual increase to at least 30 minutes of enjoyable physical activity each day.

Based on these guidelines and relevant literature (ADA, 2002; AHA, 1994; NIH, 1998; Thomas, 1995; Senekal *et al.*, 1999; Whitney *et al.*, 2002: 269-305; Laquatra, 2000: 485-515) the following essential components of a weight-management intervention were identified and are discussed in more detail:

- Identification of reasonable weight goals;
- Healthful eating component;
- Physical activity component;
- Behavioural component and psychological health;
- Other non-essential components: surgical methods and pharmaceutical therapy.

2.3.1 Identification of reasonable weight goals

Foster (1995: 35) explains that the goal of traditional weight loss strategies was simple and straightforward, namely to reduce to ideal weight. Several reasons have been put forward why programmes should rather promote the selection of a reasonable than an ideal weight to be achieved or maintained by participants:

- Physiological limits: There are various physiological factors such as genetic predisposition, resting metabolic rate and adipose tissue development, which influence the regulation of body weight (Hawks, 2001; Hill *et al.*, 2000: 443-446). Ignoring the influence of these factors may lead to unrealistic weight expectations (Foster, 1995: 36).
- Cultural pressures: Cultural pressure to be thin influences many people, especially women, to base their weight goals on idealised figures propagated by the media. Setting more moderate weight loss goals and acknowledging the arbitrary nature of cultural ideals contribute towards efforts to enhance body image, improve self-esteem and decrease weight preoccupation (Foster, 1995: 37).
- Inappropriate weight standards: The use of height-weight tables or body mass index may be inappropriate to define a reasonable weight goal for specific individuals. For example, a BMI in the normal range may be a practical target for young non-obese adults, but for obese persons it is unrealistically low and may never be achieved (Dwyer, 1996). Such individuals should be informed that they must rather aim, first, to decrease their weight by a small amount associated with improved health and, second, to maintain the new weight. Weight goals should therefore be individualized bearing in mind factors such as initial BMI and the possible decrease in comorbidity risk (Foster, 1995: 37).
- Medical consequences: Modest weight losses (5-10%), in obese individuals, if sustained, decrease morbidity, increase function and possibly decrease mortality (Dwyer, 1996). These improvements are evident even if a person loses weight, but remains either overweight or obese. There is also evidence that intra-abdominal fat loss may decrease the risk of certain comorbidities (Colditz *et al.*, 1995).
- Behavioural demands: It is easier for people to maintain modest changes in their weight and behaviour than extreme changes. It is well known that long-term success with restrictive diets is usually limited. Initial large weight losses may occur, but relapse is common. Furthermore, the behavioural demands of weight maintenance through changes in dietary intake and physical activity practices will increase as weight decreases (Foster, 1995: 37).
- Faulty assumptions: According to Foster (1995: 38), the continued focus on ideal weight goals is based on two faulty assumptions. Firstly, the assumption is made that weight is the sole indicator of treatment efficacy, especially for weight-loss programmes. Secondly, the assumption is made that all people are the same, whereby two people who are the same height are expected to attain the same weight. This is also illustrated by the assumption that the body is infinitely malleable and can be moulded at will through diet, exercise, personal effort and even surgery, and by the expectation of rewards to the individual who reaches this goal (Brownell & Wadden, 1992). The scientific facts concerning the effect of, for example, environmental and physiological factors which influence body weight are thus ignored.

The American Heart Association states the following regarding reasonable weight goals: "The weight goal for the participant should be reasonable and based on personal, cultural, and family weight history, not exclusively on height and weight charts or body mass index (BMI)" (AHA, 1994: 224). Although there are many formulas or tables to classify weight and to determine an ideal weight, most of these methods still ignore the important above-mentioned individual differences (Foster, 1995: 40). The AHA further states conclusively that "There is no scientifically validated method for defining optimum body weight for a given individual" (AHA, 1994: 224). Therefore, over the past few years there has been considerable debate about the use of so-called ideal weights (Senekal *et al.*, 1999). According to Dwyer (1996), the use of ideal weights derived from weight standards is inappropriate because it focuses only on weights associated with lowest mortality and do not acknowledge other factors that influence a healthy weight. The use of weight standards such as the BMI is not completely unacceptable or prohibited, but it must be used in combination with a consideration of all other factors which contribute to the weight management of any individual, when deciding a reasonable weight goal of a participant in a weight-management programme (Foster, 1995: 40).

However, the most important weight-management goal is most probably to help participants accept and if necessary achieve a healthier and not an idealized weight, and to adopt healthier lifestyles that will lead to a reduction in the psychological and physical health risks associated with obesity (AHA, 1994; Kassirer & Angell, 1998). This is in line with the guideline statement of the 2000 edition of the *Nutrition and Your Health: Dietary Guidelines for Americans* which is "Aim for a healthy weight" (Flegal *et al.*, 2001). However, Flegal *et al.* (2001) acknowledge that the *Dietary Guidelines for Americans* label a BMI classified in the normal weight range as a "healthy weight", but that it also points out that weight above or below the healthy range may actually be healthy and that not all adults with a weight inside the healthy weight range are at their most healthy weight. The American Health Foundation Expert Panel on Healthy Weights recommends two guidelines to formulate healthy weight goals (Meisler & St Jeor, 1996). First, the most healthful weight is one that is attained at the age of 21 years, as long as BMI are in the normal weight range and maintained throughout life. Second, overweight and obese individuals should be encouraged to lose weight so that BMI is two BMI increments lower than current weight (Meisler & St Jeor, 1996).

Senekal *et al.* (1999: 1261) state that "for many women, the first objective in long-term weight management is formulation of a reasonable weight goal – a goal that is individualized, realistic, achievable, maintainable and contributes to total well-being". More specific guidelines for the formulation of weight goals for normal weight, overweight and obese individuals are as follows:

Weight goals for normal weight individuals:

The weight goals of individuals with a normal BMI should be to maintain a stable healthy weight (Dwyer, 1996). However, the risks associated with BMI vary and are influenced by factors such as body fat distribution, body build, age, the presence of comorbid conditions, inactivity and smoking (Dwyer, 1996). The weight of an individual is also influenced by various psychological factors, for instance, depression.

Many different weights are "healthy" and do not depend only on BMI classification but also on the presence of these other factors. Therefore, besides weight-maintenance and weight-gain-prevention strategies for normal weight individuals, attention should be directed towards addressing and changing these other factors, if present, in order to reach a healthy weight (Dwyer, 1996).

Generally the weight-management approach with normal weight individuals is to establish healthful lifestyle habits to maintain a healthy weight. However, this is usually not such an easy task, as cultural pressures and the media influence many normal-weight women and female students in Western societies to be dissatisfied with their weight (Georgiou *et al.*, 1997; Page & Fox, 1998) and to set unrealistically low weight goals (Crawford & Campbell, 1999; Schulken *et al.*, 1997). While this problem affects most women, it is almost non-existent among men (Anderson *et al.*, 2003; Crawford & Campbell, 1999; Ziebland *et al.*, 1996). Women are therefore constantly aware of their weight and body size and engage in lifelong weight-loss practices to reach their ideal – but mostly unrealistic – goal weight (Liebman *et al.*, 2001; Serdula *et al.*, 1999; Wilfley & Rodin, 1995: 78). It is thus important to create awareness among normal-weight women of the fact that, despite endless efforts to reduce weight, most women do not reach their unrealistic weight goals and that women are far more inclined to gain weight or fall into a weight cycling pattern and as a consequence to experience physical health problems, decreased psychological well-being, increased body shape dissatisfaction and lower self-esteems. They should also be made aware of the fact that the decreased psychological well-being associated with weight cycling and chronic dieting impairs further attempts at effective weight management (Senekal *et al.*, 1999).

Weight goals for overweight or obese individuals

The most important factor in determining the weight goals of overweight or obese individuals should be the amount of weight loss that is needed so that weight no longer impedes normal functions, health, employment, or life activities (AHA, 1994: Smolin & Grosvenor, 2000: 222). A reasonable weight goal depends largely on the presence of risk for comorbidities, past weight patterns and all other factors which influence weight-management abilities which are present in the specific individual. A person with a strong family history of obesity and a lifelong personal history of overweight should not be promised a final weight in the normal BMI range. If weight loss is indicated, step-wise weight reduction goals, whereby the participant agrees to work toward a modest weight reduction, should be adopted (AHA, 1994). The focus of weight goals should be to reflect a reduction of body fat, which can only be achieved through modest weight losses over lengthy periods (Laquatra, 2000: 496-497). It is has been shown that a reduction of 5 to 10% or one BMI increment in initial weight is associated with improvement in health, decreased mortality and improvement in comorbid conditions (ADA, 2002; Dwyer, 1996; Laquatra, 2000: 496; NIH, 1998). A 10% weight reduction could thus be suggested to all overweight and obese individuals as an important initial weight goal (Foster, 1995: 40; NIH, 1998). The 2000 edition of the American Dietary Guidelines also advise that a loss of 5 to 15% of body weight may improve your health (Flegal *et al.*, 2001). Six months has been suggested as a reasonable time period to reach a 10% reduction in weight (NIH, 1998; Flegal *et al.*, 2001). Dwyer (1996) maintains that in most studies subjects who lost about 10% of initial body weight with a weight loss programme regained at least two thirds of it within

one year and almost all within five years. Therefore, only when the initial weight loss is maintained for some agreed-upon period (possibly also a six-month period), can further weight reduction be attempted (Dwyer, 1996; NIH, 1998). This in agreement with the recommendation by Laquatra (2000: 496) of a 10 to 15% reduction in weight over a period of one year, a maintenance period and then the year-long programme can be repeated. Foster (1995: 40) suggest that after each successive 5% weight loss interval, a decision should be made on the need for further weight loss based on the associated benefits and risks. These suggested levels of weight loss are considered to be achievable for most adults and are easier to maintain than larger losses over shorter time periods (Smolin & Grosvenor, 2000: 222).

In South Africa it is also advised that a 5 to 10% sustained weight loss should be recommended as weight goals (SASSO, 2003: 7). This should be achieved at a rate of 0.5-1.0 kg per week for a period as long as six months (SASSO, 2003: 9). Great inter-individual variability in the rate of weight loss does exist and must be acknowledged (SASSO, 2003: 9).

For individuals who are overweight without the actual presence of or risk for the development of comorbidities and who seem to be predisposed to be overweight based on family and personal weight history, a reasonable weight goal may rather be to maintain their current weight and adopt a healthier lifestyle (Whitney *et al.*, 2002: 278).

According to ADA (2002), the challenge lies in helping overweight and obese individuals to accept their individualized reasonable weight goals. The same cultural influences that drive normal weight individuals to set unrealistically low weight goals affect overweight and obese individuals to strive for unrealistic weight goals. It is therefore important to encourage and emphasize a healthier weight goal and lifestyle, while de-emphasizing cosmetic goals (Laquatra, 2000: 496). To motivate overweight or obese individuals to accept these goals, they should be made aware of the fact that it is well documented that about two thirds of weight loss is regained after a period of one year and almost all within five years, especially if the weight loss was large and over a short period. Furthermore, they must understand what can realistically be achieved with current treatment methods (Laquatra, 2000: 496).

It should also be emphasized that with weight regain an individual's weight often returns to a higher weight than before and that after each unsuccessful weight-loss episode his/her weight could actually increase (Whitney *et al.*, 2002: 278). These episodes of weight loss and regain or weight cycling have been indicated to increase blood pressure (Guagnano *et al.*, 2000; Kajioka *et al.*, 2002) and mortality (Lee & Paffenbarger, 1992), although after adjusting for BMI and weight gain the increased risk of hypertension disappeared (Field *et al.*, 1999). Weight cycling is also associated with increases in the proportion of body fat, decreased lean body mass and a subsequent decrease in resting metabolic rate (Kajioka *et al.*, 2002), which complicates further weight loss even more (Smolin & Grosvenor, 2000: 222; Whitney *et al.*, 2002: 278). Therefore, assessing an individual's weight-loss history is important before setting goals, because it can predict potential success in maintaining weight loss (Whitney *et al.*, 2002: 278). Besides these physiological and physical health effects, unsuccessful attempts also have a

deteriorating effect on psychological health (Laquatra, 2000: 496), such as decreases in self-concept, self-esteem, dissatisfaction with body shape and disordered eating attitudes.

2.3.2 Healthful eating component

2.3.2.1 The importance of healthful eating for weight-management

To maintain a constant body weight involves a complex system of neural, hormonal and chemical mechanisms (psychological conditions) together with genetic and environmental influences that regulate a balance between energy intake and energy expenditure within fairly precise limits (Hill *et al.*, 2000: 443; Laquatra, 2000: 486). Although many of these mechanisms are not clearly understood, it is known that when energy intake is constantly higher than energy expenditure, a positive energy balance develops which will result in weight gain (Peters *et al.*, 2000: 426). One way to combat this situation is by paying attention to energy intake, thus to nutrition and dietary intake. Due to the unique system which controls the energy intake of an individual, it is very important that all weight-management programmes should contain a healthful eating component that reflects recommendations based on the individual needs of each participant (Peters *et al.*, 2000: 430). This should include a personal eating plan that takes into account current eating habits, lifestyle, ethnicity and culture, energy needs, any diet prescription related to medical treatment and potential nutrient-drug interactions (AHA, 1994). Weight-management programmes should therefore not encourage the use of the same rigid dietary meal plan for all participants.

The lives of young adults between the ages of 18 to 22 years are accompanied with major transitions, usually from a small family circle to an expanded adult world, as is the case with FYFS (Rolfes *et al.*, 1998: 320). The choices made, and the actions performed, during early adulthood lay the foundation for their remaining adult years (Rolfes *et al.*, 1998: 326). The effect of poor eating habits may not affect young adults at this stage, but can result in impaired health in the long term (Rolfes *et al.*, 1998: 326). Therefore, nutrition during early adulthood plays a decisive role in the establishment of eating patterns and habits and health in later years (Mathai, 2000: 281).

2.3.2.2 Dietary composition

The promotion of healthful eating should be the cornerstone of any weight-management intervention (ADA, 2002). In the past nutrition was mostly viewed as a tool to prevent deficiency diseases (Mathai, 2000: 272). Healthful eating is now increasingly focused on the relationship between dietary composition and the development of chronic diseases and other conditions (Flegal *et al.*, 2001). The aim of dietary planning within the context of a weight-management programme should therefore be to address the weight issue, while emphasizing the prevention of premature death from the mentioned diseases (Mathai, 2000: 272). According to Mathai (2000: 274), such a nutritional plan follows the concepts of a defensive nutrition paradigm. The goal of this paradigm is to prevent disease and promote wellness through the promotion of "health-building and health-sustaining dietary patterns". With this approach the emphasis is especially placed on the importance of the inclusion of plant-based foods to prevent or decrease the risk

of developing chronic diseases (Mathai, 2000: 274). According to Mathai (2000: 281), healthful eating during early adulthood implies: consumption of five to nine servings of fruit and vegetables each day; balanced intake of foods with essential fatty acids (omega-6 and omega-3 fatty acids); avoidance of foods high in saturated fats and trans-fatty acids, inclusion of high-fibre food, especially foods high in lignans; limited intake of refined carbohydrates and increased water consumption.

A health-care provider knowledgeable about obesity and its treatment as well as about the physiology of weight loss, can help an individual to develop a nutritionally adequate diet plan tailored to his or her weight-loss goals within the context of factors such as gender, age, dietary preferences and level of physical activity. To achieve this aim the energy and nutrient composition of the diet should be based on the following:

Energy:

- Energy requirement should be calculated individually and will depend largely on reasonable weight goals. Various formulae are available to determine energy needs to maintain, gain or lose weight. These formulae commonly estimate energy requirements by adding estimates of resting metabolic rate, energy expended in physical activity and the thermic effect of food (Johnson, 2000: 26). Of the more than 190 equations available to estimate energy requirements, Johnson (2000: 26) indicates that the most widely used equation in the USA is probably the Harris-Benedict equation, which takes gender, weight, height and age into account. Besides the use of this equation to determine energy needs, the DRIs[4] for energy expenditure can also be used (IOM, 2002).
- If the weight goal is to lose weight, a minimum of 5020 kJ per day for women and 6300 kJ per day for men should be provided by the weight loss diet (AHA, 1994; NIH, 1998). These guidelines are based on helping an individual to achieve but not exceed the safe rate of weight loss (AHA, 1994). If weight loss cannot be achieved with these levels of energy restriction, if dietary and exercise compliance were achieved, the energy level should be modified and the participant be monitored (AHA, 1994). Food plans should be designed so that participants are likely to select foods that meet all the DRIs except that for energy.
- For overweight individuals with a BMI of 27 to 35 a decrease of 1255 to 2092 kJ/day should result in a 0.22 to 0.45 kg weight loss per week and consequently a 10% weight loss in six months (NIH, 1998). For individuals with a BMI >35, a decrease of 2092 to 4184 kJ/day should result in a weight loss of 0.45 to 0.9 kg per week (NIH, 1998). These latter energy deficit ranges and consequent weight losses have also been recommend by ADA (2002) for individuals who want to lose weight. Others indicate that to lose 0.45 kg (1 pound) per week, energy intake should be decreased and energy expenditure increased so that a negative energy balance of 2092 kJ/day is reach (Smolin & Grosvenor, 2000: 224; Whitney *et al.*, 2002: 282).

[4] The dietary reference intakes (DRIs) was developed by the Food and Nutrition Board of the Institutes of Medicine of the United States as a set of standards for the intake of nutrients and food components to avoid dietary deficiencies and to maximise health and improve quality of life by reducing the risk for the development of chronic diseases of lifestyle. DRI is a collective term which refers to a set of four nutrient-based reference values, namely the Estimated Average Requirement (EAR), Recommended Dietary Allowance (RDA), Adequate Intake (AI) and Tolerable Upper Intake Level (UL) (IOM, 2002).

- A total energy intake of less than 5020 kJ/day may not meet nutrient requirements (Whitney *et al.*, 2002: 282) and dietary supplementation may be needed (ADA, 2002; AHA, 1994; Smolin & Grosvenor, 2000: 224).
- Diets that provide less than 3350 kJ per day should not be used, except under the supervision of an appropriate health care professional (ADA, 2002; AHA, 1994).
- Reduction of energy intake should not require special foods or dramatic changes in eating habits (Smolin & Grosvenor, 2000: 224).

Protein:

- Protein should provide between 15% to 25% of total energy content of the diet (Laquatra, 2000: 498) and should be of high biological value (AHA, 1994)
- High biological value proteins include protein from meat, fish, poultry, diary and soy. The protein from grains, other legumes and vegetables are of low biological value. However, these protein sources are important for a healthy diet and constitute an important part of the defensive nutrition paradigm as stated earlier (Mathai, 2000: 274). These plant proteins are also high in fibre, essential micronutrients can be combined to provide all the essential amino acids required (Ettinger, 2000: 58).
- For weight reduction purposes the diet should contain adequate protein (at least 60 g/d for women and 75 g/d for men) to maintain nitrogen balance and limit the loss of lean body mass (IOM, 2003).

Fat:

- Fat should provide less than 30% of total energy content of the diet (ADA, 2002; AHA, 1998; NIH, 1998; Laquatra, 2000: 498; SASA, s.a.). For weight management purposes it is important to promote a low-fat diet (<30% of total energy content).
- Fatty acid composition should be as follows: saturated fatty acids less than 10% of total energy (AHA, 1994; SASA, s.a.), polyunsaturated fatty acids up to 10% (AHA, 1994; SASA, s.a.) and the remainder should be provided from monounsaturated fatty acids, about 10% to 15% of total energy (AHA, 1994).
- Trans fatty acids should make up <2% of total energy intake (WHO & FAO, 1995).
- Cholesterol intake should be no more than 300 mg/d (AHA, 1994; SASA, s.a.).

Carbohydrate:

- Carbohydrates should provide 50 to 55% or more of the total energy content of the diet (AHA, 1994; Laquatra, 2000: 498). The IOM (2002), indicates that 100g carbohydrate per day is required to supply adequate glucose for brain function, but recommends that diets should not contain less than 130g/day.
- Focus should be on decreasing the intake of simple sugars or refined carbohydrates and increasing the intake of complex carbohydrates and fibre (Earl & Borra, 2000: 342).
- The Glycemic Index (GI) of foods should also be considered. High GI foods are associated with a rapid rise in blood glucose and high insulin secretions, which may cause insulin resistance and

associated disorders such as the metabolic syndrome in the long term. Low GI foods such as beans, vegetables and whole grains should be recommended (Mathai, 2000: 282).

- The diet should provide 20-30 g of fibre per day (SASA, s.a.) or 10-13 g/ 4184 kJ (Smolin & Grosvenor, 2000:114)

Micronutrients:

- The diet should provide the DRIs of all micronutrients. For these purposes sufficient whole grains, fruit, vegetables, meat and meat replacers, milk and milk replacers, and essential oils should be supplied by following the recommendations of for example the American Food Guide Pyramid (USDA, 1992) and ensuring a varied food intake.
- Meal plans supplying 5020 kJ or less may not provide recommended levels of vitamins and minerals and a daily vitamin and mineral supplement may be taken so that the DRIs are met (AHA, 1994).

These guidelines indicate that regardless of energy content, it is important that the diet should supply all macro- and micronutrient needs of the individual. SASSO (2003: 12) indicates that many different nutrients are essential to maintain health and that no food can supply all the nutrients needed by the body. Therefore, as indicated by the dietary guidelines of many countries, including South Africa, a nutritionally adequate diet is composed of a variety of foods (SASA, s.a.). The dietary guidelines such as the South African Food-Based Dietary Guidelines (Vorster et al., 2001) can be combined with tools such as the American Food Guide Pyramid (USDA, 1992) to plan a healthful dietary plan. Therefore, meal plans that include the recommended daily servings from all the food groups as specified by the mentioned guides and supply more than 5020 kJ will be nutritionally adequate for participants without specialized therapeutic nutritional needs (Earl & Borra, 2000: 342). The DRIs can also be used in the planning and assessment of adequacy of a healthy diet (Earl & Borra, 2000: 342; Smolin & Grosvenor, 2000: 34). It is very important to emphasize that certain foods should not be excluded from a food plan either due to their "fattening" or due to magical reducing connotations associated with them (Rolfes *et al.*, 1998: 328).

As far as eating pattern or frequency of eating is concerned, it has been indicated that a larger number of eating episodes during the day are associated with decreased risk for obesity, while skipping breakfast and eating breakfast or dinner away from home are all associated with increased prevalence of obesity (Ma *et al.*, 2003). In a large cohort study over a four-year period, it was found that skipping breakfast was associated with health-compromising behaviours in adults such as smoking, infrequent exercise, higher BMI and more frequent alcohol use (Keski-Rahkonen *et al.*, 2003). It has further been indicated by King and Gibney (1999) that a decrease in dietary fat as well as the restriction of eating occasions to three per day was associated with being less effective in decreasing the intake of total fat and saturated fatty acids compared to more frequent eating. It would therefore seem that an eating pattern characterized by more frequent (>3) eating occasions, should be recommended as part of weight-management guidelines.

2.3.2.3 Critical assessment of popular dietary approaches to weight reduction

The different dietary approaches for weight loss are presented in Table 2.3. From this table it is evident that, although the less orthodox eating plans i.e. very low energy content and extreme changes in macro nutrient content, seem to be effective in the short term, this is not true in the longer term. However, the slower more moderate results obtained with more moderate energy restrictions cause frustration and increase the susceptibility of the individual to use more extreme approaches, especially if seen in the light of the fact that these diets are often marketed very effectively as the underlying aim is profit driven. The extreme diets should be avoided to ensure life-long healthful eating for effective weight management and physical health. The challenge therefore lies in adopting innovative nutrition education and motivation techniques to promote the use of more moderate energy restrictions and a macronutrient composition that promotes overall health.

TABLE 2.3: Different dietary approaches for weight loss

	kJ/day	Indication and Description	Advantages	Disadvantages
Starvation diet	0-840	Fasting, seldom prescribed. Individuals often use it for religionous or political purposes. Personal efforts to lose weight.	Rapid weight loss.	FAD-diet: does not address underlying problem of unhealthful eating, does not promote an acceptable basis for long-term healthful eating. Weight losses mainly due to water and lean body mass (LBM) losses. Accumulation of uric acid = gout, gallstones. Hypotension can occur.
Very low calorie diet (VLCD)	840-3350	BMI>30 and failed with other weight loss approaches. BMI 27-30 with comorbidity. Use for 12 to 16 weeks, not longer. Need vitamin and mineral supplements. Monitored by a multidisciplinary health professional team. Food intake is usually displaced by formulas. Provide 1.2-1.5g protein/ kg to limit LBM losses.	Larger, more rapid weight loss (20kg in 12 weeks). Improved health: Decreases in TC, TG, LDL, blood pressure, improved glycaemic index.	Limited long-term success, most regain all weight lost within 5 years. Attrition rate usually high. Cardiac complications, risk of sudden death. Potassium and body protein losses. Increased urinary ketone excretion, gout, ketoses. Fatigue, nervousness, euphoria, constipation, diarrhea, dry skin, anemia, menstrual irregularities. Expensive formulas must be used. Resumption of eating solid foods frequently disrupts maintenance efforts. Could be a fad-diet.
Low calorie diet (balanced)	♀: 3350-5020 ♂: 3350-5860	Some make use of specially formulated foods, prepacked foods/ preparations. Other use regular foods with multivitamin mineral supplement.	Weight loss = 0.5-1.5kg/ week Safe to use by anyone, even with comorbidities. If well planned the diet will be nutritionally adequate, providing enough servings from all major food groups.	Slower weight losses may cause frustration, difficult to maintain permanent changes in eating habits.
Moderate deficit diet	♀: 5020 ♂: 5860	Requires little, if any medical supervision.		Slower weight losses may cause frustration, difficult to maintain permanent changes in eating habits.
Low fat diet	Varies. But fat content can be <10% of total energy	Decrease total fat intake. Reduce energy intake because fat has higher energy content than protein or carbohydrates.	Provide more food for same amount of kilojoules if fat is replaced with other food. Results in modest weight losses and predict weight maintenance.	Limited food choices make it difficult to maintain. Pallatibility.
Low carbohydrate, high protein diet (e.g. Atkins diet)		Often published books aimed at lay public and are often not written by health professionals. Not based on sound scientific nutrition principles.	Rapid weight loss claimed. Higher prtein and fat intake improves satiety. Decrease fasting triglycerides and free fatty acids. Normalization of fasting insulin.	No adverse effects if used for 12 monghts, long-term effects unknown. High protein and saturated fat intake may be problematic on long-term. Poor compliance. Glycogen loss, diuresis. Could be a fad-diet
High carbohydrate, low-fat (e.g. X-diet)		Carbohydrate = 80% of TE Fat = 10% of TE Protein = 10% of TE	Rapid weight loss claimed.	Could be a fad-diet
Meal replacements	4184-6700	Replace meal with liquid drink or pre-measured frozen meal Drink usually contains: 50-60% CHO, 30% protein, 10% fat Daily recommended quantity of drink: 900kCal, 20% prot, 30% fat, 50%CHO.	Safe if they provide enough energy and contain vitamins and minerals. Reduce sensory stimulation. No need to make decisions about portion sizes.	Expensive, dependence on a particular product. Failure to develop appropriate long-term eating habits. Boredom.

Sources: (ADA, 2002; AHA, 1994; Foster *et al.*, 2003; IOM, 2003; Laquatra, 2000: 498-502; NIH, 1998; Thomas, 1995; WHO, 2003: 86-93)

2.3.2.4 Nutrition education

Contento *et al.* (1995) define nutrition education as any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition-related behaviours conducive to health and well-being. This definition has been adopted by the American Dietetic Association (ADA, 1996) and they further stated that nutrition education should form an integral component of all health promotion, disease prevention and health maintenance programmes, through incorporation into all appropriate nutrition communication, promotion and education systems as stated by the American Dietetic Association (ADA, 1996: 1183). Contento *et al.* (2002) concluded from a review of studies on nutrition education over the past 20 years that the goal of nutrition education interventions for free-living adults in community settings is clearly defined and behaviourally focused to decrease the risk of chronic disease and to promote healthful eating patterns improving the nutritional adequacy of the diet and changing behaviours. According to the IOM (2003: 86), a clear distinction should be made between nutrition education and nutrition counselling, although the contents may overlap. In nutrition counselling the focus is more directly on the motivational, emotional and psychological issues associated with the current weight-management strategies, thus addressing how to change behaviour (IOM, 2003: 86). Nutrition education provides basic information about the scientific foundation of nutrition that enable individuals to make informed choices about food, cooking methods, eating out and estimating portion sizes. Furthermore, nutrition education may also provide information on the role of nutrition in health promotion and disease prevention (IOM, 2003: 86).

Nutrition educators should be trained in the fields of human nutrition, learning theories and educational methods, including behaviour change strategies (Tuttle *et al.*, 2003). These educators are facing an increasingly difficult task these days, because a vast amount of conflicting nutrition-related messages reaches the public. To help them distinguish between the correctness of these messages, nutrition educators must apply strategies to be heard above competing information (ADA, 1996). This is especially applicable in the context of weight management as individuals are being bombarded with health and nutritional messages through the media, which often promise quick fixes and remedies to "improve" one's health (Tuttle *et al.*, 2003). Therefore, the American Heart Association indicates that nutrition education should be incorporated into weight-management programmes to encourage permanent healthful eating patterns (AHA, 1994).

Nutrition education must be "consumer driven", implying that interventions must be developed according to the needs, perceptions, behaviours, motivations and desires of the target audience (ADA, 1996; Whitney *et al.*, 2002: 613-615). According to ADA (1996), the major challenge for nutrition educators is research on the target audiences' need for nutrition education programmes and the best methods for the delivery of nutritional information to that target audience. The most effective nutrition education strategy is therefore based on a clear understanding of the needs and desires of the target audience as well as the environmental context of the problem and the desired outcomes (ADA, 1996; Tuttle *et al.*, 2003). It is also important to consider the social barriers which may alter the effectiveness of nutrition education attempts (Tuttle *et al.*, 2003). Once the nutrition education needs have been identified, a plan to address

the need and outcome measures to determine the effectiveness of the plan should be applied. After implementation of the plan, evaluation is necessary to determine its success (Whitney *et al.*, 2002: 615).

The definition of nutrition education suggests that behaviour change is the appropriate outcome criterion for evaluating the effectiveness of nutrition education (Contento *et al.*, 2002). Therefore, the intermediate goal of nutrition education is to accelerate the shift towards healthful eating, while the ultimate goal should be a sustained change in behaviour (Tuttle *et al.*, 2003). With nutrition education the knowledge of the audience is increased, which eventually results in reduction of medical care costs and improvement in the quality of life (Smolin & Grosvenor, 2000: 591). To foster a behaviour change may involve a combination of methods such as systematically increasing awareness and teaching behaviour skills, providing incentives for achieving goals and employing social support (ADA, 1996). Methods/ educational formats to deliver information include one-on-one counselling, group counselling, formal classes, self-help materials, computer-based feedback, telephone conferences and community-wide activities (Contento *et al.*, 1995; IOM, 2003: 86) in settings such as universities and schools (ADA, 1996). Educational formats that provide practical and relevant information for the audiences are the most successful (IOM, 2003: 86).

Within the context of healthful eating, the following could be recommended as relevant key nutrition related topics for inclusion in weight-management programmes: energy balance, energy needs, total fat intake, fatty acid intake, modification of fat intake, protein needs, carbohydrate needs, fibre, sugar, sugar replacers, alcohol consumption, meal times, supplementation, nutrition labels, dietary goals and a varied diet based on for example the food groups or the Food Guide Pyramid (ADA, 2002; AHA, 1994; Laquatra, 2000; SASSO, 2003).

2.3.3 Physical activity component

2.3.3.1 Importance of physical activity for weight management

Historically, exercise was not included in weight-management programmes aiming at decreasing weight through a weight loss diet. Nowadays exercise is considered to be one of the highest priorities of weight-management programmes and it is highly recommended as an indispensable component to prevent and manage obesity (Rippe & Hess, 1998; SASSO, 2003: 13).

Although there is some controversy, most studies indicate that physically active adults are less likely to gain weight and become obese during their lifetime than inactive persons (Ching *et al.*, 1996; DiPietro, 1995; Sherwood *et al.*, 2000b). Within the context of the fact that physical activity (energy expenditure) features strongly in the energy balance equation mentioned in Section 2.3.2.1, it is clear that changes in physical activity will have a profound effect on energy balance. It is therefore not surprising that it is recommended that physical activity is very important to manage weight and should be included in all weight-management programmes (Peters *et al.*, 2002). Based on a review of the literature, Rippe and

Hess (1998) mention that physical activity has an effect on all three components of energy expenditure, which includes the increase in resting metabolic rate (RMR), possible increase in the thermic effect of food, although many studies show little or no effect, and an increase in energy expended during physical activity. This statement is also supported by Hill *et al.* (2000: 449), who indicated that when weight loss has occurred without any changes in the level of physical activity, all three components of energy expenditure will decline and total energy requirements are subsequently less (Hill *et al.*, 2000: 449). Of these three components, the factor that has the greatest effect on the resulting energy balance equation is the decrease in RMR (Hill *et al.*, 2000:449). Besides the positive effects of physical activity on the components of energy expenditure, physical activity accounts for about 15 to 30% of total daily energy expenditure (IOM, 2003: 87).

Increased physical activity alone can result in a 2 to 3 kg weight loss, though it is an ineffective method to lose significant weight when not combined with dietary intervention (IOM, 2003: 81; Laquatra, 2000: 505). While it is indicated that physical activity accounts for 15 to 30% of energy expenditure, food intake accounts for 100% of energy intake and therefore changes in physical activity cannot be used without changes in dietary intake to create an energy imbalance that is conducive to weight loss (IOM, 2003:87). For overweight or obese adults who are on a weight-reduction programme, the IOM (2003: 82) and the literature review by Rippe and Hess (1998) indicate that a combination of physical activity and energy restriction is more effective for weight loss than either method alone. The continuation of physical activity after weight loss is also one of the best predictors of maintaining the new weight over the long term (Jakicic *et al.*, 1999; McGuire *et al.*, 1998; SASSO, 2003: 13; Sherwood *et al.*, 2000b). The effect on weight maintenance is brought about by preservation or increases in lean body mass (LBM) and consequently increases in RMR and energy expenditure (IOM, 2003: 81). Increases in LBM are associated with increases in RMR because muscle tissue is approximately seven times more active than fat tissue. The inclusion of resistance training may enhance this effect on RMR and consequently the ability to utilize more of the energy intake (Rippe & Hess, 1998). Weight loss, even if a healthy balanced weight loss diet is used, is always accompanied by losses of LBM, although this effect is attenuated by exercise which preserves LBM (SASSO, 2003: 13). Hill *et al.* (2000: 449) indicate that weight loss on a healthy balanced diet constitutes approximately 60 to 70% fat and 30 to 40% LBM. Therefore, physical activity plays an essential role in combating the decrease in energy expenditure followed by weight loss.

Physical activity also exerts positive changes in body composition, which include maintenance of or increases in LBM and decreases in percentage body fat (IOM, 2003: 81; Laquatra, 2000: 504; Rippe & Hess, 1998; SASSO, 2003: 13). Beside the positive effects of physical activity on body composition (LBM and total body fat content), a decrease in waist-to-hip ratio and accompanied health risk is also attributable to increased physical activity (Koh-Banerjee *et al.*, 2003). Trained individuals have greater total body lipolises at rest than obese individuals (Rippe & Hess, 1998; Ross *et al.*, 2000). Physical activity may therefore correct the lower catecholamine-stimulated lipolysis at rest observed in obese people (Rippe & Hess, 1998; Ross *et al.*, 2000). Another benefit of physical activity, which contributes to effective weight management, is that it may improve hunger and satiety mechanisms and limit appetite

(SASSO, 2003: 13). Physical activity furthermore results in improved adherence to all aspects of effective weight management, possibly due to decreased anxiety or depression and improved mood experienced (Rippe & Hess, 1998). It has been suggested that possibly the most valuable contributions of physical activity are the relief of boredom, increased sense of control and improved sense of well-being (Laquatra, 2000: 504).

Besides effective weight management, the incorporation of physical activity into daily life also exerts other positive effects on the health of adults including the reduction of premature mortality, symptoms and risks of obesity-related comorbidities such as cardiovascular disease, diabetes, pulmonary disorders, colon cancer and orthopedic conditions (Table 2.4). Regular physical activity also improves mental health and feelings of well-being (Rippe & Hess, 1998). This is in accordance with the goal of weight management stated originally, namely the improvement of the overall health of everyone (ADA, 2002). For normal-weight participants it is thus important to be physically active for the maintenance of energy balance and weight. For overweight and obese adults an increase in physical activity level is associated with a decrease in all-cause morbidity and mortality risk, regardless whether weight is lost or not, when compared with sedentary individuals of normal weight (Blair *et al.*, 1996; Barlow *et al.*, 1995).

TABLE 2.4: Health advantages of exercise

Advantage	Mechanism
Reduced risk of certain obesity-related comorbidities such as non-insulin dependent diabetes mellitus, some cancers, hypertension, cardiovascular disease and metabolic syndrome	Influence the distribution of body fat positively: Exercise alone or combined with diet reduces visceral abdominal fat and total body fat. Decreases in total cholesterol, LDL cholesterol, TG, p-insulin, blood glucose and increase in HDL cholesterol levels in the blood. May reverse the typical decline in HDL associated with the initial phase of weight loss. Physical activity has been shown to be an independent risk factor for CHD. Aerobic exercise strengthens the heart muscle; reduces resting heart rate and workload. May reduce blood pressure. Combined with diet it results in a weight loss accompanied by healthier lipid profiles than weight loss with diet.
Reduce/ eliminate need for medication to maintain normal blood glucose levels in diabetics	Exercise and reduced body fat = increasing sensitivity to insulin.
Reduced risk of osteoporosis	Weight-bearing exercise increases peak bone mass and prevents bone loss. Resistance training increases bone mineral density.
Benefits for arthritis	Increased movement of arthritic joints.
Reduced risk for cancer development	Possibly reduced risk for colon and breast cancer, though confounding factors such healthier diet by exercising participants may play a role.
Postpone or prevent changes that occur with age	Less decrease in LBM; Improve muscle strength and endurance; Improve cardiorespiratory endurance.
Improve psychological health: improved self-esteem, increased sense of control, improved mood, pain tolerance, appetite control, sleep patterns; reduce anxiety or depression	Exercise stimulates release of endorphins which are natural tranquillizers

Sources: Blair *et al.*, 1996; Laquatra, 2000: 504-506; Rennie *et al.*, 2003; Rippe & Hess, 1998; Ross *et al.*, 2000; WHO, 2003: 79-82.

It can be concluded that physical activity is essential for effective weight management by all individuals, because the associated benefits are significant and occur even in the absence of weight loss (Blair, 1993; Kesaniemi *et al.*, 2001). For all individuals, besides effective weight management, it offers an improvement in overall general health through the prevention, risk reduction or improvement of chronic diseases and improvement in psychological well-being (ADA, 2002; Rippe & Hess., 1998). Furthermore, for those who did lose weight, physical activity will help to maintain the new weight.

2.3.3.2 Recommendations regarding physical activity

Any weight-management programme should include an exercise component that is safe and appropriate for each participant. For participants who want to lose weight it is important not to create the expectation that physical activity alone will decrease weight. Furthermore, it is also important to emphasize that increased physical activity can mask initial weight losses. Increased physical activity could initially increase muscle mass and because LBM is denser than the fat it replaces, total body weight may not change. With continued exercise, the limited capacity of muscle mass to increase is overcome by the decrease in fat, resulting in a net decrease in body weight (Laquatra, 2000: 505).

For each individual the recommended intensity, duration, frequency and type of physical activity should be based on existing medical conditions, degree of previous activity, physical limitations, and individual preferences (IOM, 2003: 80). Previously sedentary people should start with short sessions of moderate-intensity activity and gradually increase this. Persons at risk of chronic diseases should consult a physician when beginning a new activity programme (IOM, 2003: 80). Those who are overweight or obese should be advised that they should be screened for conditions in which exercise could be contraindicated (SASSO, 2003: 16).

There are a number of different recommendations regarding **the amount** of additional physical activity that is necessary to contribute positively to weight management and health in general. These recommendations include the following:

- The Centers for Disease Control and Prevention, the American College of Sports Medicine and Healthy People 2010 currently recommend that Americans should engage in 30 minutes or more of moderate intensity activity on most if not all days of the week (NIH, 1998; Pate *et al.*, 1995). These 30 minutes may be accumulated in several short sessions, such as three 10 minutes sessions per day. Breaking the recommendations up into 10 minute sessions has been shown to increase compliance over the long term (Jakicic *et al.*, 1995; Pate *et al.*, 1995).
- In South Africa it is recommended that individuals accumulate 45-60 minutes of moderate to vigorous activity on most days (SASSO, 2003: 13).
- The Surgeon General's Report on Physical Activity and Health recommends that Americans should expend at least 628 kJ/day or 4184 kJ/week through physical activity. Healthy People 2010 indicates that the recommended 30 minutes daily activity will increase energy expenditure by about 4393 kJ/week. These amounts may be insufficient to prevent weight regain after weight loss (IOM, 2003: 81) and for that purpose it is recommended that 6276 to 8368 kJ/week and perhaps as much

as 12552 kJ/week of physical activity may be necessary (Ewbank *et al.*, 1995; Klem *et al.*, 1997; Rippe & Hess, 1998; Schoeller *et al.*, 1997).

Specific guidelines regarding **the type of physical activity** that individuals should engage in, have also been formulated. These guidelines include the following (Laquatra, 2000: 505; Rippe & Hess, 1998; SASSO, 2003):

- Aerobic exercise which raises heart rate and improves cardio-respiratory fitness;
- Stretching which promotes and maintains flexibility;
- Strength training exercises at least twice a week which enhances the strength and endurance of specific muscles;
- A combination of aerobic and resistance training is optimal;
- Strategies on how to increase leisure-time activity levels should be incorporated and encouraged.

The South African Society for the Study of Obesity recommends the use of a guide such as an Activity Pyramid (Figure 2.2) to guide individuals on the type and amount of physical activity to engage in (SASSO, 2003: 15).

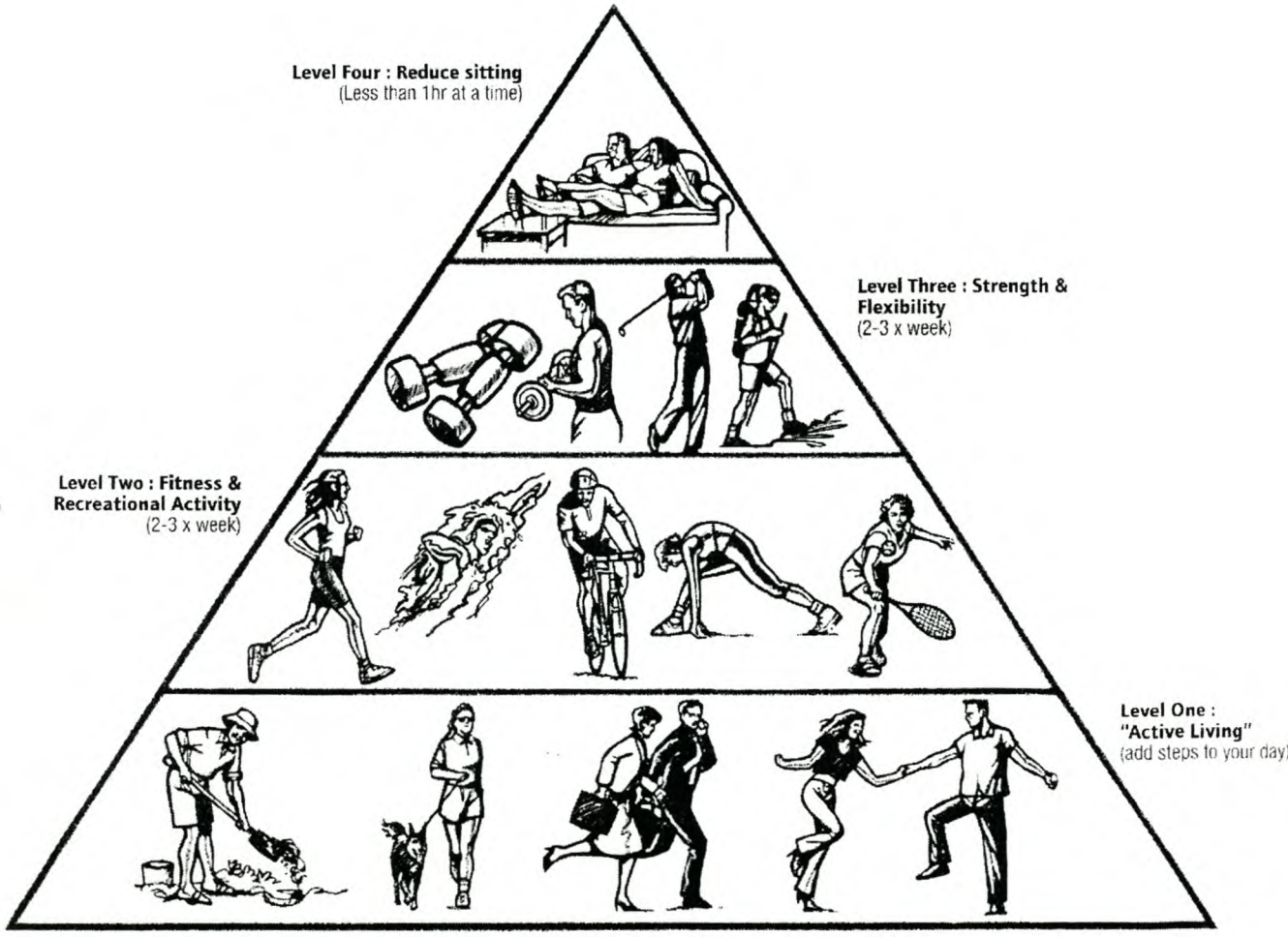

FIGURE 2.2: The activity pyramid (SASSO, 2003: 15).

Practical guidelines formulated by different groups for the implementation of the recommendations regarding the type and amount of physical activity, include the following:

- The focus of intervention should be a gradual reshaping of a participant's physical activity pattern over time rather than providing a strict, regimented and specific dose of activity in an exercise prescription (AHA, 1994).
- The most feasible mode of activity for most adults is walking. However socio-economic circumstances must be considered when making recommendations to individuals or groups in this regard (Laquatra, 2000: 505). For instance, walking or jogging may be the cheapest form of exercise, but it must be considered whether the person lives in a neighbourhood that is safe enough to do this activity. Exercise equipment at home increases the likelihood of regular exercise and is associated with greater long-term weight loss (Jakicic *et al.*, 1999).
- Participants may ultimately engage in more vigorous activities such as cycling, jogging or other vigorous sports and recreational activities and thereby achieve their energy-expenditure goals in a shorter time period (AHA, 1994).
- Strength training or resistance exercise combined with aerobic exercise may produce better long-term results than aerobic exercise alone can do (Poirier & Despres, 2001; Sothern *et al.*, 1999).
- If obese persons are inactive they should begin with low levels of physical activity and progress slowly to recommended levels and then progress to even higher levels of activity (see above) (Thomas, 1995: 115).
- A gradual progression up to 1 hour of moderate-intensity activity (e.g. brisk walking) each day, accumulated over the course of a day should be recommended. As participants become more physically fit, they will be capable of more activity (AHA, 1994).
- The development of an individualized realistic goal for increasing activity (perhaps with professional guidance) and the modification of this goal over time as activity levels increase are important (AHA, 1994).
- Activity goals and type of activities to be used are highly individualized matters. Participants should each identify goals for the types and level of physical activity they will engage in with which they are comfortable (AHA, 1994).
- Encourage people to ascertain what works for them and to try different approaches until a sustainable activity plan is developed. In order to maintain a high physical activity level each individual should choose exercise that they enjoy and that can be easily incorporated into their daily routines. The activity can be any exercise, but should be consistent with individual interests and an activity that can become a permanent part of lifestyle (Thomas, 1995: 113).

2.3.3.3 Compliance with physical activity recommendation

Although there are clear benefits for incorporating physical activity in weight-management programmes, the biggest problem in this regard is to motivate individuals to initiate and adhere to a physical activity programme (Davis & Phinney, 1994: 226). For motivation purposes participants need to be made aware of the physical activity-related factors such as the intensity, duration and frequency of physical activity and the resulting effects of lowered heart rate, increased VO_2 max, decrease blood pressure, decreased

blood cholesterol levels and other benefits (Davis & Phinney, 1994: 227) as indicated in Table 2.4. These indicators can be measured during the course or at the end of the intervention to indicate success with the exercise component. Overweight or obese individuals should also be made aware that physical activity can result in the above-mentioned advantages of physical activity, including decreased mortality, even if no weight loss is experienced (Foreyt & Poston, 1998).

It is also important to recognize that changing an individual's level of physical activity is a behavioural process (Foreyt & Poston, 1998). Therefore, it is not enough to teach participants why and how to exercise, because they still need to make the psychological commitment to exercise. They need to perceive that both the short- and long-term benefits outweigh the risks and effort of initiation and continuation of exercise. "Promoting exercise should occur from a process (behavioural) approach rather than from a product (physiological) approach" (Davis & Phinney, 1994: 227). This implies that attempts to achieve a desired behaviour (in this case exercise) should be rewarded, rather than to focus on the products of those attempts. The primary goal of exercise as part of a weight-management programme should therefore be to achieve the greatest behavioural adherence and compliance, followed by the secondary goal of achieving appropriate physiological change (Davis & Phinney, 1994: 227). It is also important to prepare the individual mentally on the amount of physical activity and the long-term duration necessary to maintain weight loss or to ensure effective weight management (Brownell, 1999). Active people say they are influenced by getting enjoyment from physical activity and support from others. They tend to have confidence in their ability to engage in regular physical activity, positive beliefs concerning the benefits of physical activity, and lack of perceived barriers to being physically active.

A minimum threshold of exercise is most probably necessary to promote long-term weight maintenance. It is also important to bear in mind that poor nutritional and lifestyle choices may override the benefits of exercise and therefore it cannot be guaranteed that regular physical activity will result in successful long-term weight maintenance. However, it is safe to assume that physical inactivity will almost certainly result in long-term weight maintenance failure (Davis & Phinney, 1994: 218).

2.3.4 Behavioural component and psychological health

2.3.4.1 Behavioural strategies

Whitney *et al.* (2002: 285) define behaviour modification as "the changing of behaviour by the manipulation of antecedents (cues or environmental factors that trigger behaviour), the behaviour itself, and consequences (the penalties or rewards attached to behaviour)". The use of behaviour modification in weight management, according to the IOM (2003: 82), is "based on a body of evidence that people become or remain overweight as the result of modifiable habits or behaviours and that by changing those behaviours, weight can be lost and the loss can be maintained". Behavioural modification is a method aimed at helping individuals to recognize, analyze and address the problems or barriers interfering with their weight management as well as the causes of these problems and barriers (Foreyt & Poston, 1998;

Laquatra, 2000: 503; Thomas, 1995: 83). The outcome of this is a gradual change in dietary intake, physical activity and other lifestyle behaviours that contribute to ineffective weight management and the gradual adoption of new behaviours (Foreyt & Poston, 1998). It is important to recognize that changing lifestyle behaviours occur gradually for most individuals (SASSO, 2003: 17). Ultimately individuals will be able to adhere to a healthy diet and exercise programme (AHA, 1994; Thomas, 1995). However, some individuals may be unwilling or unprepared to make changes due to certain barriers such as their attitudes, culture, level of discomfort, and their family and social support network (SASSO, 2003: 17).

Different theoretical frameworks can be applied to change nutrition-related behaviours. These frameworks include the knowledge-attitude-behaviour model, health belief model, social learning theory, marketing model, social action model and the transtheoretical stages of change model (Contento *et al.*, 1995). The transtheoretical model – also referred to as the stages of change model – is recommended by SASSO to be used in helping individuals change their behaviour (SASSO, 2003: 17). This model describes behaviour change as a process in which individuals can progress through a series of six stages, which include pre-contemplation, contemplation, preparation, action, maintenance and relapse (Prochaska & DiClemente, 1982; SASSO, 2003: 17; Snetselaar, 2000: 452-453). This model recognizes the fact that all individuals are not in the same stage of change and therefore the same techniques cannot be used to change a problem or behaviour. The model identifies the stage in which the individual is and the change processes of that stage can be used accordingly to change the behaviour (Snetselaar, 2000: 453).

Strategies to change behaviours may include self-monitoring, stimulus control, contingency management (rewards), and stress management, problem-solving, cognitive restructuring, social support and relapse prevention approaches (AHA, 1994; Brownell & Kramer, 1994: 237; Foreyt & Poston, 1998; Laquatra, 2000: 503; NIH, 1998; Thomas, 1995: 83).

- *Self-monitoring*

This strategy involves self-observation and self-recording of the observations (Thomas, 1995: 83). From these observations behaviours targeted for change are identified (AHA, 1994). Self-monitoring activities may include using food or activity diaries (Foreyt & Poston, 1998; Snetselaar, 2000: 456). In their food diaries individuals can record the type and amount of food eaten, when and where the food was consumed and the context in which the food was consumed (e.g. what else they were doing at the time, what they were feeling, what they were thinking, who else was there) (IOM, 2003: 83; Laquatra, 2000: 503). These records can be effective to identify eating habits and highlight thoughts, feelings, physical and emotional settings, other conditions or situations associated with eating or overeating (Laquatra, 2000: 503; Snetselaar, 2000: 456). The frequency, duration and intensity of exercise can similarly be recorded in activity diaries (AHA, 1994; Foreyt & Poston, 1998; IOM, 2003: 110). Graphs, scales and tables can also be used to document changes in anthropometric measurements (Foreyt & Poston, 1998).

The primary purpose of self-monitoring is to make individuals aware of their weight management-related behaviours so that they can identify the factors which influence how they behave (Foreyt & Poston,

1998). Self-monitoring of dietary intake and physical activity enables the individual to develop a sense of accountability (IOM, 2003: 82). The review of self-monitoring tools can also be helpful to identify their own adherence level (Snetselaar, 2000: 456) with or without the help of a health professional or support group. Besides these outcomes of self-monitoring, health care professionals can use the information to praise an individual for positive changes and help them identify where changes can still be made (Laquatra, 2000: 503). At the start of the intervention, self-monitoring promotes behaviour change due to an increased awareness of personal behaviours. It also serves as a useful index of an individual's motivation to put time and energy into the process of change. As treatment progresses it serves as an indicator of how an individual is changing, which techniques are useful, which events or behaviours are especially problematic and so forth (Brownell & Kramer, 1994: 237; IOM, 2003: 83). The periods identified by the IOM (2003, 110) that are especially useful for recording of food and activity diaries include the first month or two when starting with a weight-management programme, also the first month of the maintenance period after weight loss has occurred, and during periods of increased exposure to food such as during holidays. It is also important to re-institute this practice when weight gain has occurred in order to bring weight back under control (IOM, 2003: 110). Self-monitoring has been shown to be effective in improving intervention outcomes and individuals select this strategy as one of the mostly helpful management tools. It is also viewed as one of the cornerstones of behaviour treatment (IOM, 2003: 82)

- *Problem solving*

With problem solving the individual learns to identify and anticipate a problem that threatens to undermine success and to identify various solutions to possibly solve the particular problem (IOM, 2003: 110; Laquatra, 2000: 503). This is followed by the evaluation of the solutions and the choosing of the best possibility to solve a particular problem. The chosen solution can then be implemented, its outcome evaluated and, if not successful, it is necessary to re-evaluate alternative solutions and complete the problem-solving process again (Laquatra, 2000: 503). Such problem-solving skills will enable the individual to implement strategies that will resolve problems as they emerge (IOM, 2003: 110). Problem solving will ultimately help the individual to maintain appropriate behavioural changes in the long term (AHA, 1994)

- *Stimulus control*

With stimulus control the individual should learn to identify and control environmental cues associated with unhealthful eating or overeating and inactivity (AHA, 1994; Foreyt & Poston, 1998; Thomas, 1995: 83). Approaches can then be suggested to modify these cues, thereby changing the microenvironment of the individual to an environment that is more conducive to effective weight management (Foreyt & Poston, 1998). Dietary intake stimulus control involves the modification of the setting or the chain of events that precede eating, the type of foods consumed when eating does occur and the consequences of eating (Laquatra, 2000: 503).

Specific actions to modify cues vary from person to person but commonly involve reduced exposure to food; limiting eating times, changing /controlling eating places and activities associated with eating; the breaking of habitual or "automatic" eating routines, and learning of satiety cues (Brownell & Kramer, 1994: 240; Foreyt & Poston, 1998; Laquatra, 2000: 503). Other strategies such as buying food when not hungry, eating at specific times and places, eliminating the availability of snack foods in the house, putting down the utensils between bites and pausing during meals can be applied to facilitate the changes, depending on each individual's unique needs (Foreyt & Poston, 1998; Laquatra, 2000: 503). Stimulus control is very helpful for long-term weight maintenance, and without it the individual may experience relapse when exposed to problematic cues (Foreyt & Goodrick, 1993).

- *Stress management*

Stress may result in relapse, over-eating or under-eating and contribute to ineffective weight management (Foreyt & Poston, 1998). Stress management involves teaching relaxation techniques or problem-solving strategies to reduce stress or to cope with stressful events (Foreyt & Poston, 1998; Thomas, 1995: 84). Examples of stress-reducing techniques are meditation, regular exercise, diaphragmatic breathing and progressive muscle relaxation (Foreyt & Poston, 1998; Thomas, 1995: 84). The implementation of these techniques is important to reduce stress, especially for those individuals who over-eat or binge on unhealthy food choices in response to stress (IOM, 2003: 110).

- *Social support*

For many persons increasing support and reducing intended or unintended undermining by family members and friends (social groups) can be an important component for success (Brownell & Kramer, 1994: 242, IOM, 2003: 110). Skills to recognize intentional and unintentional undermining by social groups may be learned (IOM, 2003: 110). Positive support for weight management can effectively be supplied by family members, other participants of a programme (group support) or involvement in any outside social activity. These interactions are used for encouragement, maintaining motivation and providing reinforcement for appropriate behavioural changes (Thomas, 1995: 84). They also help individuals to learn greater self-acceptance, to develop new norms for interpersonal relationships and to manage stressful work or family situations (Foreyt & Poston, 1998). In extreme cases, the individual may need to choose between weight management or the relationship with someone who undermines effective weight management (IOM, 2003:110).

- *Cognitive restructuring*

Cognitive restructuring helps the individuals to change their thoughts (internal dialogue), attitudes, beliefs and perceptions about themselves and their weight that prevent the adoption of appropriate eating and exercise habits (AHA, 1994; Foreyt & Poston, 1998; Thomas, 1995: 84). This technique can help individuals to identify specific triggers influencing their thought process regarding their weight, eating and physical activity, which will enable them to deal with negative attitudes towards obesity in society, realize that a minor dietary infraction does not mean failure to and identify specific triggers for over-eating (IOM, 2003: 83). For example many individuals, especially women, have unrealistic weight goals

and beliefs about the personal benefits associated with weight loss. With cognitive restructuring the individual learns to actively challenge and change aspects of their internal dialogue and to modify those beliefs that are irrational in order to address their weight-management-related problems (Brownell & Kramer, 1994: 242; Foreyt & Poston, 1998). It can also be employed to help obese individuals not to set unrealistic weight loss goals and to learn to accept that a 10% weight loss reduces their risk of obesity-related comorbidities. Examples of techniques that can be used include affirmations (positive self-statements) and visual imagery (seeing oneself eating and exercising appropriately) (Thomas, 1995: 84). The selection of these techniques must be based on each individual's specific problems and needs (Thomas, 1995: 84). Positive self-statements such as " I had a piece of cake. One slice is not going to increase my weight, I will continue eating in a healthful way" can help individuals to deal with such situations (Laquatra, 2000: 503).

- *Contingency management (rewards)*

Contingency management involves the use of rewards when a behaviour was successfully changed or a goal was achieved (AHA, 1994; Thomas, 1995: 84). Rewards could include money, purchasing something special, a holiday and so forth. Rewards can keep individuals motivated to continue changing inappropriate behaviours. It is important that rewards are linked to achievable and reasonable weight management and related goals, e.g. improvements in eating behaviour, increased physical activity and ultimately small weight losses or weight maintenance.

- *Relapse prevention*

A lapse indicates temporary losses or errors or mistakes regarding new weight management habits, but does not necessary imply the loss of control because corrective action can be taken by the individual (IOM, 2003: 110; Brownell *et al.*, 1986). However, when these lapses occur often and they cluster, a relapse and the return to old behaviours occur (IOM, 2003: 110; Senekal *et al.*, 1999). The response of the individual to lapses and relapse determines the likelihood of success in future attempts (Senekal *et al.*, 1999). Therefore individuals should receive training to prepare them for possible lapses or relapse (Foreyt & Poston, 1998). The IOM (2003: 110) also stresses the importance of teaching individuals to forgive themselves for a relapse and to view it as a learning experience. This is important because the re-establishing of control is crucial for weight management (IOM, 2003: 110). As part of this training individuals are taught that lapses or relapse are normal and that they need to recognize and anticipate high-risk situations that might cause relapse and devise plans to reduce damage (IOM, 2003: 110; Foreyt & Poston, 1998). Studies have found that negative emotions, social situations such as travelling and parties are associated with relapses (Foreyt & Goodrick, 1994). Foreyt and Poston (1998) suggest that strategies such as didactic training, modelling, role-playing and visualization could be used by individuals to prevent relapse. Normal-weight individuals can also use these strategies to prevent over-eating and weight gain. These strategies will empower individuals to maintain appropriate behavioural changes in the long term (AHA, 1994).

- *Physical activity*

Foreyt and Poston (1998) and the IOM (2003:110) included physical activity as a strategy to help individuals change their behaviour to manage their weight effectively. As was mentioned in Sections 2.3.3 it has been indicated that physical activity is associated with maintenance of weight and psychological benefits such as improved body image, psychological well-being and self-esteem.

2.3.4.2 Psychological determinants

Byrne (2002) maintains that many studies have indicated that the sustained practice of the behavioural strategies adopted during weight loss is associated with successful weight management. However, psychological factors that motivate the continued use or abandonment of these critical weight maintenance behaviours have received much less attention (Byrne, 2002).

General psychological well-being therefore is a prerequisite to optimal weight management (Byrne, 2002; Senekal *et al.*, 1999). A number of interpersonal characteristics such as self-esteem, body image, self-efficacy, locus of control, motivation and assertiveness (see Section 2.7.3.3) as well as skills such as stress management, problem solving and decision making have been linked to weight management (Byrne, 2002; Senekal *et al.*, 1999). Any programme aimed at enabling an individual to manage his/her weight effectively should address these issues either in the form of self-assessments and self-management guidelines or by referring the individual to appropriate professionals for help. The interpersonal characteristics and skills important to weight management can be summarized as follows:

- Self-esteem: Refers to judgements of self-worth and affects conformity, interpersonal attraction, moral behaviour, educational orientation, personality and mental health (Gecas, 1982; Rosenberg, 1981);
- Body image: Refers to the evaluation of size, weight, or other aspects that determine physical appearance of one's own body. It is strongly influenced by parental (especially maternal) and cultural variables, peer group, and societal attitudes (Thompson, 1990);
- Self-efficacy: Refers to the belief that behaviours can be performed successfully to produce certain outcomes. Strong self-efficacy is associated with active efforts to cope with situations, given the existence of appropriate skills and incentives (Bandura, 1977);
- Locus of control: Internal locus of control refers to the perception that outcome is contingent on one's own behaviour and characteristics and thus is controllable. External locus of control refers to the perception that outcome depends on luck, chance, fate or others (Gecas, 1982; Rotter, 1966);
- Motivation: Causes, channels and sustains people's behaviour (e.g. unsatisfied needs, anticipation of expected outcome, thinness and strength of a person's preference for the expected outcome) (Owen & Frankle, 1986);
- Stress management: Stress is an "intense force, strain, agent or mental condition (stressors) which produces a defense reaction" (Taber, 1970: S-86). Certain levels of stress are a prerequisite for optimal production (Roos & Möller, 1988);
- Assertiveness: The assertion theory assumes that all people have certain basic rights (e.g. right to refuse requests, to make mistakes, to express themselves) as long as the rights of others are not

violated; that these rights should be respected; and that assertion skills can be developed (Kelley, 1979);

- Problem solving and decision making: Problems are a normal part of life and decisions need to be made on a daily basis (Roos & Möller, 1988).

2.3.5 Other non-essential components: surgical procedures and pharmaceutical management

Surgical procedures or pharmacotherapy can be included as components of a weight-management programme. However, when such methods are used they must form part of a weight-management programme addressing all other factors influencing weight management and they will not form part of a low-intensity self-help approach as was the case in this study.

According to the Southern African Society for the Study of Obesity (SASSO), individuals with a BMI>30 combined with comorbidities or individuals with a BMI>40, who have failed with previous weight loss attempts, may be considered for pharmacotherapy and surgical procedures (SASSO, 2003:18). More specific guidelines have been published and are used by others. These include that surgical procedures are indicated for individuals with a BMI≥40 or a BMI of 35 to 39 together with the concurrent presence of one or more obesity-related comorbidities and having been unsuccessful with previous non-surgical long-term weight-management attempts (NIH, 1998). Different surgical techniques such as gastric banding, vertical banded gastroplasty, different gastric bypass procedures or bypass of other segments of the small intestine are available. Weight loss is achieved through restricting food intake and malabsorption (Hill *et al.*, 2000: 448; Laquatra, 2000: 507; NIH, 1998).

Only individuals with "clinically significant" obesity (BMI≥30) or with a BMI>27 together with one or more obesity related comorbidities and who have failed to lose weight using dietary, physical activity and behavioural strategies should be considered for treatment with pharmaceutical products (summarized by ADA, 2002; Aronne, 1998; Laquatra, 2000: 506). Pharmacotherapy research is currently focusing on three approaches: (1) inhibitors of energy intake (appetite suppressants, orexins/ hypocretin antagonists); (2) enhancers of energy expenditure; and (3) stimulators of fat mobilization (ADA, 2002). Pharmaceutical agents cause an energy deficit through a number of mechanisms, such as acting on the brain to suppress appetite; producing bulk to fill the stomach, thereby suppressing appetite; possibly increasing thermogenesis; increasing metabolism; and selectively interfering with fat absorption (Laquatra, 2000: 506). Pharmaceutical agents currently available can be categorized as Central Nervous System (CNS)-acting agents and non-CNS-acting agents. The CNS-acting agents include catecholaminergic agents, serotoninergic agents, or a combination of the two. Medications that have been approved by the FDA include sibutramine and orlistat. Sibutramine is a catecholaminergic-serotoninergic CNS-acting agent that inhibits the re-uptake of serotonin and norepinephrine, which can suppress appetite, enhance satiety and increase the metabolic rate in animals (Aronne, 1998; Laquatra, 2000: 507).

Complications include hypertension, increased heart rate and other side-effects. Orlistat is a non-CNS-acting agents which inhibits pancreatic lipase resulting in malabsorption of up to 30% of dietary fat. Another advantage of this drug is that it may enhance dietary compliance with a low-fat diet. Common side-effects include steatorrhea, bloating, distension, anal leakage and fat-soluble vitamin deficiencies. These medications should always be prescribed as part as a comprehensive treatment programme including dietary, physical activity and behavioural strategies (Aronne, 1998; Hill *et al.*, 2000: 448).

The prescription and use of herbal supplements to achieve weight loss are not currently recommended (NIH, 1998). Research indicates that herbal preparations produce harmful effects and do not contain standardized amounts of the active ingredient (Stein, 2000; ADA, 2002).

2.4 APPROACHES TO WEIGHT-MANAGEMENT INTERVENTIONS

In the "Weighing the Options" model proposed by the IOM, the following approaches to weight-management interventions are mentioned: do-it-yourself (self-help) programmes, non-clinical programmes and clinical programmes (Thomas, 1995: 3). Although the focus in this model was on weight loss programmes, it could effectively be applied to any weight-management programme. The approaches of all of the three mentioned programmes contain one or more of the essential components of weight-management interventions discussed in Section 2.3, namely the formulation of reasonable weight goals, healthful eating, physical activity, behaviour modification, surgical procedures and pharmaceutical therapy.

2.4.1 Do-it-yourself (self-help) programmes

These programmes refer to any strategy that an individual uses to manage his or her weight by himself or herself. These efforts can be self-initiated or can involve a group setting. Many different do-it-yourself approaches which may vary extremely from each other are available. The components included in Do-it-yourself programmes usually involve dietary and exercise information, but may also include behaviour modification. Thomas (1995: 65) identifies five subcategories of do-it-yourself programmes based on either the sources or the type of programme that individuals use as guidance to lose weight by themselves:

- Personally formulated low-energy programme with or without exercise;
- Popular published materials such as books or magazines with diet instructions;
- Popular promoted products such as diet aids, low-calorie foods and meal replacements;
- Group participation as a source of counselling, advice, structure or reinforcement;
- Community-based and work-site programmes.

The information contained in do-it-yourself programmes can either be reliable, safe and sound or, as is often the case, scientifically incorrect. Furthermore, the information in such programmes is often not

individualized and personalized to accommodate the specific circumstances and factors that affect the weight management of a specific individual (Thomas, 1995: 65). A number of self-help manuals for the treatment of, for example, eating disorders have been published by recognized scientists such as Carter *et al.* (2003), Chan (2003), Fairburn (1995), Ghaderi (2003).

Weight-management programmes in the form of a self-help manual are typical examples of do-it-yourself programmes, which are seen as low-intensity intervention methods to bring about change in behaviour. Self-help is the most common weight-control approach used in the USA, but interventions with higher intensity are associated with better weight loss (Thomas, 1995; NIH, 1998). This is also supported by Wylie-Rosett *et al.* (2001), who found that the most intensive intervention, which included a self-help manual, computer programme and access to professional staff, resulted in a greater weight loss compared with those who only used a self-help manual. The cost of the self-help manual on its own was the lowest, but participants were more satisfied with the high-intensity approach (Wylie-Rossett *et al.*, 2001).

Some individuals will succeed when given only minimal knowledge and skills without consulting any professionals, as is the case with a self-help approach, while others may need considerable guidance, individual attention and help to change their behaviour and manage their body weight (Peters *et al.*, 2002). It is therefore suggested that self-help manuals work only for a sub-group of individuals. According to Carter *et al.* (2003), the literature on the treatment of individuals with bulimia nervosa suggest that less severe cases are more likely to benefit from a self-help approach. Individuals with a history of anorexia nervosa, more frequent binge eating at baseline, more intense concerns about shape and weight, comorbid personality disorders and higher levels of general psychopathology are the least likely to benefit from such an approach (Carter *et al.*, 2003).

According to Glasgow & Rosen (1984: 525-527), the advantages of the use of self-help manuals include the following:

- The extension of professional services to a larger number of individuals;
- The ability to intervene among individuals who would not otherwise have received advice or attention;
- Individuals who feel consultation with professionals is not required may benefit from self-help manuals;
- They can be used in combination with minimal consultation with a health care professional. Problems that a person can handle on their own can be included in the self-help manual while other problems can be addressed during consultation;
- Individuals in distant areas can be reached.
- Low cost.

Glasgow and Rosen (1984: 525-527) suggest that the greatest value in the use of self-help manuals may lie in their preventative use rather than in their implementation among those who are already affected by a

particular problem. Self-help manuals can be used in large communities, such as among all university students, especially for preventive intention.

Glasgow & Rosen (1984: 525-527) summarized the disadvantages of self-help manuals as follows:

- Motivation and self-discipline, which are often the strongest feature/characteristics of weight managers, are necessary to use self-help manuals successfully;
- Inadequately developed manuals could exacerbate behaviour problems and negatively affect the individuals' attitudes toward effective programmes;
- It may be difficult to evaluate the success of a self-help manual, because a manual may be quite effective in producing change in some areas but virtually useless in others;
- Large intersubject variability in terms of success can be expected. To address this problem it is necessary to identify effective predictors of treatment outcome to predict those who will be likely to succeed.

2.4.2 Non-clinical programmes

Non-clinical programmes and the services involved are provided to individual clients by trained counsellors who are not registered health care professionals. The programmes are popular and often commercially franchised with many weight-loss centres across countries. Information on diet, exercise and behaviour modification is provided at regular classes or meetings. The same instructional materials and guidance to deliver information are used by the different programme providers of a franchise. The information and materials are often prepared with the help of health care professionals and the latter may be involved in the management of the programmes, but are not the providers of the programme. Prepared food products, meal replacements or other products may also be sold to participants as part of the services of the programme (Thomas, 1995: 65). Examples of non-clinical programmes available in South Africa are *Weighless* and *Weight Watchers*.

2.4.3 Clinical programmes

Services that form part of clinical programmes are provided by registered health care professionals who may or may not have specialized training in weight management. Clinical programmes can involve treatment provided by a health care professional who works alone or treatment provided by a multidisciplinary group of health care professionals who work together and systematically co-ordinate their efforts, records and patient base. The programmes may or may not form part of a commercial franchise system (Thomas, 1995: 66). Clinical programmes can include all essential components of a weight-management programme (Thomas, 1995: 66) as was discussed in Section 2.3. Clinical weight-management programmes in South Africa usually involve a consultation with a dietician or doctor or with a multidisciplinary team typically including physicians, dieticians, behaviour therapists, exercise physiologists, psychologists and counsellors.

2.5 GENERAL GUIDELINES FOR THE IMPLEMENTATION OF WEIGHT-MANAGEMENT INTERVENTIONS

The guidelines for the implementation of weight-management interventions found in the literature are mainly focused on weight-loss programmes for overweight and obese persons. However, the American Heart Association (AHA, 1994) guidelines for non-pharmacological and non-surgical weight-management programmes and the criteria of the Food and Nutrition Board (FNB) of the Institute of Medicine (IOM) in the United States for the evaluation of weight-management programmes can be of value in the formulation of guidelines for the implementation of selective prevention interventions aimed at weight management. These guidelines cover the following (AHA, 1994; Thomas, 1995: 7-25):

- Consent form: Each participant should read and sign a consent form before beginning a weight-management programme. Guidelines are given regarding the information that the consent form should contain and of additional information that should be supplied beforehand to potential participants of a weight-management programme;
- Weight and dietary history: To identify any problems in this regard, each individual should be interviewed by a trained professional. These problems can then be accommodated/ addressed in the intervention.
- Medical screening: To identify any problems in this regard, each individual should be interviewed by a trained professional. These problems can then be accommodated/ addressed in the intervention.
- Composition of treatment team: It is recommended that a multidisciplinary team of health professionals be involved in the management of obesity. The inclusion of such a team should be considered for all weight-management programmes. Frank (1998) and the AHA (1994) recommend that the multidisciplinary team should consist of the following:
  - Physician – supervise the programme and have knowledge of the medical problems associated with obesity, weight loss, and weight regain;
  - Registered dietician – responsible for the nutrition component;
  - Exercise health professional – develop or approve the exercise component;
  - Behavioural scientist – develop behaviour modification techniques;
  - Lay leaders in the programme should receive appropriate training by the above-mentioned health professionals.

  All persons providing weight management services should be qualified by education, training and experience to provide these services and should have documentation of continuing education on a yearly basis in the area of weight management.
- Ensuring that a programme is safe and sound: All providers should take steps to ensure that their programmes are safe and sound for use by each participant. General guidelines for these purposes, which are based on the essential components of weight management discussed in Section 2.3, have been formulated.

Thomas (1995: 7) suggested that, to ensure the best possible treatment-participant match, four sets of factors need to be considered. These factors include the following: (1) personal, situational, and global factors, e.g. age, gender, motivation, readiness, environment, culture, economic status and so forth; (2) health status and weight-related risk factors; (3) information and guidance used by participant, e.g. media, advertising, family, friends, health-care providers; and (4) past successful, partially successful, or unsuccessful experiences with weight-management programme(s).

2.6 SUCCESS OF WEIGHT-MANAGEMENT PROGRAMMES

When the success of weight-management interventions needs to be assessed, it is important to consider the fact that such an assessment could be based on a whole range of indicators that are not necessarily all based on weight status (anthropometry). Furthermore, the factors associated with success and the predictors of success derived from these factors should also be considered/ investigated.

2.6.1 Indicators of success

Defining success of weight management ultimately involves specifying time frames, individual characteristics and any special conditions under which treatment was conducted (Thomas, 1995: 131). All components of the definition of success should be based on the definition of weight management, i.e. achieving the best weight possible in the context of overall health (ADA, 2002). This implies that the primary purpose of the success of weight management is achieving and maintaining good health (Thomas, 1995: 131).

According to Thomas (1995: 131), the indicators of successful weight management involve four components and that all weight-management programmes should be judged by how well individuals do in all four these areas (Thomas, 1995: 133). This opinion is supported by the findings and recommendations of a number of other researchers (AHA, 1994; Nawaz & Katz, 2001; NIH, 1998) .

Component 1: Long-term effective weight management

Long-term effective weight management refers to whether a programme empowered individuals to manage their weight effectively, i.e. prevention of weight gain, weight maintenance or weight loss, over a long period. The concept "long term" is viewed differently by different authors with Atkinson (1993) referring to periods of six months to five years, and Thomas (1995: 131) to more than one year. Although some debate remains about the amount of weight loss required for an individual to be classified as successful with weight loss, most studies indicate that a loss of 5-10% of initial body weight or the reduction of BMI by one unit will substantially reduce the risk of obesity-related comorbidities (Dwyer, 1996; Goldstein, 1992; NIH, 1998; Rippe & Hess, 1998) and should thus be seen as significant (Thomas, 1995: 131). However, success in this realm should be viewed within the framework of initial body weight as well as weight-management history. In the case of obese individuals normalization of weight

rarely occurs and a modest but maintained weight loss of, for example, 5-10% represents a degree of success (Goldstein, 1992). For weight maintenance when the individual is classified in the normal weight range, Dwyer (1996) indicates that the most healthful weight that should be maintained throughout life is the weight attained at the age of 21 years, as long as BMI is in the normal weight range.

Component 2: Improvement of obesity-related comorbidities

According to Thomas (1995: 131), Rössner (1997) and Atkinson (1993), the improvement of one or more risk factors associated with obesity, e.g. high blood pressure; elevated blood concentrations of cholesterol, triglycerides or glucose; and insulin-resistance, if present, constitutes an important indicator of success. These improvements can be brought about by any combination of the following factors: weight loss, changes in body fat distribution (decrease in hip to weight ratio or hip circumference), increased physical activity, improved dietary composition and improved psychological well-being (decreased stress levels) (ADA, 2002; NIH, 1998).

Component 3: Improved health practices

Improving certain health practices through a weight-management programme increases an individual's chance for successful weight management, decreases the risks of developing chronic diseases of lifestyle, and ensures the diagnoses of many major medical problems at an early stage (Thomas, 1995: 132). Health practices that should be emphasized include: increasing health-related knowledge; engaging in good eating habits; engaging in regular physical activity; obtaining regular medical attention, including seeing a physician yearly, particularly if the individual has not achieved a weight in the normal BMI range; and improving self-esteem and attitudes about self-care (ADA, 2002; Thomas, 1995: 132) and other intrapersonal characteristics and skills associated with weight management (Senekal *et al.*, 1999).

An intervention should therefore aim to constantly increase an individual's knowledge of the causes of their weight-management problems; the rationale behind the different treatment options; the benefits of adopting healthful eating and physical activity habits; the advantages and disadvantages of weight loss, weight gain, weight maintenance; and the effect of their weight management habits on their physical and psychological health (Thomas, 1995: 132). The knowledge regarding these practices could be assessed through tests before and after the intervention or indirectly through observations (Thomas, 1995: 132). The extent to which, for example, healthful eating and physical activity levels should be changed could be decided beforehand. Dietary intake can, for instance, be compared against the food groups of the American Food Guide Pyramid (USDA, 1992) and a criterion for healthful eating can be set at, for example, consuming at least the minimum recommended portion sizes from each food group (Thomas, 1995: 132). Dietary intake can then either be evaluated through 24-hour recalls, food frequency questionnaires, dietary history or a combination of these methods (Dwyer, 1999). Similarly the goals for physical activity could be decided upon before-hand, depending on the individual's current fitness level, physical abilities and so forth (see Sections 2.3.2 and 2.3.3 on healthful eating and physical activity guidelines). Regular screening of individuals, especially if they are overweight or obese, or if a comorbidity is present, should be encouraged (Thomas, 1995: 133). This will support the early

identification of diseases and the initiation of appropriate treatment. Improvement of intrapersonal characteristics or skills (see Sections 2.3.4.2 and 2.6.2.5) can be assessed using a wide variety of available questionnaires. These characteristics are important for improving eating behaviour, physical activity and psychological well-being (Senekal *et al.*, 1999). Assessment of whether these characteristics and skills improved as a result of the intervention is essential in the evaluation of any weight-management programme (Rössner, 1997).

Component 4: Monitoring of adverse effects that might result from the programme

It is important to be aware of the possibility that even a well intended, planned, executed and monitored intervention could result in adverse effects for some individuals (Thomas, 1995: 133). These effects could, for instance, be due to a very restrictive diet if, for example, a weight-management programme focuses very strongly on weight loss among obese individuals. These negative effects could also involve physical health problems such as nutritional deficiencies, psychological problems (often associated with the non-realization of realistic goals or perceived failure) and even economic problems, which prevent long-term compliance to a programme. Where possible, individuals should therefore be monitored on a continuous basis to identify any adverse effects at an early stage (Thomas, 1995: 133).

To ensure that all four of the above-mentioned components are assessed, every weight-management programme (especially self-help/do-it-yourself programmes) should include clearly defined goals and indicators of success. Effective monitoring and assessment tools and techniques should be included which can be applied either by the programme presenter or the individual to monitor success realistically. This will also ensure that any adverse effects that might arise will be identified at an early stage and the necessary actions to address them can then be implemented.

2.6.2 Factors determining success

When considering the factors that could determine the success of a weight-management programme, it is important to bear in mind that success could be determined by a combination of many factors (Coakley *et al.*, 1998; Sherwood *et al.*, 2000b). Published information regarding factors determining the success of weight-management programmes mostly refers to factors related to success with actual weight loss attempts. However, many of these factors could most probably be linked to success with other aspects of weight management such as prevention of weight gain or weight maintenance. Factors that could play a role in this regard include weight-management history, including the presence of contraindications; weight goals and reasons for weight-management attempts; actual programme content regarding each of the previously mentioned essential components; formal mode of programme delivery; support and incentives; actual attendance or actual use of a self-help method and motivation (=compliance).

2.6.2.1 *Weight-management history, starting characteristics and presence of contraindications*

A history of weight loss attempts is often associated with weight gain and weight fluctuations or weight cycling (Coakley *et al.*, 1998; Laquatra, 2000: 495). Furthermore, a strong perception of the need to lose weight and accompanying dieting behaviours is associated with weight loss but also with weight gain, indicating that these attitudes contribute to weight fluctuations and therefore such individuals will most probably not achieve success in future weight-management programmes (Bild *et al.*, 1996). Other starting characteristics which could be indicative of weight gain during a weight-management programme or of poor treatment outcomes include a higher body mass index (BMI) (Bild *et al.*, 1996; Carels *et al.*, 2003); a higher perceived negative impact of weight on quality of life; a strong perception of a higher body weight; a lower self-motivation; higher body size dissatisfaction; lower self-esteem (Morgan, 2003; Teixera *et al.*, 2002) and high health-related disfunction (Karlsson *et al.*, 1994). Carels *et al.* (2003) also indicate that a higher fat and lower carbohydrate consumption; poor body image and greater expectations for programme success are associated with being unsuccessful.

Poor treatment outcome could also be associated with poor programme attendance, unsatisfactory early weight loss, unsatisfactory improvements in weight-related quality of life, and lower self-control and self-confidence (Carels *et al.*, 2003). Women with poor treatment outcomes may also experience higher levels of guilt and feelings of failure (Carels *et al.*, 2003), which could contribute to further ineffective weight management attempts. It is well documented that socio-economic status is associated with obesity prevalence (Puoane *et al.*, 2002; Foreyt, 1995: 536). It is therefore not surprising that educational status is considered as a factor that influences the success of individuals' weight management efforts.

Contraindications for starting a weight-management programme therefore include the presence of a long history of unsuccessful dieting attempts, an abnormal fear of fat, abnormal eating attitudes, distortions in body image and dissatisfaction with body shape, purging behaviours, any other symptoms of eating disorders, unreasonable weight expectations, a perceived negative impact of weight on quality of life and low self-motivation (Coakley *et al.*, 1998; Kiernan *et al.*, 1998; Senekal *et al.*, 1999; Teixeira *et al.*, 2002). If any of these factors are actually present, a low success rate can thus be expected.

2.6.2.2 *Weight goals and reasons for weight management attempts*

As was stated in Section 2.2, weight management is usually equated with weight loss. Individuals who aim to lose weight often have higher weight-loss expectations than they can achieve, which in turn is associated with low success rates (ADA, 2002; Laquatra, 2000: 496; Pratt, 1990). The success of a weight-management attempt will therefore first and foremost be determined by whether the individual was able to formulate a reasonable weight goal (see Section 2.3.1) (ADA, 2002). It is known that more stringent weight-outcome goals are associated with less weight loss over the long term (Teixeira *et al.*, 2002). Brownell and Wadden (1992) also suggest that setting relatively modest diet, exercise and weight-loss goals may improve success with weight loss. Step-by-step weight-loss goals, for example, loss of 5-

10% of initial weight or one BMI increment followed by a six month maintenance period before further attempts, are also associated with improved long-term success.

A negative feeling (anxiety and concern) is the trigger that initiates weight-loss attempts among most overweight or obese individuals (Roberts & Ashley, 1999). The negative feeling can arise due to a health warning by health care professionals, the new identification of a risk factor (e.g. high blood cholesterol or blood pressure), the new diagnoses of a weight-related disease such as diabetes mellitus or the need to lose weight for an operation (Roberts & Ashley, 1999). This notion was supported by Klem *et al.* (1997), who indicated that, for the majority of men and women, the weight loss and maintenance of the new weight was triggered by an event or incident which preceded their successful weight-loss attempt (Klem *et al.*, 1997). In this regard, men are more likely than women to start a weight-loss strategy due to a medical trigger or because they just decided to (Klem *et al.*, 1997). Emotional or lifestyle factors (e.g. to look good for a forthcoming anniversary), seem to trigger women to lose weight (Klem *et al.*, 1997). Successful weight loss attempts among women seem to be a result of their being more committed to make behavioural changes and to lose weight, but also because of stronger social or health reasons (Klem *et al.*, 1997).

2.6.2.3 Dietary characteristics

The scientific guidelines for the composition of the dietary component of a potentially successful weight-management programme were described/ discussed in Section 2.3.2.2. However, weight managers often do not follow these guidelines but still claim that they attain some measure of success. The success claimed with many of the extreme weight reduction diets summarized in Table 2.3 (Section 2.3.2.3) are very good examples of this notion.

Klem *et al.* (1997), who reported on the characteristics of successful weight-loss maintainers enrolled in the National Weight Control Registry[5] in the USA, indicated that limiting the intake of certain types or classes of foods e.g. limiting quantities of food eaten, especially fat, and the counting of kilojoules and fat grams were useful strategies to lose and maintain weight. Women are more likely than men to use limited quantities or types of food eaten or exchange diets as methods to lose and maintain weight (Klem *et al.*, 1997). Liquid formula is also a successful method to lose initial weight, but mostly when all meals for a mean period of 20 weeks were substituted with the formula (Klem *et al*, 1997). Men were more likely than women to use liquid formula to lose weight (Klem *et al.*, 1997). Some authors indicate that abstention from eating between meals is associated with weight loss (Coakley *et al.*, 1998), while others find that eating five times per day and eating less than once a week at a fast food restaurant are associated with weight maintenance (King & Gibney, 1999; Klem *et al.*, 1997).

[5] To be included in the registry requires a minimum weight loss of 13.6 kg, which has been maintained for longer than five years.

Continuing the consumption of a prudent diet, namely energy from fat less than 30% and energy from carbohydrates 55% or more, or a diet focusing on lower fat intake after weight loss is also associated with weight maintenance or the prevention of weight gain (Carmichael *et al.*, 1998; Klem *et al.*, 1997; Sherwood *et al.*, 2000b).

McGuire *et al.* (1998) maintain that the more strict the energy restriction the more weight is lost, but also the more difficult it is to maintain the new weight. Consequently, such individuals regain the weight and are inclined to remain at that weight or become even heavier than before the weight loss attempt (Laquatra, 2000: 496; McGuire *et al.*, 1998). This concept is illustrated by the numerous fad diets which claim fast and large weight losses by emphasizing a very low energy intake, extreme changes in macronutrient composition, the exclusion of specific food groups and the combination of specific foods (see Table 2.3, Section 2.3.2.3). It is well known that the effects of these diets are usually transient and that the programmes are associated with numerous side effects (Laquatra, 2000: 501, Smolin & Grosvenor, 2000: 226)

2.6.2.4 Physical activity

The scientific guidelines for the physical activity component of a potentially successful weight-management programme were described/ discussed in Section 2.3.3. However, weight managers often do not follow these guidelines, but still claim that they attain some measure of success. This concept is also illustrated by some of the more extreme fad diets that claim success without doing any physical activity (Smolin & Grosvenor, 2000: 226).

It is generally accepted and scientifically proven that physical activity is important to the success of any weight-management programme (Bild *et al.*, 1996; Coakley *et al.*, 1998; Sherwood *et al.*, 2000b). According to Bild *et al.* (1996), the greatest opportunity for increasing physical activity and fitness lies among those who are less physically active or inactive at the start of the programme. Therefore, less physically active or inactive individuals may experience more success with a weight-management programme compared to those who already had high baseline physical activity levels because their levels of physical activity can increase more extensively during the intervention period (Bild *et al.*, 1996). Engaging in physical activity during a programme is the most consistent predictor of success with weight expectations such as weight loss or weight maintenance (Bild *et al.*, 1996; Klem *et al.*, 1997; Sherwood *et al.*, 2000b).

Individuals who are able to sustain changes in physical activity and food intake over time experience success with weight maintenance after weight loss (Anderson *et al.*, 2001; Coakley *et al.*, 1998; Carmichael *et al.*, 1998; Fuller *et al.*, 1996; Klem *et al.*, 1997; Mattfeldt-Beman *et al.*, 1999; Shick *et al.*, 1998; Wing & Hill, 2001). This is supported by studies that reported that the continuation of physical activity after weight loss is one of the best predictors of maintaining the new weight over the long term (Jakicic *et al.*, 1999; McGuire *et al.*, 1998; Sherwood *et al.*, 2000b). Physical activity has also been shown to be associated with the prevention of weight gain (Klesges *et al.*, 1992; Sherwood *et al.*, 2000b).

The type of programme that is proposed/ implemented to address physical activity levels may influence compliance and success. Programmes involving supervision or participation within a social group appear to be more successful in the long term (Laquatra, 2000: 505). However, it is generally indicated that exercise classes which form part of a weight-management programme are not well attended and are not rated by participants to be an effective tool to manage weight because of body image concerns (Mattfeldt-Beman *et al.*, 1999). When such group sessions are incorporated into a programme, it should be borne in mind that the physical activity needs of individuals vary greatly because of differences in body weight and levels of fitness, strength and flexibility. All physical activity recommendations should be individualized/ personalized and this will also contribute to increased success (AHA, 1994). A variety of activities to increase physical activity should be recommended, and individuals should be helped to choose their own activities, which they enjoy and feel comfortable with (Klem *et al.*, 1997; Laquatra, 2000: 505). Where possible, exercise at home and increasing the activities of daily living, e.g. walking, climbing stairs and so forth, to increase physical activity level should be encouraged (Klem *et al.*, 1997; Sherwood *et al.*, 2000a). Physical activities which are most frequently used to maintain weight are stationary or road cycling, aerobics, walking or running on a treadmill or the road, and weightlifting (Klem *et al.*, 1997).

Differences in the physical activity needs of men and women should also be acknowledged in the planning of interventions to increase success rates. For instance, overweight women are found to be more sedentary than overweight men (Mattfeldt-Beman *et al.*, 1999). It is more likely that women will engage in walking or aerobic dance classes, while men will engage in weightlifting and competitive sports (Klem *et al.*, 1997).

2.6.2.5 Behavioural aspects and psychological well-being

The scientific guidelines for the behavioural component and psychological health of a potentially successful weight-management programme were described/ discussed in Section 2.3.4. This component of weight management very often receives no attention in many weight-management programmes, especially in the more extreme dietary approaches. As stated by the ADA (2002), successful weight management depends on a lifelong commitment of healthful lifestyle behaviours emphasizing sustainable and enjoyable eating practices and daily physical activity; it is therefore crucial to incorporate behaviour change as a measure of success. The very poor long-term success rates with weight loss and weight management and the rising obesity epidemic are all very good indicators of the need for permanent changes.

Hardeman *et al.* (2000) maintain that underlying models and methods of behaviour change should be identified and accurately described in the evaluation of weight-management programmes, otherwise it will be difficult to replicate effective interventions in different situations, but also for the purpose of identifying more clearly which interventions were more effective. These authors also recommend that it is important that emphasis should be placed on the identification and targeting of key psychological

processes which underlie behaviour change in future interventions. They, for instance, indicate that the key psychological cognition that needs to be enhanced if using the Social Learning / -Cognitive Theory is self-efficacy and therefore programmes based on these behavioural models should incorporate measures to determine changes in self-efficacy (Hardeman *et al.*, 2000).

The link between different intrapersonal characteristics and skills associated with weight management and the effect thereof on success can be summarized as follows (Senekal *et al.*, 1999):

- Self-esteem: A low self-esteem is associated with undesirable outcomes, while a high self-esteem is essential for effective weight management;
- Body image: Overestimation of body size leads to unnecessary attempts to reduce weight. Therefore, satisfaction with body size is necessary for effective weight management;
- Self-efficacy: Self-efficacy may predict which dietary behaviours individuals feel capable of changing, how much effort they will expend while trying to adopt the new behaviour, and how long they will persist in the face of obstacles. A better self-efficacy is associated with changing behaviours and more success with weight management;
- Locus of control: Internal locus of control potentially promotes long-term weight management. Individuals are inclined to attribute outcomes to their own actions; identify problematic behaviours and cognitions and take steps to change them; manage environmental influences more effectively;
- Motivation: Thinness is currently a prerequisite for beauty and acceptance, theoretically resulting in high levels of motivation for effective weight management. In practice, the success rate at achieving thinness is low, because long-term motivation and permanent lifestyle changes are lacking; unattainable weight goals are formulated; and because some processes that influence weight are genetically determined. Motivation is necessary to be successful in weight-management programme; however, the reasons behind the motivation can influence success;
- Stress management: Effective stress-management skills are important for long-term weight management, because over-eating or under-eating are often used as short-term methods for alleviation of stress and thus contribute to ineffective weight management;
- Assertiveness: Assertiveness is not directly linked to weight management in the literature, but it contributes to stress management, peer resistance and the ability of individuals to set reasonable weight goals and reach and maintain them;
- Problem solving and decision making: Ineffective problem solving and decision making could contribute to stress and thus to ineffective weight management.

When a high self-esteem, better body image, high self-efficacy, internal locus of control, abilities to manage stressful situations and being assertive, and problem-solving and decision-making skills are learned, it will contribute to desired changes in eating behaviour, physical activity and psychological well-being and therefore the success of an individual in a weight-management programme. The application of behavioural strategies as discussed in Section 2.3.4 is important to create a change in these intrapersonal characteristics and skills.

Reasons why individuals seem to be unable to change behavioural patterns include a lack of self-discipline when not enrolled in a specific programme, having accepted themselves as being overweight and having difficulty in accepting a new body image when they lose weight (Van Staden & Gerhardt, 1991). On the other hand, successful weight maintainers seem to have coping skills that enable them not to over-eat as a response to cravings or stressful situations (Kayman *et al.*, 1990).

2.6.2.6 Formal mode of programme delivery

A good match must exist between the programme and the individual to maximize the chances of achieving long-term weight management (Fuller *et al.*, 1996). Thus, each programme must identify those individuals who best belong in the programme (Fuller *et al.*, 1996). Individuals must also be helped to decide if the current programme is the best to address their goals and characteristics (Fuller *et al.*, 1996).

Programme delivery at the work-site of the individuals was found to be more successful in terms of achieving weight loss and adherence, if compared to delivery at a physician's office or medical university (Hoke & Franks, 2002). Weekly weigh-ins, group contact and "kilojoule counting" were viewed as methods which increase individuals' success with a programme (Mattfeldt-Beman *et al.*, 1999). Although the group format may be highly effective in producing success, such programmes usually experience a high drop-out rate and discontinuations, mainly due to feelings of discouragement because of failure, the lack of privacy in a group and sharing actual weight figures with members of the group (Van Staden & Gerhardt, 1991). Klem *et al.* (1997) indicate that the most often used method that produced successful weight loss and maintenance was not formal assistance, but rather the use of commercial or self-help programmes. Jeffery and French (1999) noted that there may be a trade-off between the ability of a behaviour change programme to attract participants and its effectiveness. That is, while more intensive programme formats (e.g. clinic-based groups) produce larger treatment effects, the effort required of participants in such programmes often means that fewer people will participate in them and, therefore, the overall impact of the programme may be small (Jeffery & French, 1999; Klem *et al.*, 2000). In the long-term it is also indicated that the group format is not more effective than a low-intensity approach, because most individuals will regain weight after discontinuation of group meetings (Klem *et al.*, 2000). Greater public health impact might be produced by a less intensive format such as a correspondence course, which produces more modest outcomes but which appeals to a greater number of participants (Klem *et al.*, 2000).

Comments by the participants in weight-management programmes or users of self-help programmes concerning the actual content and presentation of the programme indicate that these factors, which are linked to interest, stimulation and eventual motivation, might also influence success. In a study by Mattfeldt-Beman *et al.*, (1999) it was found that information and activities which are found useful by most participants include nutrition-related information, calorie counting and weekly weigh-ins/group contacts. Written feedback on food records, exercise patterns, behavioural activities, sharing progress/ graphs, weekly goal setting/action plan/ small group and written handouts were also rated as useful content of a programme by many participants (Mattfeldt-Beman *et al.*, 1999). The least useful

information and activities included an exercise prescription, recipes and food tasting, and exercising in groups. Women are generally more likely than men to find the information and activities useful to control their weight and to continue to record their daily food intake as a weight management strategy (Mattfeldt-Beman *et al.*, 1999). Although only a few individuals in a programme may actually use self-regulatory activities such as exercise, self-monitoring of food intake and weekly weighing, such individuals are always more successful (Mattfeldt-Beman *et al*, 1999). Women are likely to use a formal programme or professional assistance, while men are more likely to their own initiatives or strategies to manage their weight (Klem *et al.*, 1997).

According to Mattfeldt-Beman *et al.* (1999) older participants tend to be more likely to participate in group sessions and find these more helpful with their weight-management strategies. These authors recommended that group sessions could work with younger participants if the methods of information delivery undergo small changes, for instance, adopting more flexible and creative ways, increasing the use of home studies or home-based learning classes, home visits and the application of technologies such as e-mail, fax and so forth. Younger women are more likely to participate in a correspondence course treatment format (such as mailed information with home tasks included) than a group meeting format (Klem *et al.*, 2000). The group format may not be the most effective format for young women due to the fact that they are undergoing a number of major life changes such as entry into or completion of college and entry into committed relationships and don't have the time to attend group sessions (Klem *et al.*, 2000). More educated individuals tend to find the following to be less useful strategies to manage their weight: sharing their progress, weight and exercise graphic records, setting weekly goals and developing action plans in groups (Mattfeldt-Beman *et al.*, 1999). This indicates that for young adults with more education, a self-help approach may the most effective method to use.

2.6.2.7 Support and incentives

Support services in a weight-management programme may refer to any kind of assistance provided to participants (IOM, 2003: 93). These support services could include emotional support, dietary support, and support services for physical activity. Heshka *et al.* (2000) indicated that weight-management programmes are more likely to be successful if accompanied by support services. However, not all services are applicable to all individuals and all settings (IOM, 2003: 94). Social support may be very important to ensure success (Sherwood *et al.*, 2000a). Approval of the weight-management programme by physicians, family members and friends has been associated with continued participation and greater weight loss (Neumark-Sztainer, 1995; Pratt, 1990). This is also illustrated by the finding that married participants or those who live with someone are usually more successful in a weight-management programmes compared with those who are single, widowed, divorced or separated (Mattfeldt-Beman *et al.*, 1999).

Incentives may be an effective tool to increase motivation and encourage participation in a weight-management programme, but also to decrease the drop-out rates. Incentives may have a greater effect if the participants' own money is involved (Forster *et al.*, 1988; Jeffery *et al.*, 1983) than when the

investigator's funds are used as financial incentives (Jeffery & French, 1999; Jeffery *et al.*, 1993). For instance, if participants pay an amount at the beginning of an intervention and they know that they will be paid back double that amount if they are successful at the end of the intervention or that they will lose their money if they are unsuccessful can act as a strong incentive (Forster *et al.*, 1988; Jeffery *et al.*, 1983). On the other hand, Jeffery and French (1999) indicated that individuals are more inclined to participate if they know they could win money, but that this may not necessarily have an effect on their success with weight-management efforts (Jeffery & French, 1999).

2.6.2.8 Actual compliance or use of a self-help method

Attendance of intervention sessions and continued adherence to programme components are related to long-term success (Mattfeldt-Beman *et al.*, 1999). Possible characteristics of drop-outs in weight-management programmes include younger individuals, those who expect to lose more weight and those who were unable to achieve a reasonable weight loss goal at the beginning of the programme (Pratt, 1990). Neumark-Sztainer *et al.* (1995) reported that perceived spouse support is an important positive predictor of compliance in weight-management programmes. This is in line with the reasons why participants discontinue a weight-management programme, as reported by Van Staden and Gerhardt (1991). These reasons included factors such as indifference or lack of support from family and friends, other overweight family members unwilling to join weight-loss programmes, discouraging remarks from others, and more easily irritated with others when on weight-loss programme (Van Staden & Gerhardt, 1991). Besides the importance of support to increase compliance, it has also been indicated that incentives are important in this regard (Forster *et al.*, 1988; Jeffery & French, 1999).

It is expected that compliance will not be optimal among participants who experienced only a small initial success or no initial success, low commitment to the programme, suffer from stress and had past emotional difficulties (Thomas, 1995: 123; Yass-Reed *et al.*, 1993). It has also been reported that factors such as age, starting weight and percentage body fat does not influence whether a programme will be completed or not. However, Mattfeldt-Beman (1999), reported that older participants are more likely to continue to attend group meetings as a strategy to manage their weight, while this was not applicable to almost all of the participants younger than 35 years. Therefore, the formal mode of the programme is a very important consideration of compliance. Jeffery and French (1999) reported that a self-help method is very effective in reducing attrition and that young adults would rather use this method than to participate in group sessions.

2.6.3 Significant predictors of weight-management programmes

The predictors of weight loss, weight gain, weight maintenance and compliance with regard to weight-management programmes are summarized in Table 2.5, Table 2.6, Table 2.7 and Table 2.8 respectively. From Table 2.5 it is evident that participants with characteristics such as a more social support, a higher initial BMI, engaging in physical activity during the programme, a high perceived self-efficacy and the incorporation of behaviour modification techniques could be expected to lose weight on a weight-loss programme. It is important also to acknowledge some conflicting predictors found by different researchers, such as dietary restraint, which was found to be both a non-predictor and a positive predictor of weight loss. Another example would be repeated weight-loss attempts. Bild *et al.* (1999) found this factor to be a predictor of weight loss during their study; they also found it to be a predictor of weight gain amongst those who did not lose weight on the weight-management programme. It is also indicated that a lower success rate early in the programme is predictive of drop-out or being unsuccessful during the rest of the programme (Poston & Ericsson, 1999; Thomas, 1995: 121; Tseng *et al.*, 2002). From Table 2.6 it is evident that intrapersonal characteristics such as a lower self-motivation, body image problems and low self-esteem are predictive of weight gain during a weight-management programme (Teixeira et al., 2002). Other predictors of weight gain include a higher fat and energy intake and lower physical activity frequency (French *et al.*, 1994; Sherwood *et al.*, 2000b). It was mostly found that psychopathology does not influence weight-management abilities as it was found to be a non-predictor of weight loss (Table 2.5), weight maintenance (Table 2.7) and compliance (Table 2.8) (Karlsson *et al.*, 1994; Poston & Ericsson, 1999; Thomas, 1995: 121; Tseng *et al.*, 2002). Experiencing perceived stress could, however, be indicative of not being successful with weigh loss during a programme (Thomas, 1995: 121). The most important predictors of weight maintenance are the continuation of physical activity, self-monitoring and contact with programme organizers (Table 2.7) (Thomas, 1995: 125). Perceived health improvements, incentives where the participants' money is involved and a support base are predictive of compliance with a weight-management programme (Table 2.8).

These predictors, together with associations described in Section 2.6.2, are important to consider when evaluating a weight-management programme. Measures to determine the success of a programme should therefore be based on the predictors as indicated in these tables.

TABLE 2.5: Predictors of weight loss during a weight-management programme

PREDICTORS	REFERENCE
Positive predictors	
❖ *Personal factors*	
High initial body weight or BMI	Bild *et al.*, 1996; Hoie & Bruusgaard, 1999; Morgan, 2003; Neumark-Sztainer *et al.*, 1995; Thomas, 1995: 121*; Tseng *et al.*, 2002; Womble *et al.*, 2001
High resting metabolic rate or resting energy expenditure	Thomas, 1995: 121
High perceived self-efficacy, improved self-efficacy during programme	Thomas, 1995: 121; Roach *et al.*, 2003
Self-perception of being overweight	Bild *et al.*, 1996
Female	Bild *et al.*, 1996
Employment outside home	Neumark-Sztainer *et al.*, 1995
Dieting and previous weight loss and regain†	Bild *et al.*, 1996
Poorer baseline eating behaviours	Neumark-Sztainer, 1995
Perceived hunger, dietary restraint†, trait anxiety?	Womble *et al.*, 2001
❖ *Process Factors*	
Frequent attendance	Thomas, 1995: 121; Tseng *et al.*, 2002
Early success	Thomas, 1995: 121; Tseng *et al.*, 2002
❖ *Treatment factors*	
Increased length of treatment	Thomas, 1995: 121
Having social support	Thomas, 1995: 121
Engaging in physical activity, lower baseline physical fitness level	Bild *et al.*, 1996; Klem *et al.*, 1997; Sherwood *et al.*, 2000b; Thomas, 1995: 121
Incorporation of behaviour modification techniques such as self-monitoring and goal setting, keeping food records	Streit *et al.*, 1991; Thomas, 1995: 121
Negative predictors	
Repeated weight loss attempts†	Thomas, 1995: 121
Experiencing perceived stress	Thomas, 1995: 121
Opposite of positive predictors	Thomas, 1995: 121
Non-predictors	
Total body fat, fat distribution, body composition	Thomas, 1995: 121
Personality/ psychopathology	Poston & Ericsson, 1999; Thomas, 1995: 121; Tseng *et al.*, 2002
Dietary restraint†	Thomas, 1995: 121
Binge eating	Sherwood *et al.*, 1999; Thomas, 1995: 121; Tseng *et al.*, 2002
Baseline psychological characteristics	Karlsson *et al.*, 1994

†Contradictors

*Thomas (1995) summarized predictors from literature

TABLE 2.6: Predictors of weight gain or being unsuccessful during a weight-management programme

PREDICTORS	REFERENCE
Higher baseline fatness	Bild *et al.*, 1996
Perception of being overweight	Bild *et al.*, 1996
Dietary fat intake	French *et al.*, 1994; Sherwood *et al.*, 2000b
Energy intake	Sherwood *et al.*, 2000b
Decreased frequency of physical activity	French *et al.*, 1994; Sherwood *et al.*, 2000b
Higher number of recent dieting attempts and recent weight loss	Teixeira *et al.*, 2002; Bild *et al.*, 1996
Higher perceived negative impact of weight on quality of life	Teixeira *et al.*, 2002
Lower self-motivation	Teixeira *et al.*, 2002
Higher body size dissatisfaction	Teixeira *et al.*, 2002
Lower self-esteem	Teixeira *et al.*, 2002
More difficulties in resisting emotional and social eating cues (high disinhibition)	Karlsson *et al.*, 1994
High baseline health-related dysfunction	Karlsson *et al.*, 1994

TABLE 2.7: Predictors of maintenance of weight loss

PREDICTORS	REFERENCE
Positive predictors	
Physical activity	Thomas, 1995: 125
Self-monitoring	Thomas, 1995: 125
Positive coping style	Thomas, 1995: 125
Continued contact	Thomas, 1995: 125
Normalization of eating	Thomas, 1995: 125
Reduction of comorbidities	Thomas, 1995: 125
Negative predictors	
Negative life events	Thomas, 1995: 125
Family dysfunction	Thomas, 1995: 125
Weight gain at three months predict relapse at 12 months	Poston & Ericsson, 1999
Non-predictors	
Eating behaviour	Cuntz *et al.*, 2001
Eating-related cognition	Cuntz *et al.*, 2001
Psychopathology	Cuntz *et al.*, 2001
Personality traits	Poston & Ericsson, 1999

TABLE 2.8: Predictors of compliance in weight-management programmes

PREDICTORS	REFERENCE
Positive predictors	
Closed-group classes	Thomas, 1995: 123
Use of refundable deposits	Thomas, 1995: 123
Perceived health improvements	Thomas, 1995: 123
Perceived spouse support	Neumark-Sztainer *et al.*, 1995
Negative predictors	
Younger participants	Honas *et al.*, 2003
Stress	Thomas, 1995: 123
Small initial success	Thomas, 1995: 123
Low commitment to the programme	Martin *et al.* 2002
Low perceived energy	Thomas *et al.*, 1995: 123
Past emotional difficulties	Yass-Reed *et al.*, 1993
Past physical or emotional difficulties while dieting	Yass-Reed *et al.*, 1993
A limited number of close friends	Yass-Reed *et al.*, 1993
Divorced	Honas *et al.*, 2003
Higher number of people who annoy the dieter about his or her weight	Yass-Reed *et al.*, 1993
Non-predictors	
Age	Thomas, 1995: 123
Baseline weight	Honas *et al.*, 2003; Thomas, 1995: 123
Percentage of body fat	Thomas, 1995: 123
Mood	Thomas, 1995: 123
Age of onset of obesity	Thomas, 1995: 123
Hunger susceptibility	Thomas, 1995: 123
Psychological characteristics	Karlsson *et al.*, 1994

2.7 PUBLISHED PROGRAMMES

Preventive intervention programmes aimed at weight gain prevention are still in the early phases and only a few published interventions could be traced. The main characteristics of the identified programmes are summarized in Tables 2.9 to 2.11. Two of these programmes were aimed at adults from the general population (Pound of Prevention studies by Forster *et al.*, 1988; Jeffery & French, 1997, 1999), only one was aimed specifically at university FYFS (Matvienko *et al.*, 2001) and one was aimed at mothers and daughters from a low socio-economic community (Stolley & Fitzgibbon, 1997). More programs seemed to be aimed at school children, of which three were included (Caballero *et al.*, 2003; Donnelly *et al.*, 1996; Simonetti *et al.*, 1986). The mode of delivery of these programmes ranged from low-intensity interventions for adults (Forster *et al.*, 1988; Jeffery & French, 1997, 1999) to high-intensity interventions

for university students (Matvienko *et al.*, 2001) and school children (Caballero *et al.*, 2003; Donnelly *et al.*, 1996; Simonetti *et al.*, 1986).

As far as the Pound of Prevention programmes (POP) are concerned, the first POP study was effective in prevention of weight gain among participants (Forster *et al.*, 1988), but the second POP study was not successful. However, the second POP study did have an effect on behaviour indicators. An increase in weighing frequency, but no effect on dietary intake or physical activity levels was recorded (Jeffery & French, 1999). The higher intensity approach among students only had an effect on the BMI at one year following the intervention of those participants with an initial BMI>24. The intervention students did have a lower intake of energy, carbohydrate and protein following the intervention. However, they were not able to maintain this one year after the cessation of the intervention despite, the fact that they maintained an increased level of nutrition knowledge (Matvienko *et al*, 2001). Although these studies did report on dietary intake (Jeffery & French, 1999; Matvienko *et al.*, 2001) and physical activity (Jeffery & French, 1999), none reported on any psychological variables or behavioural change techniques. This situation clearly points to the fact that limited well-designed evaluated programmes for the prevention of weight gain among students and adults are available.

The pilot study of the intervention for African-American mother and daughter dyads (not included in Tables 2.9 to 2.11) reported a decrease in daily fat intake in grams and in daily percentage of total calories consumed by the intervention group, compared to controls at 6 weeks follow-up, but no significant differences in nutrition knowledge or attitudes. The mothers' self-reported eating patterns improved more than the daughters. Differences in BMI were not reported (Fitzgibbon *et al.*, 1995). The full trial (included in Tables 2.9 to 2.11) indicates that at 12 months the intervention group had a lower saturated fat intake and percentage of energy from fat than the control group. However, no differences in BMI were found between the 2 groups (Stolley & Fitzgibbon *et al.*, 1995).

The weight-gain prevention studies among children differ from those aimed at adults in that the interventions were delivered in classrooms, and school teachers and family-members were involved. The most comprehensive study in this regard is the Pathways study, which aimed to prevent obesity among American Indian school children. The main outcome – namely, a decrease in the rate of % body fat gain over three years – was not achieved. The only effect that was found was a decrease in energy intake, but the authors speculated that this decrease may be biased because no differences in weight or physical activity were found (Caballero *et al.*, 2003). Although physical activity questionnaires did report increased levels of physical activity among the intervention group, this was not found when using a direct measure of energy expenditure from physical activity (Caballero *et al.*, 2003). The study did, however, have a positive effect on decreasing the fat content of school menus, which did not result in decreased % body fat gain, but could possibly have other positive health effects later in life. Another intervention aimed at school children using classroom activities, involvement of teachers and food service staff did not have any effect on BMI after two years (Donnelly *et al.*, 1996). In the programme implemented by Simonetti *et al.* (1986) it was found that a multi-media programme, which was a more intensive

intervention using pamphlets, slides and short films, was effective in decreasing the number of obese and overweight students when compared to the other experimental group, which only received a low intensity intervention using only written material, and the control group.

From the information provided in the papers describing the studies summarized in Tables 2.9 to 2.11 it was not possible to obtain a clear picture about the presence or absence of positive and negative predictors of compliance and success as discussed in previous sections in this literature review. Sherwood *et al.* (2000b), who reported on the predictors of weight gain of participants in the second POP study, did find that a high dietary fat and energy intake and a lower frequency of exercise was predictive of weight gain.

The results of these studies indicate that the effectiveness of the identified programmes as weight-gain prevention interventions was not very high, irrespective of whether a low- or higher-intensity approach was followed. However, it is important to note that the study designs of some of the studies were not optimal and that important data/ results were often not included. The results from the adult programmes did indicate that a low-intensity approach may be effective to some extent. In the light of the fact that compliance with higher-intensity programmes could be problematic, and that their longer-term success is not much better than the success rates found for lower-intensity programmes, the emphasis should possibly be placed on the development and evaluation of the latter for specific target groups. This is in line with the recommendation by Thomas (1995) that future obesity preventive intervention research should emphasize working with high-risk individuals by matching or targeting specific risk factors through selective and indicated prevention strategies. In this process it is of vital importance that the evaluation of a particular programme/ intervention be executed in a scientific and accountable manner, as is described in the next sections.

TABLE 2.9: Weight-gain prevention programmes: entry criteria, recruitment, sample size, ethnicity, socio-economic status (SES), gender and baseline age.

	Entry criteria	Recruitment	Sample size	Ethnicity and SES	Gender and baseline age
ADULTS					
Forster *et al.* (1988) *Pound of Prevention*	Adults who participated in a cross-sectional population survey and whose weight was normal or less than 115% of ideal weight.	Subjects participating in cross-sectional population survey received invitation letter for orientation meeting at community health department.	n=219 I: n=103 C: n=108	Ethnicity not reported Most had some post-high-school education	28.4% male Mean age 45.9 years
Jeffery & French, (1997, 1999) *Pound of Prevention*	Adults aged 20-45 years; willingness to participate for 3 years; non-pregnant or given birth < 12 months ago; no treatment for serious medical or psychological disorder.	Telephone, newspaper advertisement and mailings to employees of large educational institutions. Women of low SES were recruited via telephone solicitations in neighbourhoods with a high concentration of low-SES households, information booths at shopping centres in low-SES neighbourhoods and among women participating in the Special Supplemental Nutrition Program for Women, Infants and Children.	n=1226 Education only: n=251 Education plus lottery: n=256 Control: n=478	Men: 94% white; 96% had at least college degree High-income women: 92% white Low-income women: 76% white	20% male Mean age: Men =35.2 High income women = 36.6 Low-income women = 31.0
UNIVERSITY STUDENTS					
Matvienko *et al.* (2001)	Being a freshman or sophomore, aged 18 to 26, no previous nutrition class exposure.	Posted flyers, advertisement in student newspaper.	n=40 female students: I: n=21 C: n=19	87.5% Caucasian 5% African American 2.5% Asian 5% Unidentified	100% female I: age=19.3±0.8 C: age=19.5±1.1
ADULTS & CHILDREN					
Stolley & Fitzgibbon, (1997)	Daughters 8 to 12 years and their mothers living in the low-income Cabrini-Green housing project in Chicago and attending the Cabrini-Green Tutoring Program.	Letter to mothers and daughters in Tutoring Program, advertisement in tutoring newsletter, presentation at Tutoring Program.	n=62 mothers n=65 daughters I: n=32 mothers & n=32 daughters C: n=30 mothers & n=33 daughters	African-American Low-income	Mean age: I: mothers = 31.5 I: daughters = 9.9 C: mothers = 33.7 C: daughters = 10.0
CHILDREN					
Caballero *et al.*, (2003) *Pathways*	3rd grade school children.	School was selected if >90% of 3rd grade children were American Indian, retention from 3rd to 5th grade in the 3 year pilot study was >70%, meals prepared on site, minimum facilities to deliver physical activity, approval. Baseline data was collected from all children who agreed to participate at end of their 2nd grade.	n=41 schools in 7 communities n=1704 I: n=879 C: n=825	SES not reported American Indian	Gender not reported Age: not reported Grade 3
Donnelly *et al.*, (1996)	School children in Grades 3 to 5; mean age 9.2 years.	Recruitment schools not reported; children recruited through schools.	n=338 I: n=102 C: n=236	94% Caucasian	Gender not reported Mean age 9.2 years
Simonetti *et al.*, (1986)	School children; 3 to 9 years.	Recruitment of schools not reported, children recruited through schools.	n=1321 MA: n=367 WA: n=358 Control: n=596	Not reported	Gender not reported Age 3-9 years

SES=Socio-economic status; I=intervention group; C=control group

TABLE 2.10: Weight-gain prevention programmes: intervention strategies including target behaviour, behaviour change methods and modes of delivery

	Target behaviour	Behaviour change methods	Modes of delivery
ADULTS			
Forster *et al.*, (1988) First *Pound of Prevention*	Change diet and exercise.	Goal/ target specified, self-monitoring, contingencies/ incentives (money withdraw if weight was gained each month)/ reward, information/ food diaries.	Monthly newsletters; Group: educational courses (4 sessions midway through year).
Jeffery & French, (1997, 1999) Second *Pound of Prevention*	Paying attention to weight and making small changes in eating and exercise habits.	Goal/ target specified, self-monitoring, contingencies/ incentives/ reward, rehearsal of relevant skills, environmental changes, social encouragement/ pressure/ support, information, homework.	Monthly newsletters of 2-4 pages focussing on one of the program messages; Nutritionist, health educator; Group: once every 6 months low cost intervention activities were offered; family, friends.
UNIVERSITY STUDENTS			
Matvienko *et al.* (2001)	Scientific principles of weight regulation: Increase knowledge of nutrition, physiology, metabolism, in order to change diet and exercise habits.	Incentives/ skills/ information/ rehearsal of relevant skills/ personal experiments/ homework.	Two-credit college course, lectures, discussions, classroom exercises, laboratory exercises.
ADULTS & CHILDREN			
Stolley & Fitzgibbon, (1997)	Physical activity and low-fat and low-energy diets.	Contingencies/ incentives/ reward, increasing skills, stress management/ coping skills, rehearsal of relevant skills, planning/ implementation, social encouragement/ support, information, personal experimentation/ data collection..	Group: 11 week, 1 hour per week session family; Written; Clinical psychologist, dietician.
CHILDREN			
Caballero *et al.*, 2003 *Pathways*	Promote healthier dietary practices at school and at home, reduce fat content of school meals and increasing moderate to vigorous physical activity.	Goal/ target specified, (self)monitoring, increasing skills, rehearsal of relevant skills, environmental changes, social encouragement/ pressure/ support, persuasion, information, modelling by others.	Group, family, friends; Written/ postal; Nutritionist, health educator; Four components: Classroom curriculum, food service, physical education, family.
Donnelly *et al.*, (1996)	Improve physical and metabolic fitness by diet and physical activity.	Environmental changes, information.	Classroom; School teacher, food service staff.
Simonetti *et al.*, (1986)	Change in diet and nutrition.	Information.	Classroom, family, qualified staff, school teacher. Multi-media group (pamphlets, slides, short films, discussions with teachers, family). Written action group (printed material).

TABLE 2.11: Weight-gain prevention programmes: study design, duration of intervention and follow-up, attrition, baseline BMI/ weight, effect on weight, other effects

	Design	Duration of intervention and follow-up	Attrition	Mean baseline BMI / weight	Effect on weight	Other effects
ADULTS						
Forster *et al.*, (1988) First Pound of Prevention	RCT	Intervention: 12 months Follow-up: at 12 months	Attrition =42%	BMI = 23.1	Mean weight change at 12 months ($p<0.05$): I (n=103): mean = -0.95 kg C (n=108): mean = -0.14 kg	75% returned post cards 29% attended 1 of the 4 group sessions Those who attended more weigh-inns and returned more postcards and attended weight-loss programme lost more weight
Jeffery & French (1997, 1999) Second Pound of Prevention	RCT	Intervention: 36 months Follow-up: at 12 months	Attrition = 28%	BMI Men = 28.1 High-income women = 26.2 Low-income women = 28.2	Mean weight gain of total group = 1.7 kg for 3 year = 0.5 kg per year After 1 year (all $p>0.05$): Men (n=198): education only: mean = 0.33 kg education plus lottery = 0.88 kg control = 0.88 kg High-income women (n=523) education only= 0.47 kg education plus lottery =0.23 kg control = 0.63 kg Low-income women (n=331) education only = 0.96 kg education plus lottery = 1.47 kg control = 0.59 kg After three years (all $p>0.05$): Control = +1.8 kg, Newsletter = +1.6 kg Newsletter + incentive = +1.5 kg	The intervention had no effect on weight but positive effects on behaviours: Non-significant trends: declines in energy and fat intake for both treatment groups, greater decline in physical activity level of control group. Significant changes: increased reported frequency of weighing among intervention groups (vs decrease in control) and smaller decrease in reported frequency of healthy weight loss practices in the intervention than the control group. At end of 3 years: 80% read most or all of newsletters, 68% returned postcards, newspaper readership was higher in newspaper + incentive group ($p<0.05$) 25% attended 1 of the 4 group sessions
UNIVERSITY STUDENTS						
Matvienko *et al.* (2001)	RCT	Intervention: 4 months Follow-up: 12 months	After 16 months I: n=18 C: n=15 Attrition =17.5%	BMI: I: 24.6 C: 23.7	4 months follow-up mean BMI ($p>0.05$): I: 24.6 and 24.5 at 16 months C: 24.1 and 25.2 at 16 months If students with BMI>24 were compared at 16 months: I (n=11): weight = -1.4 kg C (n=6): weight = +9.2 kg ($p=.025$)	After 4 months Nutrition knowledge of intervention group improved ($p=0.001$) Intervention group consume fewer energy and carbohydrates and protein than control group (all $p<0.05$). After 16 months Nutrition knowledge higher in intervention group ($p=0.05$) Differences in energy, carbohydrate, protein intake disappeared

RCT: Randomized Control Trial; I=Intervention group; C=Control group; MA = multi-media intervention group; WA=written action intervention group

TABLE 2.11 (continued):

	Design	Duration of intervention and follow-up	Attrition	Mean baseline BMI / weight	Effect on weight	Other effects
ADULTS & CHILDREN						
Stolley & Fitzgibbon, (1997)	RCT	Intervention: 18 months Follow-up: 12 months	Attrition =17-22%	I: mothers = 29.1 I: daughters = 18.4 C: mothers = 30.8 C: daughters = 20.1	No significant difference within and between groups for mothers' weight, p-values for daughters' weight not reported. Actual weight data not reported.	Intervention mothers consuming less daily saturated fat ($p<0.05$) and lower percentage of energy from fat ($p<0.0001$). Intervention daughters less energy from fat ($p>0.05$).
CHILDREN						
Caballero *et al.*, (2003) *Pathways*	RCT	Three years initial phase, Three years intervention phase.	Attrition =17%	I: BMI=19.0 C: BMI=19.1	No significant change over time between groups for BMI, triceps, %body fat ($p>0.05$) BMI after 3 years: I: BMI=22.0 C: BMI=22.2 % children above 85th percentile for BMI in both groups increased	Lower energy and fat intake for intervention group ($p<0.05$) Increased knowledge among intervention group: increased self-efficacy to be physically active; but no increased self-efficacy to choose healthy foods
Donnelly *et al.*, (1996)	Non-RCT	Intervention: 2 years Follow-up: twice a year during intervention Follow-up laboratory data: at 2 years	Attrition =41%	I: BMI = 18.3 C: BMI = 18.5	No effect on weight ($p>0.05$): I (n=44): baseline BMI = 17.9±3.8 follow-up BMI = 1.9±4.3 C (n=64): baseline BMI = 18.1±2.6 follow-up BMI = 19.3±3.2	Meals provided at intervention school: Decreases in total energy and fat and increase in carbohydrate and fibre ($p<0.05$) No differences in dietary intakes or physical activity levels
Simonetti *et al.*, (1986)	Non-RCT	Intervention: 12 months Follow-up: at 12 months	Attrition =0%	% obese/overweight: MA group = 40.3% WA group = 34.9% Control = 33.4%	Proportion of obese children: MA: baseline = 13.3%; follow-up = 11.7% (-1.6%) WA: baseline = 10.6%; follow-up = 11.2% (+0.6%) C: baseline = 11.4%; follow-up = 12.1% (+0.7%) Proportion of overweight children MA: baseline = 27.0%; follow-up = 23.7% (-3.3%) WA: baseline = 24.3%; follow-up = 23.7% (-0.6%) C: baseline = 22.0%; follow-up = 22.2% (+2.2%)	No other measurements taken

RCT: Randomized Control Trial; I=Intervention group: C=Control group; MA = multi-media intervention group; WA=written action intervention group

2.8 EVALUATION OF WEIGHT-MANAGEMENT PROGRAMMES

2.8.1 Definition of programme evaluation

Through the years many researchers or evaluation experts have published definitions of the concept "evaluation research". Although evaluation is a common activity practised in everyday live, the practice of programme evaluation in organizational settings is much more difficult and complex. The following earlier definitions of evaluation research from 1963 to 1989 were summarized by Schalock, (1995: 4-5):

"Evaluation is the collection and use of information to make decisions about (an education) programme" (Cronbach, 1963: 672).

"The purpose of evaluation research is to measure the effects of a programme against the goals it sets out to accomplish as a means of contributing to subsequent decision making about the programme and improving future programming" (Weiss, 1972: 4).

"Programme evaluation is the systematic collection of information about the activities, characteristics, and outcomes of programmes for use by specific people to reduce uncertainties, improve effectiveness, and make decisions with regard to what those programmes are doing and effecting" (Patton, 1986: 14).

"Evaluation research is the systematic application of social research procedures for assessing the conceptualization, design, implementation, and utility of social intervention programmes" (Rossi & Freeman, 1989: 18).

From these definitions it is evident that the concept of evaluation research seems to have become more complex over the years. Despite this, Schalock (1995: 5) points out that common themes seem to arise throughout. These include the use of research procedures to systematically collect information about the activities, characteristics and outcomes of social programmes, on the one hand, and the application of programme evaluation data for decision making and/ or programme improvement purposes, on the other hand. These two themes are also reflected in the following more recent definition of programme evaluation by Rossi *et al.* (1999: 20): "Programme evaluation is the use of social research procedures to systematically investigate the effectiveness of social intervention programmes that is adapted to their political and organizational environments and designed to inform social action in ways that improve social conditions".

2.8.2 Considerations that should guide the planning of evaluations

The most important considerations that guide the planning of evaluations involve the purpose of the evaluation, the programme structure and circumstances, and available resources (Rossi *et al.*, 1999: 39).

2.8.2.1 The purpose of evaluation

Posavac and Carey (2003: 13) indicated that there is only one overall purpose for evaluating programmes, which is to contribute to the provision of quality services to people in need. Therefore, evaluation is complementary to, and supportive of, the development and provision of effective and responsive programmes (Owen & Rogers, 1999: 40). Programme evaluation will provide feedback from programme activities and outcomes, which can be utilized in different ways to improve service delivery.

Evaluations are initiated for many reasons and the underlying purpose of these reasons may differ (Rossi *et al.*, 1999: 39). Therefore, one of the first tasks facing an evaluator is to determine the underlying purpose of the evaluation. Rossi *et al.* (1999: 39-43) mention the following four broad purposes for programme evaluation: programme improvement, programme accountability, knowledge generation and political ruses or public relations. The focus of programme improvement is to use evaluation information to strengthen the plans for services and their delivery in order to improve the outcomes of programmes or to increase their efficiency (Babbi & Mouton, 2001: 339; Posavac & Carey, 2003: 14; Rossi *et al.*, 1999: 40). This type of evaluation is also referred to as formative evaluation, because the purpose is to form or shape the programme to perform better (Posavac & Carey, 2003: 14). Accountability is also referred to as judgement-oriented evaluation or summative evaluation, because its purpose is to render a summary judgement on programme performance, thus helping decision makers to decide whether a programme should be started, continued, terminated or chosen instead of alternatives (Babbi & Mouton, 2001: 337; Posavac & Carey, 2003: 14; Rossi *et al.*, 1999: 41-42). Knowledge-oriented evaluation refers to the generation of new information regarding the nature and effects of an intervention and consequently the contribution to the social science knowledge base (Babbi & Mouton, 2001: 339; Rossi *et al.*, 1999: 42). This information is disseminated through journals, conferences and professional outlets and may be useful for the development of new public programmes (Rossi *et al.*, 1999: 42). In some instances the purpose of evaluation is not to obtain information about programme performance, but rather to establish public relations or to impress funders or political decision makers (Rossi *et al.*, 1999: 42). Posavac & Carey (2003: 15), also refer to monitoring as another broad reason for programme evaluation. This involves an ongoing process of supplying feedback on critical process or outcome variables that will indicate whether the quality of the programme is being maintained (Posavac & Carey, 2003: 15; Rossi *et al.*, 42).

The end-result of programme improvement (=formative) and accountability (=summative) evaluations is some kind of decision or action, e.g. whether to terminate a programme or cease funding (judgement or summative) or whether to improve and fine-tune a programme (improvement or formative) (Babbi & Mouton, 2001: 339). However, it must be borne in mind that some evaluations are done to increase the

understanding of how programmes work and how people change their attitudes and behaviours as a consequence of the implementation of a successful programme (knowledge generation) (Babbi & Mouton, 2001: 339).

2.8.2.2 The programme structure and circumstances

Programmes differ from each other as far as organizational structures and environmental, social and political circumstances are concerned (Rossi *et al.*, 1999: 44). These factors, which influence evaluation designs, were classified by Rossi *et al.* (1999: 44) into the following three categories:

- The stage of programme development

The stage of programme development, i.e. whether it is new or innovative, established but still in the developing and restructuring phases or whether it is established and presumed stable, determines the evaluation approach that will be conducted or the questions that are to be answered (Rossi *et al.*, 1999: 44). The different stages of programme development and the consequent differences in evaluation approaches are described in Table 2.12.

TABLE 2.12: Stages of programme development and related evaluation functions (Rossi *et al.*, 1999: 45).

Stage of programme development	Question to Be Asked	Evaluation Function
Assessment of social problems	To what extent are community needs and standards met?	Needs assessment; problem description
Determination of goals	What must be done to meet those needs and standards?	Needs assessment; service needs
Design of programme alternatives	What services could be used to produce the desired changes?	Assessment of programme logic or theory
Selection of alternative	Which of the possible programme approaches is best?	Feasibility study; formative evaluation
Programme implementation	How should the programme be put into operation?	Implementation assessment
Programme operation	Is the programme operating as planned?	Process evaluation; programme monitoring
Programme outcomes	Is the programme having the desired effects?	Outcome evaluation
Programme efficiency	Are programme effects attained at a reasonable cost?	Cost-benefit analysis; cost-effectiveness analysis.

- The Administrative and political context of the programme

These factors are relevant when different stakeholders are involved in the planning of a programme and the establishment of its definition, goals and objectives. Academic researchers who conduct an evaluation study on their own initiative for knowledge-generation purposes are usually free to determine their own definitions, goals, objectives and so forth (Rossi *et al.*, 1999: 47).

- The conceptual and organizational structure of the programme

Programme conceptualization, which is also referred to as programme theory or the programme plan, refers to "the distinctness and explicitness of its plan of operation, the logic that connects its activities to the intended outcomes, and the rationale provided for why it does what it does" (Rossi *et al.*, 1999: 50). If uncertainty exists about whether the programme conceptualization is appropriate for the problem the programme addresses, it is useless for the evaluation design to focus on how well those concepts are implemented (Rossi *et al.*, 1999: 50).

The organizational structure of a programme is also important when planning an evaluation. The characteristics of the programme such as the target population, facilities and collaboration with other organizational entities have implications for the range of evaluation questions to be covered, data collection procedures, resources required for the evaluation and stakeholder groups that need to be involved (Rossi *et al.*, 1999: 50).

2.8.2.3 Resources available

Besides the purpose of the evaluation or the structure and circumstances of the programme, the planning of an evaluation is also influenced by the available resources. An important task of the evaluator is therefore to make a detailed estimation of all the expenses associated with the completion of the steps essential to the plan. This estimation must be in line with the funds that are available for the expenses. Funding is usually necessary for evaluation activities, materials, equipment, facilities, methods of analysis and personnel (Rossi *et al.*, 1999: 52).

2.8.3 Steps for planning an evaluation

Posavac and Carey (2003: 35) suggested several steps that an evaluator could follow while planning an evaluation. The first step involves reviewing the literature to learn from the successes and failures of other evaluation studies, by focusing on the following questions:

- In what ways are the published programmes similar to the programme being considered for evaluation?
- What research designs were used?
- Can some of the measures of the outcome criteria of the published programmes be adapted?
- How reliable and valid were the measures?
- What statistical analyses were used?
- Is there consensus among the published reports?
- If there are conflicting findings, are these conflicts due to different approaches to sampling, design or interpretation?
- What issues were not addressed?

The second step in the planning of an evaluation involves decisions regarding the methodology involved. The evaluators will need to make methodological decisions regarding sampling procedures, research design, data collection and statistical analysis (Posavac & Carey, 2003: 37). The identification of these

different methodological components will be based on the questions that need to be answered by the evaluation research (see Section 2.8.4) (Rossi *et al.*, 1999: 38). Methodological decisions regarding sampling procedures involve the identification of the target population, whether the entire population, a random sample, or a sample selected for other reasons will be evaluated and the reasons behind these decisions (Posavac & Carey, 2003: 38). Another crucial methodological issue is choosing a research design and the methods and techniques that will supply the best information for the execution of the evaluation (Posavac & Carey, 2003: 38; Rossi *et al.*, 1999: 38). Methodological decisions regarding the research design depends on the purpose of the evaluation, the preferences of the stakeholders, the time available for the completion of the project and the funds available (Posavac & Carey, 2003: 38). Methodological decisions regarding data collection include the techniques and methods that will be used to collect data, identification of personnel responsible for data collection, and where and when data collection will take place (Posavac & Carey, 2003: 39). The selection of the best statistical procedures for data analyses should be based on the most simple but complete procedures of which the results can be easily understood by stakeholders (Posavac & Carey, 2003: 39).

The third step in the planning of an evaluation involves the preparation of a written proposal for the planned research and its presentation to the funding agencies and programme personnel. This written proposal will consist of specifications of the target population, the purpose of the evaluation, resources available to develop and implement the evaluation, how data of key questions will be collected (methods) and analyzed, strategies for dissemination of results, ethical issues, budget, timeline and other considerations. Input can be made from the parties involved, until all agree on the above-mentioned sections and the readiness of the programme. The presentation of a written proposal will help the funding agencies and programme personnel to understand the evaluation process, feel comfortable with it, and also to be enthusiastic about the information that will be obtained (Posavac & Carey, 2003: 40).

2.8.4 Evaluation questions

Rossi *et al.* (1999: 62) indicate that the primary way in which an evaluation is tailored to the unique circumstances associated with the programme under investigation is the construction of relevant questions and the planning of how to answer them. The evaluator should analyze the programme independently and develop a set of candidate evaluation questions that cover all the potentially relevant issues. Therefore, while designing an evaluation, it is important to identify which questions the evaluation must answer. Detailed construction of these questions will structure the evaluation, which will lead to appropriate and thoughtful planning, and will lay the foundation for informative discussions about who is interested in the answers and how they could be used (Rossi *et al.*, 1999: 62).

Although the questions are distinct and unique to each programme, Rossi *et al.* (1999: 63) proposed five recognizable types of questions depending on the programme issues they address. The common methodological frameworks in evaluation correspond with the five types of questions that can be asked (Table 2.13).

TABLE 2.13: Methodological frameworks of the different evaluation types and the questions they answer.

Methodological frameworks	Classification of evaluation type according to Owen & Rogers (1999)	Answer questions about...
Needs assessment	Proactive evaluation	...the need for programme services and the social conditions a programme is intended to address
Assessment of programme plan (theory)	Clarificative evaluation	...programme conceptualization and design
Assessment of programme process/ Process evaluation	Interactive evaluation Monitoring	...programme operations, implementation and service delivery
Impact Assessment/ Impact evaluation/ Outcome evaluation.	Impact evaluation	...programme outcomes and impact
Efficiency assessment	Impact evaluation	...programme cost and cost-effectiveness

Sources: Rossi *et al.*, 1999: 63; Owen & Rogers, 1999

2.8.5 Methodological frameworks

2.8.5.1 Needs assessment

A programme is usually initiated to address a specific problem. To characterize this problem, a needs assessment is undertaken as the first step before the designing and planning of a new programme (Babbi & Mouton, 2001: 341; Posavac & Carey, 2003: 7). Needs assessment provides information about the services that are needed and identifies the most applicable intervention to address the problem in the target population (Owen & Rogers, 1999: 42). The following information could be provided by a needs assessment study (Owen & Rogers, 1999: 42; Rossi *et al.*, 1999: 64):

- The nature, magnitude and distribution of a problem by obtaining information about the need or problem by reviewing of relevant literature;
- The extent to which there is a need for intervention to address this problem;
- The implications of the two above-mentioned circumstances for the conceptualization and design of the intervention – thus what forms of service are likely to be attractive to the target population;
- Whether other attempts to find solutions for this problem have been implemented and the identification of the best practice "models" and the creation of benchmarks. Using benchmarks refers to the practice of modelling activities (therefore what will be done by the programme) on leaders in their field;
- Other information provided by relevant research or conventional wisdom about the problem.

Needs assessment is an important step in ensuring the effective planning and evaluation of a programme (Babbi & Mouton, 2001: 341). However, it is also an important indicator of whether the needs of a participant or group in an established programme are being met. Hereby, certain aspects of the programme can be changed in order to improve it. This is supported by Owen and Rogers (1999: 41), who maintain that needs assessment or needs analysis involves the assessment of the degree to which the projected programme can respond to an intended perceived need of the target population.

2.8.5.2 Assessment of programme theory

After characterizing the problem of a target population with a needs assessment study, the next step would be to identify the best programme to successfully address the problem. "The conceptualization and design of the programme must reflect valid assumptions about the nature of the target problem and represents a well-founded and feasible approach to resolving it" (Rossi *et al.*, 1999: 65). According to Rossi *et al.* (1999: 156), programme theory refers to the "plan of the programme", which in turn refers to a conception of the appropriate structure, functions, and procedures of a programme to attain its goals. Assessment of programme theory is applicable to especially new programmes, but could also involve established programmes. For established or ongoing programmes this assessment will explain how well the programme addresses the needs that it aimed to meet (Rossi *et al.*, 1999: 65). In the literature the assessment of programme theory is also referred to as clarificative evaluation (Owen & Rogers, 1999: 42-44). Both needs assessment and programme theory concentrate on the evaluation of the design of a programme rather than its implementation (Owen & Rogers, 1999: 43).

2.8.5.3 Assessment of programme process

Process evaluation refers to the evaluation of the implementation of a programme which refers to the activities and operations of the programme, thus providing information on how well the programme is functioning (Rossi *et al.*, 1999: 67). If process evaluation is conducted in an ongoing manner, it is referred to as programme monitoring. Process evaluation is also referred to as *interactive evaluation* and *monitoring evaluation* by Owen & Rogers (1999: 44). Interactive evaluation provides information about the delivery or implementation of a programme or about selected components or activities. The information provided is orientated towards the improvement of current or future programmes or just to establish what is happening (Owen & Rogers, 1999: 44-46). Monitoring evaluation is done on established and ongoing programmes to monitor the progress of a programme through the evaluation of identified quantitative performance indicators (Owen & Rogers, 1999: 45).

Typical information provided by process assessment includes the following (Babbi & Mouton, 2001: 341; Owen & Rogers, 1999: 45; Rossi *et al.*, 1999: 192):

- How congruous the actual services are with the goals of the programme;
- Whether services are delivered to the intended target population
- Whether services are delivered as originally intended and how well service delivery is organized;
- The effectiveness of programme management;
- The use of programme resources;

- Whether and how the organization of the programme and delivery of services can be changed to make the services more effective and/ or efficient.

For effective impact assessment (see Section 2.8.5.4) it is important to know how well the programme was implemented in order to conclude that it did actually affect the target population. It is often claimed that programmes are not implemented and executed as their design intended. Many factors could contribute to this type of situation including the following: the programme was simply poorly managed, political interference compromised the implementation, unavailability of personnel, problems with facilities, the programme design was not well structured, the intended programme participants are not available in the numbers required, programme participants are not co-operative, intended programme participants cannot be identified precisely, and insufficient funds (Rossi *et al.*, 1999: 67).

2.8.5.4 Impact assessment

In the literature impact assessment is also referred to as impact evaluation or outcome evaluation (Babbi & Mouton, 2001: 341; Rossi *et al.*, 1999). After establishing that the programme has been correctly implemented through process assessment, it is now possible to determine whether the programme had any effect on the participants and whether it produced the intended improvements in the problem it aimed to address (Posavac & Carey, 2003: 8; Rossi *et al.*, 1999: 70).

Impact assessments provide answers to the following issues/ questions:

- Whether the desired outcomes were attained;
- Whether the programme was effective in producing change in the identified problem;
- Whether the programme produced unintended side effects;
- Whether the implementation strategy led to the intended outcomes.

These questions assume that a set of operationally defined objectives and criteria of success were identified/ formulated. The objectives may be social-behavioural, community or physically related. Objectives such as the prevention of weight gain in a target group could be seen to be of social-behavioural nature (Rossi *et al.*, 1999: 70).

Evaluators often combine process assessment and impact assessment so that a link can be established between the implementation of the programme and the outcomes observed (Rossi *et al.*, 1999: 70). When an impact assessment is conducted without any process evaluation, it is referred to as a *black box evaluation* (Rossi *et al.*, 1999: 71). With this type of evaluation the evaluator may learn what the programme effects are, but does not know what, if any, of the programme processes caused the effects (Posavac & Carey, 2003: 25; Rossi *et al.*, 1999: 71). In some situations this form of evaluation is acceptable because it is not necessary to improve the product which is being evaluated, e.g. the evaluation before buying a car. However, this approach is not recommended for the evaluation of social programmes (Posavac & Carey, 2003: 26).

It is suggested that impact assessment is most appropriate for mature, stable programmes with a well-defined programme model and a clear use for the results (Owen & Rogers, 1999; Rossi *et al.*, 1999: 72). However, other new, innovative programmes can also undergo impact assessment if there is a need for such results, e.g. if decision makers want to use the results to decide to expand the programme or obtain funds (Rossi *et al.*, 1999: 72). Rossi *et al.* (1999: 70) mention the following primary reasons for conducting an impact assessment:

- When there is an interest in determining whether a programme has been successful thus far in addressing the specific problems it aimed to address;
- To compare the effectiveness of different but similar programmes; and
- To evaluate a new effort/ approach to address a particular problem.

To ensure that impact assessments are conducted effectively, the evaluator must compose a plan that can be used as a guide in the process. This plan should address the following:

- The specification of the outcome variables;
- Development of new or identification of existing techniques or methods to measure the outcome variables;
- Identification of a research design that will facilitate the determination of the status of participants regarding the outcome variables but could also the estimation of what their status would be if they had not been exposed to the intervention.

The most difficult or complex task of the evaluator is to estimate what the effect of the programme would be if it was not used by the participants. According to Rossi *et al.* (1999: 70), this is referred to as the *counterfactual* because "it describes a condition contrary to what actually happened to programme recipients". Thus, the evaluator must choose the correct evaluation design to assess the impact that the programme had on the participants as well as what the effect on them would have been had they not been exposed to the programme. There are many different ways in which these assessments can be conducted, but some methods provide more credible information in this regard than others, although no single one can be seen as a "gold standard" for evaluation design. The general rule that applies in this regard is that the most rigorous research design will result in the more plausible estimation of intervention effects. The better designs generally require more skills, more time to complete and they cost more. Therefore evaluators must review all available design options to determine the most applicable and appropriate one for the specific programme and conditions. Because there is no universal "gold standard" evaluation design, the evaluator should apply the "good enough rule" (Rossi *et al.*, 1999: 204). This rule states that "the evaluator should choose the best possible design from a methodological standpoint after having taken into account the potential importance of the results, the practicality and feasibility of each design, and the probability that the design chosen will produce useful and credible results" (Rossi *et al.*, 1999: 240). In the better designs the effects of a programme are measured by comparing the outcome variables of participants and non-participants before and after the intervention. This comparison before the intervention takes place is of great importance, because ideally the participants and non-participants

should be identical in all aspects. The different research designs for impact assessment and the type of controls used for each design are described in Table 2.8.

Although not a universal golden standard, the optimal recommended design to establish the effects caused by an intervention is a randomized controlled trial. Randomized designs are used when the evaluator can randomly assign the target population to an intervention and control group. These are called true experiments and the difference found between the groups regarding their outcome variables could then be attributed to the experimental intervention. However, it is not always possible to obtain true experiments from the target population and then the evaluator can choose a non-randomized quasi-experimental design to compare a selected experimental and control group with a statistical approach. Sometimes the above-mentioned impact assessment designs (RCT and quasi-experimental design) cannot be used, usually due to a lack of funds, time or because of circumstances where the construction of a control group is impossible. Other approaches to impact assessments, which do not involve collecting new or analyzing existing data, can then be considered. These types of impact assessments are called judgmental approaches and are summarized in Table 2.14.

TABLE 2.14: The description of different research designs in respect to intervention assignment, type of controls used and data collection strategies*.

RESEARCH DESIGN	INTERVENTION ASSIGNMENT	TYPE OF CONTROLS USED	DATA COLLECTION STRATEGIES
DESIGNS FOR PARTIAL COVERAGE PROGRAMMES			
Randomized Control Trials			
"True" experiments	Random assignment controlled by researcher	***Randomized controls:*** The target population is randomly assigned to an experimental group, who will be served by the programme, and a control group, who will receive no programme. These designs may have more than one experimental group, each receiving different interventions or variation in the intervention or several control groups, to which different control conditions apply, e.g. no intervention, placebo intervention, treatment as usual, etc.	Minimum data needed are after-intervention measures; typically consist of before, during and after measures.
Quasi-experiments			
1. Regression-discontinuity	Non-random but fixed and known to researcher	***Regression-discontinuity controls:*** Assignment of population to an intervention or a control group on the basis of measured values on a precisely identified selection instrument. Selected targets compared to unselected targets, holding selection constant.	Typically consists of multiple before- and after-intervention outcome measures
2. Matched controls	Non-random and unknown	***Matched constructed controls:*** Intervention group is matched on selected characteristics with controls, which are non-randomly selected by researcher.	Typically consists of before- and after-intervention measures
3. Statistically equated controls	Non-random and often non-uniform	***Statistically equated controls:*** Participants and non-participants are non-randomly selected. The two groups are compared and any initial differences between them regarding selected characteristics are adjusted by statistical methods.	Before-and after or after-only intervention outcome measures and control variables
4. Generic controls	Nonrandom	***Generic controls:*** Intervention effects among participants are compared with established norms about typical changes in the target population or with outcome measures available on general population.	After-intervention outcome measures on targets plus publicly available "norms" of outcome levels in general population
DESIGNS FOR FULL-COVERAGE PROGRAMMES			
Simple before-and-after studies	Non-random and uniform	***Reflexive controls:*** Participants are compared with themselves using the measurements before and after the intervention.	Outcome measured on exposed targets before and after intervention
Cross-sectional studies for non-uniform programmes	Non-random and non-uniform	Targets differentially exposed to intervention compared with statistical controls.	After-intervention outcome measures and control variables
Panel studies: Several repeated measures for non-uniform programmes	Non-random and non-uniform	***Repeated measures reflexive controls:*** This technique is similar to reflexive controls, but the same participants are observed repeatedly over time before, during and after the intervention.	Repeated measures of exposure to intervention and of outcome
Time series: Many repeated measures	Non-random and uniform	***Time-series reflexive controls:*** This technique is also similar to reflexive controls, but rates of occurrence of some event or other such social indicators are compared at frequent time points before and after the intervention. Large aggregates compared before and after intervention.	Many repeated before- and after-intervention outcome measures on large aggregates

*Summarized from Rossi *et al.* (1999: 260-266).

The data gathered during impact assessments can be either qualitative (mostly not numerical) or quantitative (expressed numerically). Advocates of qualitative data claim that the cause(s) of problems can be better understood through the collection of data from intimate acquaintance with people and their problems, which are not provided by the numerical representation of quantitative data. However, quantitative data can be expensive to gather on an extensive basis, are subject to misinterpretation, involve procedures that are difficult to implement, and may contain information that is not uniformly collected across all cases and situations. Furthermore, the need for researchers to deliver data that are scientifically plausible and include relatively precise estimates of the net impact of a programme, requires systematically and uniformly collected quantitative data (Rossi *et al.*, 1999: 271).

Finally, when impact assessment is planned, inference validity issues need to be considered. "The paramount purpose of an impact assessment is to arrive at valid inferences about whether a programme has significant net effects of the desired sort" (Rossi *et al.*, 1999: 271). For impact assessments to achieve inference validity they must be reproducible and/or generalizable (Rossi *et al.*, 1999: 271). Reproducibility refers to the ability of a research design to produce results that are robust enough that another researcher using the same design in the same setting would achieve the same results. Reproducibility depends on the power of the research design, the fidelity with which the design was implemented, and appropriateness of the statistical models used to analyze the results. Therefore, powerful research designs, using large numbers of observations that are analyzed correctly will have a high reproducibility. RCTs usually have a high reproducibility, while cross-sectional surveys or judgement assessments will have low reproducibility (Rossi *et al.*, 1999: 271-272).

Generalizability refers to the applicability of the findings to similar situations that were not studied, for instance, similar programmes in comparable settings (Rossi *et al.*, 1999: 272). According to Rossi *et al.* (1999: 272) generalizability is affected by the following:

- Characteristics of the sample, e.g. a successful weight-gain prevention programme for university students may be generalizable to students at other universities, but not to a general sample of young adults of the same age because they may, for instance, not have comparable intellectual abilities;
- Inappropriate sample of the population, e.g. testing a weight-gain prevention programme on a sample of adolescent girls;
- Programme administrators and conditions, e.g. assessments of a programme administered by highly dedicated and skilful researchers may not be generalizable to programmes administered by government workers who do not have the same levels of commitment and skills;
- Programme settings, e.g. the results produced may be a reflection of certain community settings, such as a low income level, and are then not generalizable to other communities with different settings (e.g. with a high income level). Similarly the results of an impact assessment of a weight-gain prevention programme for female students may reflect the environment of the participating students.

Rossi *et al.* (1999: 273) point out that an inherent trade-off between reproducibility and generalizability is usually necessary in the design of impact assessments. This implies that evaluation researchers may have to choose between whether the impact assessment will reflect mostly reproducible or mostly generalizable results. According to Rossi *et al.* (1999: 273), some evaluation experts emphasize that generalizable evaluations are more valid and relevant for policy purposes than very rigorous designs with low generalizability. These authors suggest that each evaluator must assess how strong the trade-off constraints of a programme are and then make an appropriate decision. For programmes in the early stages of development and implementation it is suggested to rather focus on reproducible impact assessment designs, because this will facilitate the identification of programmes that have an effect under similar conditions. This can then be followed by the execution of more generalizable impact assessments of such programmes (Rossi *et al.*, 1999: 273).

2.8.5.5 Efficiency assessment

Efficiency assessment, which involves cost-benefit analyses and cost-effectiveness analyses, "provide a frame of reference for relating costs to programme results" (Rossi *et al.*, 1999: 365). These assessments are used to make decisions for the allocation of resources and to gain the support of planning groups and political constituencies who determine the fate of interventions. With cost-benefit analyses the outcome of the programmes are expressed in monetary terms, which refers to the "analytical procedure for determining the economic efficiency of a programme, expressed as the relationship between costs and outcomes" (Rossi *et al.*, 1999). With cost-effectiveness analyses the outcome of the programmes are expressed in substantive terms, which refers to the efficacy of a programme in achieving intervention outcomes in relation to the programme costs (Rossi *et al.*, 1999). It is always important to know what the cost of a programme is and whether the impact of the programme justifies the costs. Some programmes may not find enough resources because their costs are too high for their impact. Other programmes may compete for resources and the ones likely to qualify are those with the greatest impact but cost the least. Questions about efficiency become relevant when it is known that the programme is well implemented and produces the desired outcomes (Rossi *et al.*, 1999).

2.9 CONCLUDING REMARKS

Weight gain prevention programs targeted at young adults such as FYFS, can be classified as selective obesity-prevention interventions. Selective prevention implies improving the knowledge and skills of a target group who were identified as being at risk for gaining weight and are consequently at risk for developing obesity, but are not yet obese. Any scientifically acceptable selective obesity-prevention intervention should contain a healthful eating component, a physical activity component, as well as a behavioural and psychological health component, related to the unique weight-management needs of a particular target group. Another important component involves the identification of reasonable weight goals, which should be aimed at achieving the best possible weight in the context of overall health. The concept of weight-management is applicable to all individuals regardless of BMI classification. Therefore, the mentioned essential components should be included in any weight management

programme, even when targeted at normal weight participants. In the assessment of the impact of a particular programme it is therefore also important to not only assess changes in the weight status of the participants, but to also include indicators of the mentioned essential components. Different approaches are available to deliver weight-management information to target groups. These may be classified into three categories which include do-it-yourself (self-help), non-clinical or clinical programmes. General guidelines have been formulated to assist health professionals with the effective implementation of a particular weight management programme. The success of weight-management programmes is influenced by a variety of aspects such as the mode of program delivery, the coverage of essential components, incentives and support systems. In the planning, implementation and evaluation of such programmes, attention should be given to predictors of success with weight loss, predictors of weight gain, predictors of weight maintenance, and predictors of attrition. Only a limited number of well described, developed and evaluated weight gain prevention programs aimed at adults, students or children have been published, emphasizing the need for the development of such programs for specific target groups. The effectiveness of the published programmes in limiting or preventing weight gain among the target groups was is not very good in terms of weight status, although, some programs did show a few positive behaviour changes among participants. Finally, the assessment of the implementation (process assessment) and impact of potential programmes should be rigorously designed to provide valid and reliable results. In this process attention should be given to aspects that should guide the planning and execution of any evaluation, evaluation questions and specifically for impact assessment the use of randomized or quasi-experimental trials.

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CHAPTER 3

ARTICLE 1

The association between the BMI of first-year female university students and their weight related perception and practices, psychological health, dietary intake, physical activity and other physical health indicators.

INTRODUCTION

The health of students studying at tertiary institutions (e.g. college or technikon or university) is considered to be a matter of increasing concern for researchers and health professionals (Hendricks & Herbold, 1998; Sax, 1997). The transition from high school to a tertiary institution is said to be an especially problematic stage in adult development (Adlaf *et al.*, 2001). Research indicates that this transition is accompanied with decreases in self-concept and psychological well-being (Hesse-Biber & Marino, 1991; Page & Fox, 1998; Sax, 1997). It has also been indicated that first-year female students (FYFS) suffer from psychological distress (Adlaf *et al.*, 2001; Ko *et al.*, 1999; Roberts *et al.*, 1999), depression and anxiety more than in previous decades (Sax, 1997). The transition also implies that students have to adapt to a new social, academic and psychological environment in which they are now suddenly free to make their own decisions. In order to adapt and find a way of becoming accepted or popular with their peer group, young women become increasingly concerned about maintaining an attractive body and a culturally acceptable body shape (Hesse-Biber & Marino, 1991; Striegel-Moore *et al.*, 1989). This phenomenon can often be traced back to the intensity with which the media in Western societies push the thin ideal and stigmatise the obese as ugly, awkward, weak, sad, unsuccessful, lacking in control (Rothblum, 1990). Consequently, the thin figure has become most women's idealized standard on which their weight goal is based, whether this goal is realistic or not (Anderson *et al.*, 2003; Crawford & Campbell, 1999; Schulken *et al.*, 1997; Ziebland *et al.*, 1996).

Research indicates that female students exhibit high levels of concern about weight and body shape, are preoccupied with thinness (Schwitzer *et al.*, 1998; Sciacca *et al.*, 1991), perceive their body weights and sizes to be excessive and consider themselves overweight when their actual weight is classified as normal (Adame *et al.*, 1990; Anderson *et al.*, 2003; Baily & Goldberg, 1989; Sciacca *et al.*, 1991; Senekal, 1988b; Stephens *et al.*, 1999). They are also strongly inclined to select underweight body silhouettes as the size they feel is representative of what women should look like or as their ideal weight (Schulken *et al.*, 1997).

To reach their often unrealistically and usually unattainable low weight goals, many female students engage in regular dieting behaviours (Cogan *et al.*, 1996; Page & Fox, 1998; Senekal, 1988b; Senekal *et al.*, 2001; Striegel-Moore *et al.*, 1989). The main reasons underlying these dieting behaviours is not to benefit their health (Page & Fox, 1998; Rodin, 1981), but rather to improve their appearance and self-image, to fare better socially and because they feel good after they lose weight (Page & Fox, 1998; Radbill & Ross, 1995). In fact, a higher fat percentage has been found not to be predictive of the weight management decision-making of female students (Page & Fox, 1998).

Female students have been shown to use unsound, unhealthy and extreme dietary practices such as self-induced vomiting, crash diets, fasting for more than 24 hours, binging, or pills and laxatives, which could all have a negative effect on their physical and mental health (Douglas *et al.*, 1997; Koszewski & Kuo, 1996; Kurtzman *et al.*, 1989; Page & Fox, 1998). Preoccupation with weight may also result in chronic dieting (Fallon & Rozin, 1985), which in turn is related to the development of abnormal attitudes towards eating, concerns about body image, decreases of self-concept, decreases in psychological well-being and increases in eating disorders (French *et al.*, 1995; Polivy & Herman, 1987). The majority of female students exhibit at least a few of the symptoms of disordered eating (Hesse-Biber, 1989; Protinsky & Marek, 1997). Prevalence studies have shown that anorexic-like attitudes and behaviours are common among fifteen percent or more of college campus women (Heatherton *et al.*, 1995; Hesse-Biber, 1989; Nelson *et al.*, 1999; Prouty *et al.*, 2002). Female problem eaters have furthermore been shown to have low physical and personal self-esteems and are psychologically distressed (Nelson *et al.*, 1999).

Despite the intense focus on thinness and weight reduction that is evident in groups such as female students in Western societies, it is well documented that obesity is increasing at an alarming rate among all age groups in both developed and developing countries (Pi-Sunyer, 1993; SAHR, 2002; WHO, 1998: 8, 61). Obesity prevalence among female university students ranges from less than 1% to 7% in South Africa and other countries, while overweight accounts for 5% to 20% (Bellisle *et al.*, 1995; DiGioacchino DeBate *et al.*, 2001; Douglas *et al.*, 1997; Sciacca *et al.*, 1991; Schulken *et al.*, 1997; Senekal *et al.*, 1988b: 152; Steyn *et al.*, 2000). In the long-term obesity could contribute to an increased morbidity, due to the increased risk of the development of chronic diseases of lifestyle such as diabetes mellitus, cardiovascular disease and cancer (Colditz *et al.*, 1995; Despres, 1993; Wadden *et al.*, 2002; WHO, 1998).

However, it is important to bear in mind that other life-style factors such as smoking, dietary intake and physical activity may also have a profound effect on the development of these conditions (Hendricks & Herbold, 1998; Pate *et al.*, 1995). A yearly comparison of the health of American first-year students since 1966 indicated that since 1995 the prevalence of smoking has been on the rise (Sax, 1997).

Furthermore, many students are said to be too sedentary. Prevalence studies indicate that about half of undergraduate female students do not participate in regular moderate or vigorous physical activity (Douglas *et al.*, 1997; Suminski *et al.*, 2002). Senekal (1988b) also found that the level and amount of physical activity that FYFS engage in was lower than during the previous years at high school. As far as dietary intake is concerned, adolescents and students are notorious for having poor eating habits. The dietary intake of students has been found to be high in total fat and saturated fat, low in fibre, vegetable and diary foods, and high in alcoholic beverages, soft drinks, sweets, chocolates, rusks and foods from fast--food restaurants (Georgiou *et al.*, 1997; Hoffman, 1989; Koszewski & Kuo, 1996; Senekal., 1988b). Such dietary patterns have typically been associated with a higher prevalence of overweight and obesity and the above-mentioned chronic diseases of lifestyle.

As the burden of weight-related conditions such as eating disorders and chronic diseases of the lifestyle is increasing world-wide and in South Africa (WHO, 1998; SAHR, 2002), much has been written about the need for appropriate interventions to ensure effective weight management practices from an early age on. This paper describes the baseline relationship between the BMI and the dietary intake, physical activity, smoking habits, body-shape perception, eating attitudes and behaviours and weight-management related parameters of the participants in a weight-management intervention trial.

METHODS AND PROCEDURES

Study design

This paper is based on the cross-sectional baseline data of a weight-management intervention trial with a non-randomized quasi-experimental study design. It is important to note that the instruments used to assess the different variables were specifically designed or selected to fulfil the aim and objectives of the weight-management intervention, which focussed on the detection of change that occurred in the variables over time.

Study population and sample size

The population consisted of all first-year female students (FYFS) staying in residences exclusively for female students (n=883) on the campus of Stellenbosch University in South Africa. From the 12 residences available for exclusive female accommodation in 2002, seven (n=509) were selected by the researchers for data collection. The selection criteria, which were based on the study design of the weight-management intervention trial, are described in the second article (Chapter 4).

Subjects were recruited over a three-week period during February and March of 2002, during their first month at university. For subject recruitment purposes, an evening meeting for all FYFS was organized with the help of the student bodies at each of the seven residences. In an introductory PowerPoint-based presentation students were informed about the aim of the study as well as what would be expected of them if they chose to participate. After the presentation the students could volunteer for participation in the study. The final baseline sample included n=360, which represents a 71% response rate within the seven selected residences and 41% sample of the total population. The majority of the sample consisted of white students.

Anthropometric measurements

The anthropometric measurements included weight, height, triceps skinfold, midupper-arm circumference, waist circumference and hip circumference. The same two standardized field workers, who completed a Level 1 anthropometry course, took all the measurements using the techniques described by Lee and Nieman (1996).

To provide information on actual body composition from easily obtainable anthropometric measures such as weight and height, several indices have been developed. Of these the most widely used height-weight index is the Quetelet's index (Lee & Nieman, 2003: 179). This index is more commonly known as the body mass index (BMI) and is computed as weight (kg)/ height $(m)^2$ (Bastow, 1982). The WHO and NIH recommend the use of the BMI for the evaluation of a person's weight as well as obesity prevalence within a population (WHO, 1998: 10; NIH, 2000). The BMI has a high correlation with estimates of body fatness and a low correlation with height (Willett *et al.*, 1999). Garrow and Webster (1985) concluded that it is both a convenient and reliable indicator of obesity. The weight of the study population was measured in light clothing without shoes to the nearest 0.1 kg using a calibrated electronic scale (BW-150 from You-We Scales). The students were measured while standing in the centre of the scale without support and with the weight distributed evenly on both feet, while looking directly in front of them. Height without shoes was measured to the nearest 0.1 cm with a stadiometer. The students stood with their feet together and heels, buttocks, scapulae and back of the head touching the vertical surface of the stadiometer, if possible. Any hair obstructions were removed and the head was placed in the Frankfort horizontal plane. Students were then asked to inhale deeply and hold their breath before the measurement was taken. For interpretation purposes the BMI was categorized according to the World Health Organization guidelines, namely BMI<18.5 = underweight; BMI ≥18.5 and <25 = normal; BMI ≥25 and <30 = overweight and a BMI≥30 = obese (SASSO, 2003: 4; WHO, 1998: 9). For the purposes of statistical analysis the obese and overweight subjects were grouped into one category, namely BMI≥25, because there were only three subjects in the obese category.

Although the BMI is a good indicator of body weight, it does not necessarily reflect body composition, lean body mass and fat mass. It is important to distinguish between these body compartments, because body fat is associated with increased mortality and the risk of developing obesity-related comorbidities (WHO, 1998: 43-60; NIH, 2000). The BMI should therefore be combined with other measures, which could be easily performed in a clinical setting to estimate body fat. The most widely used method of indirectly estimating body fat is to measure skinfold thickness at various sites (Lee & Nieman, 2003: 185). The triceps skinfold is the most commonly used single-site skinfold measurement to assess body composition mainly because of its easy accessibility (Lee & Nieman, 2003: 187, 191). Although single-site measurements cannot be used to estimate percentage body fat, the triceps skinfold can, however, be used as an index of subcutaneous adipose tissue or fat stores (Lee & Nieman, 2003: 227). The triceps skinfold of the study population was taken to the nearest 0.2 mm using a calibrated Harpenden calliper. The subjects first stand with an elbow flexed to a 90^0 angle with the palm of the hand facing upwards. A

mark is then made on the posterior midline of the right arm over the triceps muscle at the midpoint between the lateral projection of the acromion process of the scapula and the inferior margin of the olecranon process of the ulna. The skinfold was then taken at this mark, while the student stands erect with arms hanging loosely at the side of her body and her palm facing anteriorly. The percentiles (for females aged 18 to 24.9 years) published by Frisancho (1990) were used to classify the student's triceps skinfold in five categories, namely ≤ 5th percentile=low fat content, >5th and ≤15th percentile=below average, >15th and ≤85th percentile=average, >85th and ≤95th percentile=above average and >95th percentile=high fat content.

The mid-upper-arm muscle circumference (MAMC), the mid-upper-arm muscle area (MAMA) and the mid-upper-arm fat area (MAFA) can be computed using the triceps skinfold and mid-upper-arm circumference (MAC). MAMA and MAMC are used as an index of lean tissue or muscle in the body to predict changes in total body muscle mass on the basis of changes either in the circumference or volume (MAMC) or in the cross-sectional area (MAMA) of one muscle group. The MAMA or MAMC can reflect the change of the size of the arm muscle due to changes in weight or nutritional status over time (Lee & Nieman, 2003: 227). The changes that occur in MAMA are larger than the changes that occur in the MAMC and the MAMA is therefore a more useful indicator of muscle protein reserves in the body (Lee & Nieman, 2003: 228). MAMA has also been shown to be related to total body muscle mass in adults (Heymsfield *et al.*, 1982).

The MAC of the study population was measured to the nearest 0.1 cm using a non-stretchable measuring tape. The measurement was taken at the same mark which was used to measure the triceps skinfold. The measuring tape was placed around the right upper arm, perpendicular to the long axis of the arm, at the level of the triceps skinfold site, while the student stands with arms hanging relaxed by the side of her body. The the MAMC, MAMA and the MAFA were calculated[6] and then classified according to the percentiles published by Frisancho (1981) into five categories. For MAMC and MAMC these were interpreted as ≤5th percentile=wasted, >5th and ≤25th percentile=below average, >25 and ≤75th percentile=average, >75th and ≤95th percentile=above average and >95th percentile=high muscle mass. For MAFA the classifications under percentiles were interpreted as ≤5th percentile=low fat content, >5th and ≤25th percentile=below average, >25 and ≤75th percentile=average, >75th and ≤95th percentile=above average and >95th percentile=high fat content.

Fat distribution around the upper body, especially the abdomen (android obesity), has been shown to increase a person's risk of the development of insulin resistance, hyperinsulinemia, non-insulin-dependent diabetes mellitus, hypertension, hyperlipidemia, stroke and mortality (Lee & Nieman, 2003: 182). This association is not evident for those with a fat distribution mainly around the hips or thighs (gynoid obesity). It has also been indicated that fat distribution is a more important risk factor for morbidity and mortality than the total quantity of body fat or obesity (NIH, 2000). Therefore, even when BMI is not

[6] Formulas not included, but can be found in Lee and Nieman (2003: 227-228).

markedly increased or the person is not obese, an increased total abdominal fat can still be an independent risk predictor (Lee & Nieman, 2003: 182). Two approaches for assessing total abdominal fat in a clinical setting that are relatively easy to perform are the waist-to-hip ratio and waist circumference (Lee & Nieman, 2003: 182). The waist and hip circumferences of the study population were measured to the nearest 0.1 cm using a non-stretchable measuring tape. The waist circumference (WC) was taken at the level of the narrowest point between the lower rib border and the iliac crest after normal expiration. The hip circumference (HC) was taken at the level of the greatest posterior protuberance of the buttocks. The student stands relaxed with feet together, while the measurer ensures that the measuring tape is horizontal when these measurements are taken. The waist-to-hip ratio (WHR) was calculated by dividing WC by HC and then categorized as low risk (<0.8) or increased risk (≥0.8) of the development of the above-mentioned disease conditions (Hammond, 2000: 372). However, the WC has recently been shown to be a better independent predictor of total abdominal fat content than the WHR and also a better predictor of disease risk (Rankinen *et al.*, 1999; Turcato *et al.*, 2000; WHO, 1998: 11). Therefore, the student's risk of the development of these disease conditions was also categorized based on WC categories, namely low risk (<0.8 cm), increased risk (80-87.9 cm) or substantial risk (≥88 cm) of the development of diseases (SASSO, 2003: 4; WHO, 1998: 12).

Blood pressure

Hypertension is the most common public health problem in developed countries (Krummel, 2000: 596) and is also prevalent amongst many South Africans (SAHDS, 1998: 210-214). Hypertension results from persistently high arterial blood pressure and is defined with a systolic blood pressure above 140 mm Hg and/or diastolic blood pressure above 90 mm Hg (Krummel, 2000: 596). If hypertension is untreated it may lead to a variety of diseases such as end-stage renal disease, congestive heart failure and peripheral vascular disease (Krummel, 2000: 596). In large community surveys it is easier to determine hypertension than most other chronic diseases of life style or risk factors for these diseases that require the collection of blood samples or other difficult and costly measures (SAHDS, 1998: 206). Therefore, blood pressure was included as a health indicator in this study. Normal blood pressure (normotension) was defined as a systolic blood pressure (SBP) less than 130 mm Hg and a diastolic blood pressure (DBP) less than 85 mm Hg (Krummel, 2000: 596). The blood pressure of the study population was measured using a *Microlife™ BP 3BA0 Automatic Blood Pressure Monitor*.

Instruments

Dietary intake

The aim of the dietary assessment was to track changes in the frequency of intake of specific food items and amounts from specified food groups over time in the intervention study. For these purposes a quantified food frequency questionnaire (Addendum A), including 90 items (Column 1, Figure 3.1) allocated to nine groups, was developed. The nine groups included starch; vegetables; fruit and fruit juices; milk and cheese; meat, chicken and fish; fats; fast foods and take-aways; "other" items (e.g. doughnuts, sweets, chocolates, cookies, cake, tart, muffin); drinks (alcoholic and soft). A food item was

included in the list if it was considered to be an item that might be commonly consumed by the target group or if it had specifically been shown to be associated with the weight status of female students (Senekal, 1988b). The list of food items did not necessarily reflect a complete twenty-four hour intake of total energy and nutrients.

Portion size estimation was based on standard portion sizes which were indicated in the questionnaire in the form of a symbol or a description. Models depicting the actual portion size of each symbol were given to each student to facilitate usual portion size estimation. These models included an amorphous flour model of half a cup (symbol = ), a matchbox (symbol = ) and a tennis ball (symbol = ●). Different size glasses, cups and spoons were also displayed. Usual portion size was recorded by indicating whether it was half the size, the same, one-and-a-half times the size or twice the size of the standard portion size (Column 2, Figure 3.1). After indicating the portion size of a food item, students had to indicate the frequency of intake as number of times consumed per day, per week, per month or never/seldom (Column 3, Figure 3.1).

COLUMN 1	COLUMN 2					COLUMN 3			
	Std Portion	1× Std	½ × Std	1½ × Std	2 × Std	Per day	Per week	Per month	Never/ seldom
Example: ***PUMPKIN, BUTTERNUT, CARROTS: cooked or salad***					×		3		
GRAINS									
BREAD and/or ROLLS: white	1 slice/ roll								
BREAD and/or ROLLS: brown, whole wheat, health etc.	1 slice/ roll								
BREAKFAST CEREALS *(other):* Rice crispies, Cornflakes, Coco pops, Fruit loops									

FIGURE 3.1: Example of the food frequency questionnaire

The completion of the questionnaire and use of the models was thoroughly explained and illustrated to the students using a PowerPoint presentation. Fieldworkers circulated between the students while they were completing the questionnaire to assist them where necessary.

For data analysis purposes the usual portion size for each food item in grams was computed by multiplying the standard portion size in gram, derived from the South African MRC Food quantities manual (Langenhoven *et al.*, 1991a), by the factor indicated by each student on the questionnaires. The resulting value in grams was subsequently multiplied by the indicated frequency of intake and transformed to reflect a 24-hour intake by dividing it either by one (consumed every day), or by seven (consumed weekly) or by 28 (consumed monthly). The final value reflected the daily intake in grams of a particular food item, which was used to monitor the change in intake over time. The gram amounts of each food item in each of the mentioned nine food groups were also added together to represent the total

amount in grams consumed from each of these food groups. Although the dietary data did not necessarily represent a complete 24-hour intake, the intake from the food groups was compared to the American Food Guide Pyramid (USDA, 1992). For this purpose the nine food groups were merged to be equivalent to the six food groups included in this Guide (Table 3.1). The carbohydrate, protein and fat content of the standard potion size of each of the 90 food items in the questionnaire were first determined using the South African MRC food composition tables (Langenhoven *et al.*, 1991b). The following macronutrient criteria, which were based on the proposed South African exchange lists (Personal communication, 2003, Ms A Behr, Nutrition Directorate, National Department of Health, South Africa), were then formulated to determine in which food group a food item should be included: Starch group: 15g carbohydrate and 3g protein. Dairy group: 12g carbohydrate, 8g protein, 5g fat. Meat, fish, poultry, eggs, nuts, dried beans group: 7g protein. Fat group: 5g fat. Vegetable group: 5g carbohydrate, 2g protein. Fruit group: 15g carbohydrate. Items that do not traditionally fall into one of the six food groups of the Food Guide Pyramid (e.g. koeksister, energy bars, pizza, pie, etc.) were added to one or more groups based on macronutrient content (see Table 3.1). The portion sizes from all items in each of the six food groups were then added together and a mean±SD portion was calculated for each food group.

TABLE 3.1: Allocation of food items to the six food groups of the American Food Guide Pyramid*.

Food group in American Food Guide Pyramid	Food group on food frequency questionnaire	Food items in food groups on food frequency questionnaire
Bread, cereal, rice & pasta group	From "Grains"	Bread and/or rolls; breakfast cereals, oats, maize porridge, rice, mealie rice, samp; pasta; legumes
	From "Fast Foods and Take-Aways"	Pizza, pie, sausage roll, toasted sandwich, hamburgers, pancake
	From "Other"	Vetkoek, samoosas, koeksister, doughnuts; muffin, scone, cake; rusks; cookies; Provita; chips; energy bars, health bars; Sugar; ice cream; custard; tart; sweets; jam, syrup, honey.
	From "Drinks"	Beer, cider; fizzy soft drinks; energy drinks; milkshake.
Fruit group	From "Fruit"	All items on the questionnaire under the "fruit" heading, including fruit juice
	From "Other"	Raisins
Vegetable group	From "Vegetables"	All items on the questionnaire under the "vegetables" heading
	From "Grains"	Potato: cooked, baked; Potato: mashed or cooked/baked with fat added or potato salad; Potato: fried in any fat.
Milk, yogurt and cheese group	From "Milk and Cheese"	All items on the questionnaire under the "milk and cheese" heading
	From "Drinks"	Milkshakes
Meat, poultry, fish, eggs, nuts, dried beans group	From "Meat, fish, chicken"	All items on the questionnaire under the "meat, fish, chicken" heading
	From "Grains"	Legumes
	From "Fast Foods and Take-Aways"	Pizza, pie, sausage roll, hamburgers.
	From "Other"	Nuts
Fat	From "Fats"	All items on the questionnaire under the "fats" heading
	From "Grains"	Potato: mashed or cooked/baked with fat added or potato salad; Potato: fried in any fat
	From "Milk and Cheese"	Full cream/Low fat: milk, yogurt, sour milk (maas), on porridge/ to eat or drink; Milk: in coffee/tea; Milk Drinks: Milo, Nesquik, Horlicks; Cheese: gouda, cheddar on bread.
	From "Meat, fish, chicken"	Red Meat: med-high fat cuts; schnitzels, cordon bleu; chicken/turkey with skin; fried chicken; fried fish; sausages; bacon; Eggs: scrambled, baked, omelette.
	From "Fast Foods and Take Aways"	Pizza, pie, sausage roll, hamburgers, pancake, Mexican food, Chinese food.
	From "Other"	Vetkoek, samoosas, koeksister, doughnuts; muffin, scone, cake; rusks; cookies; chips; energy bars, health bars; chocolate; ice cream; custard; tart; cheese sauce, white sauce, meat sauce; nuts.

* Source: USDA, 1992

The questionnaire was tested for reliability using 27 FYFS in a residence that was not included in the study. These students completed the food frequency questionnaire twice, nineteen days apart. Independent sample t-tests indicated the usual intake of hamburgers (in grams) differed significantly between the two administrations of the questionnaire. No significant differences in the intake from any other food item or of the total intake in grams from any of the nine food groups were found. Spearman correlations were also computed to assess the reliability of the food frequency questionnaire. Only the following 10 food items did not correlate significantly: maize porridge; mango/ pawpaw/ pineapple; milk

powder in coffee/tea; chicken/turkey (without skin); fried chicken; fried fish; eggs (scrambled, baked omelette); soft margarine or spread; Chinese food and tart (e.g. milk tart, lemon meringue). For the remaining 80 items the r-value ranged from 0.95 to 0.39 and the p-value from 0.000 to 0.040. When grouped in the nine food groups, the values obtained with the two administrations were significantly correlated for all nine groups with r-value as follows: starch (0.61, p=0.000), vegetables (r=0.53, p=0.008), fruit (r=0.69, p=0.000), milk and cheese (r=0.59, p=0.000), meat, fish and chicken (r=0.70, p=0.000), fat (r=0.22, p=0.024), fast foods (r=0.74, p=0.000), other (r=0.83, p=0.000) and drinks (r=0.80, p=0.000).

Physical activity

The Baecke Questionnaire of Habitual Physical Activity was developed by Baecke *et al.* (1982) to measure three components of physical activity, namely physical activity at work, sport during leisure time and physical activity during leisure time, excluding sport (Addendum A). The questionnaire was developed, calibrated and tested for reliability using men and women between the ages of 20 to 32 years from a white population in the Netherlands (Baecke *et al.*, 1982). The test-retest reliability of the work, sport and leisure-time indices were 0.88, 0.81, and 0.74 respectively (Baecke *et al.*, 1982). Other reliability studies showed similar or better test-retest results in male and female Caucasian university staff and students ages 20 to 59 years (Jacobs *et al.*, 1993) and Dutch men and women aged 20 to 70 years (Pols *et al.*, 1995). Validation studies also showed significant relationships between the Baecke physical activity indices and other physical activity questionnaires (Cauley *et al.*, 1987; Albanes *et al.*, 1990; Miller *et al.*, 1994), energy intake (Albanes *et al.*, 1990; Miller *et al.*, 1994), VO_2max, % body fat, Caltrac readings and activity diaries (Richardson *et al.*, 1995 ; Jacobs *et al.*, 1993; Pols *et al.*, 1995). The Baecke Questionnaire is a self-administered questionnaire that consists of 16 questions. The three mentioned sections of habitual physical activity can be identified from the 16 items and a score is computed for each of these three sections. These scores are referred to as the work index, sport index and leisure-time index. The score for the work index is calculated from the first eight items, for the sport index from items nine to 12 and for the leisure-time index from items 13 to 16 in the questionnaire. All items except items one and nine are answered by choosing one of five options, namely 'never', 'seldom', 'sometimes', 'often', and 'always/very often'. These are scored using a 5-point Likert scale. In item nine respondents are asked about the type of sport the subject practises most frequently as well as the number of hours per week and months per year the subject practises this sport. Scoring of this item is based on the description supplied by Baecke *et al.*, (1982). No norms for level of activity based on the score for these three indices or the total score have been published. However, the long-term pattern of habitual physical activity is measured and therefore the mean scores of each index can be computed and compared between follow-up measurements to reflect changes over time (Baecke *et al.*, 1982).

Body Shape

The body shape questionnaire (BSQ) was developed by Cooper *et al.* (1987) to measures concerned with body weight and shape (Addendum A). The BSQ is an effective tool to assess concerns with body shape in both community samples and among eating disordered patients in clinical situations. However, it is

recommended that it should rather be interpreted as a measure of the extent of psychopathology than a means of case detection (Cooper *et al.*, 1987). Good test-retest reliability was indicated in an undergraduate American university sample with a test-retest reliability coefficient of 0.88 (Rosen *et al.*, 1996). The BSQ has been validated in clinical and non-clinical populations of different age and cultural backgrounds (Cooper *et al.*, 1987; Evans & Dolan, 1993; Dolan *et al.*, 1990; Mumford *et al.*, 1991; Rosen *et al.*, 1996). The questionnaire has also been successfully used in a community sample of young British women (Cooper *et al.*, 1987) and British and American undergraduate university students (Evans & Dolan, 1993; Rosen *et al.*, 1996). It is a self-report questionnaire that consists of 34 questions. For each item on the questionnaire the subject can choose one of six possible answers that best describes their behaviour over the past month. A 6-point Likert scale is used to score the questions as follows: Never=1, Rarely=2, Sometimes=3, Often=4, Very often=5 and Always=6. A total score between 34 and 206 can be obtained. High scores on the BSQ can be associated with probable cases of bulimia nervosa, women who are concerned about weight and shape, a greater dissatisfaction with body shape and patients with an eating disorder (Cooper *et al.*, 1987). Although definite cut-off points have not yet been published on clinical situations, a score of ≥129 was used to identify probable cases of bulimia nervosa, obese dieters or body image therapy patients. A lower cut-off point of <112 was used to identify students who are probably satisfied with their bodies. These cut-off scores are based on the mean scores and standard deviations (129.3±17.0) of probable cases of bulimia nervosa (Cooper *et al.*, 1987) and the mean scores of 129.9±29.0 found for body image therapy patients and 123.1±27.9 for obese dieters (Rosen *et al.*, 1996). These cut-off points were also used for a black South African undergraduate university student sample (Senekal *et al.*, 2001).

Eating Attitudes

The Eating Attitudes Test (EAT) was developed by Garner and Garfinkel (1979) to measure a broad range of behaviours and attitudes characteristic of the symptoms of anorexia nervosa (Addendum A). From the original 40-item questionnaire (EAT-40) an abbreviated 26-item version (EAT-26), which was found to be highly predictive of the EAT-40, was developed (Garner *et al.*, 1982). Of the two scales, the EAT-26, which was used in this study, is most frequently used to assess attitudes and behaviours characteristic of eating disorders (Johnson-Sabine *et al.*, 1988; Whitaker *et al.*, 1989). The EAT-26 was developed and tested on a sample of Anorexia nervosa patients and female university students (Garner *et al.*, 1982). The latter had significantly lower mean EAT-26 scores (Garner *et al.*, 1982). It cannot, however, be assumed that a high EAT score is diagnostic for anorexia nervosa in non-clinical groups (Button & Whitehouse, 1981; Garner *et al.*, 1982). In non-clinical situations it may be used as a screening test for eating disturbances and anorexia nervosa (Button & Whitehouse, 1981; Clarke *et al.*, 1983; Garner *et al.*, 1982; Thompson & Schwartz, 1982). However, it must be borne in mind that in non-clinical populations, respondents with an eating disorder may give the wrong reply and that non-responders may be over represented among those who have an eating disorder (Fairburn & Beglin, 1990; Vandereyken & Vanderlinden, (1983). Internal reliability (Cronbach's α) of the EAT-26 ranges from 0.65 for adult Polish women, 0.84 for Polish adolescents (Wlodarczyk-Bisaga & Dolan, 1996) to 0.87 for

white British women (Evans *et al.*, 1997) and has also been validated in different cultural and age groups (Evans *et al.*, 1997; Garner *et al.*, 1982; Johnson-Sabine *et al.*, 1988; Mumford *et al.*, 1991). The EAT-26 has been successfully used in college populations (Garner *et al.*, 1982; Nelson *et al.*, 1999; Prouty *et al.*, 2002). Meadows *et al.* (1986) maintain that the widespread use of the EAT-26 also facilitates comparisons between studies or populations.

The questionnaire consists of 26 items, of which the students can choose one of six possible answers which are scored as follows, except in the case of one item (number 25) in which case the scoring is reversed: 'Never=0', 'Seldom=0', 'Sometimes=0', 'Often=1', 'Very often=2' and 'Always=3'. A total score of zero to 78 can be obtained. According to Garner *et al.* (1982) a cut-off point of ≥20 should be used to identify subjects with disordered eating attitudes and behaviours. However, the cut-off point of ≥21, which is reported to be associated with the highest sensitivity and specificity in unselected groups in the general population (Mann *et al.*, 1983), was used in this research. A high score should be interpreted as indicative of experiencing abnormal eating patterns, which could interfere with normal psychosocial function (Button & Whitehouse, 1981; Garner & Garfinkel, 1979). High scorers may include normal dieters, subjects with an abnormal preoccupation with weight and food intake, partial syndromes and subjects with anorexia or bulimia nervosa (Button & Whitehouse, 1981; Clarke & Palmer, 1983; Johnson-Sabine *et al.*, 1988; King, 1989).

Self-concept

The Adolescent Self-Concept Scale (ASCS) developed by Vrey and Venter (1983) was used to measure the self-concept of the students (Addendum A). The scale is based on the Tennessee Self-concept Scale developed by Fitts (1965), but specifically adapted for South Africans. The ASCS is not limited to adolescents and it has been used successfully in different South African populations, e.g. adolescents (Vrey & Venter, 1983), black female university students (Senekal *et al.*, 2001) and adults aged 25 to 50 (Day *et al.*, 2001). The ASCS has a good internal reliability (Cronbach's α) of 0.85 (Vrey & Venter, 1983). The questionnaire consists of 100 items and the subject can choose between two possible answers for each item. A total score between zero to 100 can be obtained. The cut-off points suggested by Vrey and Venter (1983) were used to classify students into three groups based on their self-concept, namely a high self-concept >78; a medium self-concept 63-78 and a low self-concept <63 (Vrey & Venter, 1983).

General psychological well-being

The General Health Questionnaire (GHQ) was developed by Goldberg (1972) to be used as a screening instrument for the diagnoses of possible cases of non-psychotic psychiatric disorders among patients attending medical consultation settings (Goldberg, 1972) (Addendum A). It is a self-administered questionnaire that differentiates between psychiatric patients as a general class from those who consider themselves to be well. For the purposes of this study the 30-item GHQ (Goldberg *et al.*, 1976), which was developed from the original 60-item version, was selected. The questionnaire was originally calibrated on British populations and thus constructed for white population groups (Goldberg *et al.*, 1976). The main

shortcoming of the GHQ are its tendency to miss patients with long-standing psychiatric disorders (Goldberg *et al.*, 1976). Subjects with a psychiatric illness for 'several years' can obtain a low score on the GHQ, because of the nature of the response scale (Goldberg *et al.*, 1976). A patient may select the 'same as usual' option for most questions and therefore not obtain a high score, despite having a psychiatric disorder (Goldberg *et al.*, 1976). Because the sample included in this study represented the general student population a high prevalence of long standing psychiatric disorders is not expected. For each of the 30 items on the GHQ the respondent is asked to compare his recent state with his usual state by choosing one of four possible answers: 'not at all' (score=0), 'same as usual' (score=0), 'rather more than usual' (score=1) and 'much more than usual' (score=1). A total score between zero and 30 can be obtained. A high score is indicative of poorer mental health. The suggested cut-off point of ≥6 to distinguish between high and low scorers was used in this study (Goldberg *et al.*, 1976). A higher score is also associated with a greater inability to carry out one's normal 'healthy' functions. The GHQ can be used for comparing two populations by simply assessing their proportions of high scores, or by comparing their distributions of GHQ scores and their mean GHQ scores (Goldberg, 1972; Tarnopolsky *et al.*, 1979).

Additional questions

Additional questions were included to obtain social demographic and health information such as birth date, academic programme, whether in school previous year, accommodation previous year, medication use, chronic diseases or illnesses, present and past smoking habits, and whether they are seeing a psychologist. Questions regarding weight related issues and eating practices were also included: perception of current weight, weight-loss practices over the past two years and at present, dissatisfaction with different body parts, present weight goals and different reasons for eating (Addendum A).

Data collection

After recruitment of FYFS, they completed a battery of questionnaires and their anthropometric measurements were taken in a secluded area.

Data processing and statistical analysis

After data collection all questionnaires were checked for completeness by the primary researcher. Incomplete and incorrectly completed questionnaires were returned to students for corrections. However, for the following reasons some variables still contain missing values: students who could not be reached shortly after data collection for corrections, students who refused to fully complete questionnaires and students who still left out questions after the corrections had been done. The complete food frequency questionnaires of 28 students were excluded from data analysis, because they had been either poorly or incorrectly completed. If one of the nine food group sections was incomplete, but the rest of the food frequency questionnaire was correctly completed, only that particular food group was excluded from analyses. This resulted in the n for each of the nine food groups not necessarily being the same for all food groups.

Data were entered in Microsoft excel spreadsheet and cleaned. The scores for the different questionnaires were computed using Microsoft Excel. Subsequently all data were then transferred to an SPSS data editor. The different anthropometric indices or measures were computed and applicable data were categorized according to the indicated cut-off points. Dietary intake data were processed on SPSS, as was described in the section on the food frequency questionnaire.

All data were then analyzed using SPSS computer software (SPSS/PC, Version 11.0, 2003) (Brace *et al.*, 2003). All variables were firstly tested for normality using the Kolmogorov-Smirnov and Shapiro Wilk tests. Means and standard deviations (Mean±SD) were calculated for continuous variables and frequencies for categorical variables. To determine the differences between the BMI categories for the responses to categorical variables, cross-tabulations were constructed with BMI category as classification variable. The Pearson's Chi Square statistic was used to test for significant differences in group profiles. To determine the difference of the mean±SD BMI of the response categories for each categorical variable, the Independent Sample t-test was used in the case of two response categories and the One-way Anova test followed by the Bonferroni post hoc test in the case of three or more response categories. The mean±SD scores for each of the three indices of the Baecke questionnaire were compared between the three BMI categories using the One-way Anova test followed by the Bonferroni post hoc test. To test for relationships between all the continuous variables, except the dietary intake, a Pearson's correlation matrix was constructed. A stepwise multiple regression was done to identify specific predictors of the BMI in the study population. In all statistical analyses a p-value of <0.05 was designated to be statistically significant.

Ethical issues

Ethical permission was obtained from the Faculty of Science Ethical Committee as well as the Dean of Student Affairs of the University of Stellenbosch. After being thoroughly informed, each volunteer signed a consent form in the presence of two witnesses. Students could not participate anonymously because of the longitudinal design of the intervention trial. They were, however, assured that data would be handled confidentially and only published within group context.

RESULTS

Socio-demographic information

The mean±SD age of the students was 18.6±0.4 years. Most of the students were in school and stayed with their parents the year before entering university and were Afrikaans speaking (Table 3.2). No significant differences in this regard were evident between the three BMI categories. There were also no significant differences in the mean BMI of the students in the response categories of the socio-demographic questions.

TABLE 3.2: Socio-demographic information of first year female students (n=360)

		n	%
Home language	Afrikaans	291	80.8
	English	64	17.8
	Other	5	1.4
Origin previous year	City	101	28.1
	Farm	48	13.3
	Town	211	58.6
In school previous year‡		339	94.2
Accommodation previous year	With parents	289	80.3
	In a school hostel	48	13.3
	Privately	21	5.8
	Other	2	0.6

‡% who reported yes, the remainder not indicated answered no

Prevalence of diseases and the use of medications and supplements

As is indicated in Table 3.3, the self-reported prevalence of chronic diseases and other conditions was less than 1% for all diseases or conditions except for constipation and hypercholesterolnemia. Only one student suffered from both anorexia and bulimia nervosa, while five others suffered from one of the two. Diseases mentioned in the "other diseases" category included anaemia (n=1), asthma (n=7), Charcot-Mary-Tooth disease (n=1), epilepsy (n=1), Hartnup's disease (n=1), hypotension (n=5) and sinusitis (n=6). Only 1.7% (n=6) indicated that they had been seeing a psychologist at the time of the study.

The drugs most frequently used include anti-depressants and oral contraceptives. Half of the FYFS used vitamins and/or minerals supplements and different kinds of herbal remedies accounted for most of the items mentioned under the "other medicine" category. No significant differences were evident between the mean BMI or BMI categories of the response categories of each of the questions on the prevalence of diseases and the use of medications or supplements.

TABLE 3.3: Self-reported disease prevalence and use of medication and supplements‡ (n=360)

	n	%
Coronary heart disease	1	0.3
High blood pressure	2	0.6
Diabetes Mellitus	2	0.6
High blood cholesterol	6	1.7
Constipation	24	6.7
Anorexia Nervosa	3	0.8
Bulimia Nervosa	3	0.8
Other chronic diseases	22	6.1
Insulin	2	0.6
Hypoglycaemic substances	0	0
Sleeping tablets	6	1.7
Tranquillizers	6	1.7
Anti-depressants	10	2.8
Oral contraceptives	51	14.2
Vitamins and minerals	185	51.2
Other medicines	44	12.2

‡% who reported yes, the remainder not indicated answered no

Smoking habits

At the time of the survey 13.1% (n=47) of the students smoked a mean of 7.84±5.67 cigarettes per day. Of those students who did not smoke, 13.1% (n=41) indicated that they had smoked previously but stopped 14.0±12.9 months ago. Thus, 75.6% (n=272) of the total sample did not smoke at the time of the survey or had never smoked before. Students who did smoke previously had a significantly higher (p=0.006) mean BMI (n=41; mean±SD BMI=22.7±2.9) than the students who did not smoke at the time of the survey or had never smoked before (n=272; mean±SD BMI=21.6±2.5). No further significant differences in this regard were evident between the mean BMI or the three BMI categories.

Anthropometric measurements and blood pressure

The mean BMI of the FYFS falls within the normal BMI range, while a tenth can be classified as overweight, less than 1% as obese and 7.2% as underweight (Table 3.4). The mean of the WC, WHR, triceps skinfold, SBP and DBP all fall within the normal range of their respective categories. WC and WHR indicate that less than 10% of the FYFS have an increased risk of the development of chronic diseases of lifestyle due to increased android fat deposits. Triceps skinfold and MAFA indicate that the majority of the FYFS had an average body fat content. The MAMA and MAMC indicate that the majority of FYFS also had an average muscle content. Although the values of these measures seemed to be distributed around the average, it is evident that for the triceps skinfold, MAMA, MAMC and MAFA more students are classified in the upper range (>75th percentile) than in the lower range (≤25th percentile).

Blood pressure results indicate that the majority of the sample were normotensive. A few students were classified under the high-normal range (130/85 to 139/89), but no students had blood pressure readings indicative of hypertension (> 140/90 mm/Hg).

TABLE 3.4: Mean±SD and column percentages for categories of anthropometric measurements and blood pressure of first-year female students (n=360)

Measurement	Mean±SD	Cut-off points	Interpretation	%
Weight (kg)	60.4±8.5			
Height (m)	1.665±0.06			
BMI	21.8±2.6	<18.5	Underweight	7.2
		18.5-24.9	Normal	81.9
		25-29.9	Overweight	10.0
		≥30	Obese 1	0.8
Waist circumference (cm)	69.8±6.3	<0.80 cm	Ideal	93.1
		80.0-87.9 cm	Increased risk	5.3
		≥88 cm	Substantial risk	1.7
Hip circumference (cm)	97.8±6.9			
Waist-Hip ratio	0.71±0.04	<0.8	Ideal	95.6
		≥0.8	Increased risk	4.4
Triceps skinfold (mm)	19.5±5.8	≤5th	Low fat content	1.1
		>5th but ≤15th	Below average	8.9
		>15th but ≤85th	Average	72.5
		>85th but ≤95th	Above average	16.4
		>95th	High fat content	1.1
MAMA (mm^2)	3407.4±510.4	≤5th	Wasted	1.9
		>5th but ≤25th	Below average	15.8
		>25th but ≤75th	Average	57.5
		>75th but ≤95th	Above average	24.4
		>95th	High muscle	0.3
MAMC (mm)	206.3±15.5	≤5th	Wasted	1.9
		>5th but ≤25th	Below average	15.0
		>25th but ≤75th	Average	58.1
		>75th but ≤95th	Above average	24.7
		>95th	High muscle	0.3
MAFA (mm^2)	2351.5±845.5	≤5th	Low fat content	1.7
		>5th but ≤25th	Below average	16.9
		>25th but ≤75th	Average	51.9
		>75th but ≤95th	Above average	23.3
		>95th	High fat content	6.1
Systolic BP (mm/Hg)	101±10.7	<130	Normal	98.3
		≥130	High	1.7
Diastolic BP (mm/Hg)	60±8.7	<85	Normal	98.1
		≥85	High	1.9

MAMA = Mid-arm muscle area

MAMC = Mid-arm muscle circumference

MAFA = Mid-arm fat area

BP=Blood pressure

Weight-related perceptions and practices

Table 3.5 indicates that just more than a third of the students thought that they were overweight. The mean BMI of the students who thought they were overweight falls within the normal weight category, although it is significantly higher than the mean BMI of students who perceived their weight as normal and those who perceived themselves as underweight. There was a highly significant difference between the three BMI categories as far as perception of own weight is concerned. Almost all of those who were actually overweight perceived themselves correctly as overweight. A third of the students whose weight was actually normal thought they were overweight, while the other two-thirds perceived their weight correctly as normal. The students who were actually underweight were strongly inclined to think that their weight is normal.

The weight goals of students indicated that less than a fifth were satisfied with their weight; only a few wanted to gain weight, while all the others wanted to lose some weight varying from 1 to 3 kg to ≥4 kg (Table 3.5). The mean BMI of students who wanted to gain weight falls within the underweight category and was significantly lower than the mean BMI of students classified in the other response categories for weight goals. The mean BMI of those who wanted to lose ≥4 kg was the highest, but could still be classified as normal. The results for the other students also clearly show that the higher the mean BMI, the less satisfied the students are with their weight, although the mean BMI remains within the normal range for all response categories. There was a highly significant difference between the three BMI categories as far as weight goals were concerned. Underweight students were mostly satisfied with their weight, although almost a third still wanted to lose 1-3 kg. Very few of the normal weight students were satisfied with their weight, with half of them wanting to lose between 1-3 kg, while a third wanted to lose ≥4 kg. Overweight students mostly wanted to lose ≥4 kg and almost none were satisfied with their weight.

Only a very small number of students were on a weight-reduction diet at the time of the study (Table 3.5). Students who were on a diet had a significantly higher mean BMI than those who were not on a diet and were all from the normal or overweight BMI categories.

More than half of the students indicated that they had tried to lose weight during the past two years (Table 3.5). Although the mean BMI of those who tried to lose weight was significantly higher than those who did not, it was still within the normal BMI range. Furthermore, a fifth of the underweight and more than a half of the normal weight students attempted to lose weight. There was a significant difference between the BMI categories in this regard, with the overweight students having been most inclined and the underweight students having been the least inclined to have attempted weight reduction over the past two years.

Most of the students who tried to lose weight during the previous two years lost weight, but more than half of those who did lose weight, regained it (Table 3.4). There was no significant difference in the mean BMI of those students who did lose weight and those who did not lose weight. Underweight,

normal weight and overweight students seemed to be equally successful in achieving weight loss. However, the students who were unable to maintain the weight loss had a significantly higher mean BMI than those who did maintain the weight loss. Although not significant, overweight students were more likely to regain the weight.

TABLE 3.5: Weight-related perceptions and practices and association with mean±SD BMI and BMI categories of FYFS

	Frequency		BMI		Column % of actual BMI categories by weight related perceptions and practices			Pearson
					Underweight	Normal	Overweight	Chi-square
	n	%	Mean±SD	p-value	%	%	%	p-value
Perception of current weight								
Underweight	5	1.4	19.1±2.6[a]	0.000[§]	11.5	0.7	0	0.000
Normal	221	61.4	20.8±1.9[a]		88.5	67.0	7.7	
Overweight	130	36.1	23.6±2.6[b]		0	32.3	92.3	
Weight goals								
Satisfied	57	15.8	19.3±1.5[a]	0.000[§]	61.5	13.7	2.6	0.000
Lose 1-3 kg	161	44.7	21.2±1.8[b]		26.9	51.2	10.3	
Lose ≥4 kg	136	37.8	23.7±2.5[c]		0	34.8	87.2	
Weight gain	4	1.1	17.5±1.1[a]		11.5	0.3	0	
Currently on weight reduction diet								
Yes	14	3.9	23.8±2.0	0.001[†]	0	3.8	7.7	0.279
No	343	95.3	21.7±2.6		100	96.2	92.3	
Tried too lose weight past 2 years								
Yes	199	55.3	22.5±2.3	0.000[†]	19.2	56.5	71.8	0.000
No	160	44.4	20.9±2.7		80.8	43.5	28.2	
Tried too lose weight and ...								
Did lose weight	167	87.0	22.6±2.3	0.721[†]	80.0	87.4	85.7	0.868
Did not lose weight	25	13.0	22.4±2.3		20.0	12.6	14.3	
Did lose weight and ...								
Maintain the new weight	68	41.0	22.0±2.1	0.002[†]	50.0	42.8	26.1	0.298
Gain weight back	98	59.0	23.0±2.4		50.0	57.2	73.9	

[§]One-way ANOVA, means with the same letter do not differ significantly using Bonferroni post-hoc test

[†]Independent Samples t-test

Dissatisfaction with body parts

As is indicated in Table 3.6, students were mostly dissatisfied with the shape and size of their stomach, buttocks and thighs, while just less than half were also dissatisfied with their middle and hips. Students who were dissatisfied with a particular body part had a significantly higher mean BMI than those who were satisfied with all body parts except the calves. Significant differences in dissatisfaction with body parts between the three BMI categories were also found for all body parts except the calves. Underweight students were the least dissatisfied with their different body parts and overweight students the most. The only body part that the majority of overweight students were not dissatisfied with was the calves. The normal weight students were also inclined to be specifically dissatisfied with their stomachs, buttocks and thighs. Underweight students were most dissatisfied with their buttocks, normal weight students with their thighs and overweight students with their stomachs.

TABLE 3.6: Dissatisfaction with the shape and size of specific body parts and association with mean±SD BMI and BMI categories of FYFS

		Frequency		BMI		Column % of BMI categories by satisfaction with body parts			
						Under-weight	Normal	Over-weight	
Dissatisfied with		**n**	**%**	**Mean±SD**	**p†**	**%**	**%**	**%**	**p‡**
Arms:	***Yes***	120	33.8	23.0±2.7	0.000	15.4	31.4	64.1	0.000
	No	235	66.2	21.2±2.4		84.6	69.6	35.9	
Stomach	***Yes***	214	60.5	22.3±2.7	0.000	26.9	60.0	86.8	0.000
	No	140	39.5	20.9±2.2		73.1	40.0	13.2	
Middle	***Yes***	149	42.0	22.7±2.7	0.000	15.4	41.4	64.1	0.000
	No	206	58.0	21.2±2.3		84.6	58.6	35.9	
Hips	***Yes***	166	46.8	22.6±2.6	0.000	15.4	45.9	74.4	0.000
	No	189	53.2	21.1±2.4		84.6	54.1	25.6	
Buttocks	***Yes***	227	63.9	22.1±2.5	0.004	38.5	65.5	69.2	0.017
	No	128	36.1	21.3±2.8		61.5	34.5	30.8	
Thighs	***Yes***	250	70.8	22.3±2.4	0.000	15.4	74.3	82.1	0.000
	No	103	29.2	20.5±2.6		84.6	25.7	17.9	
Calves	***Yes***	96	27.1	22.1±2.8	0.116	15.4	26.6	39.5	0.910
	No	258	72.9	21.7±2.5		84.6	73.4	60.5	

†Independent Samples t-test

‡Pearson's Chi Square

Psychological health

The mean BSQ score fell in the low BSQ score category (Table 3.7). The individual score of three quarters of the students also fell in the low-score category, while the remaining students were equally spread over the medium- and high-score categories. The mean BMI of students with medium and high BSQ scores did not differ significantly, but it was significantly higher than the mean BMI of students with a low BSQ score. There was a significant difference between the three BMI categories for BSQ score categories. Overweight students were the most dissatisfied with their body shape and underweight students the least. In fact, almost half of the overweight students had medium or high BSQ scores. A quarter of the normal weight students and just less than a tenth of the underweight students fell in the medium and high BSQ categories.

The mean score of the ASCS fell in the medium self-concept category (Table 3.7). The individual scores of the majority of students fell in the medium or high self-concept categories, with only a fifth having a low score. Students with a low self-concept had a significantly higher mean BMI than students with a high self-concept. The mean BMI of students with a medium and high self-concept did not differ significantly. Although no significant difference between the three BMI categories was found for self-concept categories, overweight students were inclined to be the least likely and underweight students the most likely to have a high self-concept. Similarly, overweight students were also the most likely and underweight students the least likely to have a low self-concept. The percentage of students with a medium self-concept was about the same in all three BMI categories.

The mean EAT score fell in the normal EAT score category (Table 3.7). Less than a tenth of the students had a high EAT score. The high scorers also had a significantly higher mean BMI than students with normal EAT scores. There was no significant difference between the three BMI categories for EAT score categories.

The mean GHQ score of the students fell within the high GHQ score category (Table 3.7). The majority of students also fell in the high GHQ score category. No significant difference in the mean BMI of the normal and high scorers was evident. There was also no significant difference between the three BMI categories for the percentage normal and high scorers.

TABLE 3.7: Mean±SD GHQ, ASCS, EAT and BSQ scores, classification according to categories and association with mean±SD BMI and BMI categories of FYFS.

Questionnaires	Score	Classification of questionnaire score according to categories				BMI		Column % of BMI categories by questionnaire categories			Pearson Chi-square
								Underweight	Normal	Overweight	
	Mean±SD	Categories		n	%	Mean±SD	p	%	%	%	p
BSQ	87±32.2	<112	Low	274	76.1	21.4±2.5[a]	0.000[§]	92.3	77.3	56.4	0.011
		112-128	Medium	43	11.9	23.1±2.5[b]		0	11.5	23.1	
		>128	High	43	11.9	23.1±2.8[b]		7.7	11.2	20.5	
ASCS	72.0±12.6	<63	Low	70	19.4	22.4±3.0[a]	0.031[§]	15.4	18.3	30.8	0.273
		63-78	Medium	158	43.9	21.9±2.6[a,b]		38.5	44.4	43.6	
		>78	High	132	36.7	21.4±2.3[b]		46.2	37.3	25.6	
EAT	8.5±9.0	<21	Normal	329	91.6	21.7±2.6	0.025[†]	88.5	92.5	87.2	0.438
		≥21	High	30	8.4	22.8±2.7		11.5	7.5	12.8	
GHQ	9.1±3.9	<6	Normal	68	18.9	21.8±2.5	0.830[†]	15.4	19.3	17.9	0.875
		≥6	High	292	81.1	21.8±2.6		84.6	80.7	82.1	

[§]One-way ANOVA, means with the same letter do not differ significant using Bonferroni post-hoc test

[†]Independent Samples t-test

BSQ = Body Shape Questionnaire

ASCS = Adolescent Self-Concept Scale

EAT = Eating Attitudes Test

GHQ = General Health Questionnaire

Reasons for eating

The students were inclined to eat for various reasons other than hunger (Table 3.8). The most frequently indicated reasons for eating (≥60% of total group) were that they were bored, while they study or when they were not hungry. All the other reasons, except eating when problems arise, were indicated by more than a third of the students. Students who eat because others do or because of a lack of self-control or who eat too much had a significantly higher mean BMI than those who did not. Students who eat while they are studying had a significantly lower mean BMI than those who did not.

Significant differences between the three BMI categories were found for five out of the ten listed reasons for eating. Overweight students were the most likely to eat because others do, because of a lack of self-control and to eat too much, while underweight students were the least likely to eat because of these reasons. Normal weight students were the most likely to eat when not hungry, while underweight students were the least likely to do this. More underweight and overweight students were inclined to eat when problems arise than normal weight students.

The most frequent reasons for eating indicated by underweight students (between 45 and 69%) include when studying, when frustrated, when bored and when stressed. The most frequent reasons for eating indicated by normal weight students (between 61 and 78%) include when studying, when bored and when not hungry. More than half of the normal weight students also indicated that they are inclined to eat too much. More than half of the overweight students indicated that they eat for almost all the listed reasons, with the most frequent reason mentioned being boredom. More than two thirds of the overweight students indicated that they are inclined to eat too much.

TABLE 3.8: Reasons for eating other than hunger and association with mean±SD BMI and BMI categories of FYFS

		Frequency		BMI		Column % of BMI categories by reason for eating			
						Under-weight	Normal	Over-weight	
Inclined to eat...		n*	%	Mean±SD	p†	%	%	%	p‡
While studying	***Yes***	216	60.3	21.6±2.7	0.026	69.2	61.1	48.7	0.209
	No	142	39.7	22.1±2.5		30.8	38.9	51.3	
When frustrated	***Yes***	166	46.5	21.9±2.8	0.543	57.7	44.2	56.4	0.175
	No	191	53.5	21.7±2.4		42.3	55.8	43.6	
Because others	***Yes***	175	48.9	22.0±2.5	0.040	23.1	49.8	59.0	0.013
do	***No***	183	51.1	21.6±2.7		76.9	50.2	41.0	
When not hungry	***Yes***	215	60.1	21.9±2.6	0.141	30.8	63.1	56.4	0.005
	No	143	39.9	21.6±2.7		69.2	36.9	43.6	
When bored	***Yes***	278	77.7	21.7±2.6	0.216	80.8	78.2	71.8	0.619
	No	80	22.3	22.1±2.7		19.2	21.8	28.2	
When stressed	***Yes***	136	38.0	22.1±2.9	0.109	46.2	35.2	53.8	0.052
	No	222	62.0	21.6±2.4		53.8	64.8	46.2	
When problems	***Yes***	98	27.5	22.1±3.0	0.273	38.5	24.7	41.0	0.042
arise	***No***	259	72.5	21.7±2.4		61.5	75.3	59.0	
Lack of self-	***Yes***	157	43.9	22.3±2.6	0.001	23.1	44.4	53.8	0.046
control	***No***	201	56.1	21.4±2.5		76.9	55.6	46.2	
Stress before	***Yes***	159	44.5	21.9±2.7	0.289	42.3	44.2	48.7	0.842
exam/tests	***No***	198	55.5	21.7±2.5		57.7	55.8	51.3	
Too much	***Yes***	198	55.6	22.2±2.6	0.000	19.2	56.8	71.1	0.000
	No	158	44.4	21.2±2.5		80.8	43.2	28.9	

*n may vary due to missing values

†Independent Samples t-test

‡Pearson's Chi Square

Dietary intake

The mean gram per day eaten from each of the nine food groups is presented in Table 3.9. The only significant difference between the three BMI categories for mean intake from the nine food groups was that underweight students ate more fruit ($p<0.05$) than overweight or normal weight students do (data not included in the table). Also presented in Table 3.9 is a comparison with the recommended portions from each food group of the American Food Guide Pyramid, which is discussed in detail in the discussion section below.

TABLE 3.9: Mean±SD gram and number of portions from the nine food groups consumed by FYFS.

Original Food group	n*	Mean±SD of gram of food items†	Merging of food groups to compare with American Food Guide Pyramid	Number of portions from original food groups	Recommended portions from American Food Guide Pyramid‡
Starch (g)	324	202.8 ± 107.5	CHO from starch	2.8±1.7	
			CHO from the "other"	4.1±4.8	
			CHO from fast foods	0.8±0.8	
			CHO from drinks	0.7±0.9	
Total starch portions				8.4±5.9	6-11
Vegetable (g)	332	191.5 ± 148.9	including potatoes	2.9±1.9	3-5
Fruit (g)	330	532.9 ± 395.1	including raisins	4.5±3.8	2-4
Milk & Cheese (g)	332	228.4 ± 178.8	including milkshakes	1.3±0.9	2-3
Meat, fish, poultry (g)	330	141.6 ± 95.2	PROT from meat, fish, poultry	2.4±1.6	
			PROT from Legumes & nuts	0.2±0.3	
			PROT from Fast foods	0.5±.04	
Total meat portions				3.1±1.8	2-3
Fat (g)	324	15.7±16.4	FAT from fat group	1.7±1.7	
			FAT from Fast foods	0.7±0.7	
			FAT from "Other"	2.7±2.5	
			FAT from Meat, fish, poultry	2.2±1.9	
			FAT from Milk & cheese	0.9±0.7	
			FAT from Potato chips/ salad	0.7±0.7	
Total fat portions				8.9±5.2	Sparingly
Fast foods (g)	332	60.9 ± 52.0			
Other (extras) (g)	330	144.2 ± 122.5			
Drinks (g)	330	246.6 ± 275.1			
Non-alcoholic drinks	330	117.4±172.3			
Alcoholic drinks	330	128.9±180.7			

*n vary due to missing values

†The gram intake of food groups as calculated from gram of each food item in each food group, not representative of macronutrient content

‡USDA (1992)

Physical activity

The mean±SD of the three indices of the physical activity questionnaire for the total group and the three BMI categories are presented in Table 3.10. Students with a normal BMI had a significantly higher score for the sport index, indicating more regular participation in physical activity, than underweight or overweight students. The mean scores for the work and leisure time indices were similar for normal, under- and overweight students. At the time of the study just more than a quarter of the students (27.2%) did not participate in any physical activity that is performed for the purpose of conditioning the body, improving or maintaining health and improving or maintaining physical fitness (data not presented in the table).

TABLE 3.10: Mean±SD scores of the three different components of the three physical activity indices for the total group and the three BMI categories of FYFS.

Physical activity questionnaire indices	n[§]	Score of indices Mean±SD	Mean±SD of indices by BMI categories Underweight Mean±SD	Normal Mean±SD	Overweight Mean±SD	P-value[‡]
Work Index	353	2.5±0.4	2.4±0.5	2.5±0.4	2.5±0.5	0.156
Sport Index	346	2.4±0.7	2.2±0.7	2.4±0.6	2.2±0.5	0.038
Leisure Index	357	3.3±0.5	3.3±0.6	3.3±0.5	3.3±0.6	0.926

[§] n vary due to missing values

[‡]One-way ANOVA, although significant differences for sport index, Bonferroni post hoc test did not find a significant difference for mean±SD score between categories

Relationships between BMI, psychological variables and physical activity:

A correlation matrix for BMI, psychological variables and physical activity is presented in Table 3.11. A higher BMI is associated with a lower self-concept (ASCS-score), higher dissatisfaction with body shape (BSQ score) and disordered eating attitudes and behaviours (EAT score). A low ASCS score is associated with a higher BSQ score, EAT score as well as a higher work index score and lower sport and leisure index scores. A higher BSQ score is associated with a higher EAT score, ASCS score, BMI, decreased psychological well-being (GHQ score) and a higher work index score. A higher GHQ score is associated with higher BSQ, EAT, sport and leisure index scores. Although significant, many of these correlations were poor, as is indicated by the low r-values.

TABLE 3.11: Spearman correlation matrix between BMI and scores of psychological questionnaires

2 tailed		ASCS	BSQ	EAT	GHQ
BMI	r	-0.115	0.413	0.255	0.003
	p	0.029	0.000	0.000	0.948
	n	360	360	359	360
ASCS	r	1.000	-0.454	-0.312	-0.028
	p	.	0.000	0.000	0.602
	n	360	360	359	360
BSQ	r		1.000	0.681	0.117
	p		.	0.000	0.027
	n		360	359	360
EAT	r			1.000	0.110
	p			.	0.038
	n			359	359
GHQ	r				1.000
	p				.
	n				360

BSQ = Body Shape Questionnaire

ASCS = Adolescent Self-Concept Scale

EAT = Eating Attitudes Test

GHQ = General Health Questionnaire

Predictors of BMI

The multiple regression model that was constructed using the scores of the EAT, BSQ, ASCS and GHQ revealed that 16% of the variability in BMI can be explained by body shape and a further 1% by eating attitudes and behaviours. For this study population an increase in BMI will be accompanied with an increase in dissatisfaction with body shape and decreased disordered eating attitudes and behaviours.

TABLE 3.12: Stepwise multiple regression with BMI as dependent variable (n=359)

	Variable in equation				
	B	**F**	**t**	**P**	**Cumulative adjusted R^2**
Constant	18.55		46.383	0.000	
BSQ	0.042	66.8	7.626	0.000	0.16
EAT	-0.049	37.1	-2.510	0.013	0.17

BSQ = Body Shape Questionnaire

EAT = Eating Attitudes Test

DISCUSSION

Socio-demographics and physical health

The socio-demographic profile of the students is in agreement with what was expected as indicated from previous research at the same university (Senekal, 1988b) and from statistics on FYFS staying in exclusively female residences as supplied by the university administration. For most of the students the transition made to university was from high school, most were Afrikaans speaking and most stayed with their parents the year before entering university.

The self-reported prevalence of chronic diseases of lifestyle such as coronary heart disease, hypertension, diabetes mellitus and hypercholesterolemia was low (<2%) and the low prevalence of hypertension was supported by the actual blood pressure results. Among adult South Africans older than 15 years hypertension prevalence is 21% (Steyn *et al.*, 2000). While the actual prevalence for South African females aged 15-24 years was found to be 4.1%, only 0.2% self-reported that they suffer from hypertension (SADHS, 1998). The prevalence of chronic diseases of lifestyle is expected to be low among young adults and to increase with age (Krummel, 2000: 597). There is also a strong possibility that the actual prevalence might be higher than the self-reported level, because the white population in SA have a genetic predisposition to hypercholesterolemia (Fourie & Steyn, 1995). It has been indicated that 25-26% of white South African adults typically suffer from hypercholesterolemia (Fourie & Steyn, 1995). For black FYFS it was found that 3.8% actually had cholesterol levels above the cut-off point of 5.2 mmol/l (Steyn *et al.*, 2000), while the self-reported prevalence in our study population was 1.7%. Cholesterol is known as the silent killer (Krummel, 2000: 596) and it is possible that these self-reported

prevalences are an underestimation of actual prevalences because many students may not yet have tested their cholesterol levels.

Constipation is the medical problem that seemed to be the most prevalent and it is often linked to low fibre intake (Beyer, 2000: 669). Although total fibre intake was not determined in this study, the relatively high intake of fruit and vegetables (6.1 portions per day excluding fruit juice versus the 5-9 recommended by the American Food Guide Pyramid (USDA, 1992)) could indicate that the fibre intake of the FYFS was not a problem. However, it has been reported that white South African females between the ages of 16 to 24.9 years typically consume a mean±SD of 13.8±7.1 g of fibre per day as was indicated by 24 recalls and 18±9.4 g/day as indicated by other methods (Vorster *et al.* 1997: 89). This is much lower than the recommended dietary fibre intake of 25 to 30 g/day (SASA, s.a.). It has also been indicated that the fibre intakes of females are much lower than for males of the same age group (Vorster *et al.*, 1997: 89). The intake of high-fibre starches and/or legumes is also important to reach the recommended dietary fibre intake. Although our study population did consume enough portions from the starch group, these portions were mainly supplied by low-fibre foods from the "other" food group. The consumption of legumes was also very low. It could therefore be possible that the fibre intake from wheat and legume sources was inadequate in our study population.

A summary of the literature on the prevalence and incidence of eating disorders (only studies that used strict definitions of eating disorders as defined by DSM-III-R, DSM-IV, Russell or Feighner) by Hoek and Van Hoeken (2003) indicated an average prevalence of 0.3% for anorexia nervosa and 1.0% for bulimia nervosa among young females. This is in line with the self-reported prevalences found in our study population (0.6% for both conditions).

The low use of any form of medication also points to the fact that FYFS enrolled at the University of Stellenbosch are a group of healthy young adults. Despite these general indicators of good health, half of the students indicated that they used vitamin or mineral supplements. However, other researchers reported even higher usage of such supplements (62%) in other student populations (Dundas & Keller, 2003) or the 67% usage for graduate female students (Driskell, 1999). Although we did not investigate the reasons why our study population used supplements, it can be speculated that they will be in line with what has been reported for other student populations, namely that family members advised them to do so, because of advertisements in newspapers and magazines, or because a dietician or pharmacist advised them to do so (Dundas & Keller, 2003).

An international comparison of current tobacco smoking among university students (female n=10816) from 23 countries found a mean smoking prevalence of 27% for female students (Steptoe *et al.*, 2002). This prevalence ranges from 2% to 46% among different countries, with a 4% prevalence among South African (almost exclusively black) students (Steptoe *et al.*, 2002). According to Sax (1997), who reviewed the yearly surveys which have been done since 1966 on first-year students (freshmen) of 600

American tertiary institutions, cigarette smoking decreased from 16.6% in 1966 to 8.9% in 1987, but since then smoking prevalence has risen to a high of 14.6% among the 1995 freshmen (male and female). The smoking prevalence (13.1%) of our study population is lower than the 15.3% reported for American female first-year students (Sax *et al.*, 1997), a bit higher than the 11.7% reported for adult South African women (Van Walbeek, 2002), but much higher than the 4% and 1.0% reported for black South African students (Steptoe *et al.*, 2002; Steyn *et al.*, 2000) and the 5.6% reported for South African females aged 15-24 years (SADHS, 1998: 232). It can be speculated that the smoking prevalence among FYFS will rise as they progress to their second and third years at university because reported prevalence rates of college females samples (all students, not only FYFS) is much higher at 29% (Rigotti *et al.*, 2000) and 27% (Steptoe *et al.*, 2002). Over and above the fact that smoking is strongly associated with the development of certain chronic diseases of lifestyle later in life (Krummel, 2000: 570), smoking by young women has also been associated with concerns about gaining weight (French *et al.*, 1994; Tanoue, 2000) and considering themselves to be overweight (Adame *et al.*, 1990; Kelley *et al.*, 2003).

Weight status

The mean BMI (21.8) and body composition as is reflected by mean triceps skinfold, MAMA, MAMC and MAFA of the study population falls well within the normal ranges. When compared to the 1988 results of a survey done among FYFS at the same university (Senekal *et al.*, 1988b: 152), BMI values are almost similar to what was reported 15 years ago (BMI=21.5) and for another sample of white female students at another SA university in 1995 (BMI=21.3) (Sheward, 1995). These BMI values are in line with the values reported for European university students, who had a mean BMI of 20.5 (Bellisle, *et al.*, 1995) and white American college students with a mean BMI equal to 21.5 (Schulken *et al.*, 1997), 21.4 (Cogan *et al.*, 1996), 21.6 (Akan & Grilo, 1995), 21.7 (Rosen *et al.*, 1996) and 22.3 (DiGioacchino DeBate *et al.*, 2001). However, the mean BMI found for a sample of Black FYFS in South Africa was 22.8 (Steyn *et al.*, 2000). The first South African Health and Demographic survey which was conducted in 1998 indicates that the mean BMI of 15- to 24-year-old women from all ethnic groups was 23.7 at that point (SAHDS, 1998). This is also more in line with the BMI of 23.5 reported by Van der Westhuizen (1991) for a group of white South African females between the ages of 20 to 24 years. The higher BMIs reported by Van der Westhuizen (1991) and the SAHDS (1998) are possibly related to the fact that the samples included a much wider range of socio-economic groups than is included in a university student population. It is well recognized that obesity prevalence amongst females is higher in the lower socio-economic groups (Puoane *et al.*, 2002; Foreyt, 1995: 536).

The prevalence of overweight among FYFS enrolled at the University of Stellenbosch has increased over the past 15 years from 6.7% (Senekal, 1988b: 152) to 10.0%, while the prevalence of obesity has remained nearly constant (0.95% during 1988 and 0.8% during 2002). These prevalences are, however, much lower than those found for young females (15 to 24 years) who participated in the SADHS, with 20.0% of these women being overweight and 9.6% obese (SAHDS, 1998). These national statistics are more in line with what was reported for black South African FYFS at another university, of whom 18.2% were overweight and 6.5% obese (Steyn *et al.*, 2000). Our sample was predominantly white, which does

not reflect the ethnic distribution in South Africa, namely that 77.2% are black, 8.8% of mixed ancestry, 2.6% Asian and 10.7% white (Statistics South Africa, 1996). This could explain the more similar prevalence of overweight and obesity reported for the Black FYFS with the SAHDS sample. Previous studies done during the 1980s and early 1990s found overweight and obesity prevalence for young females between the ages of 15-24 years to be 24.8% and 12.9% respectively for black females (Steyn *et al.*, 1991), and 23.1% and 4.6% for white females (Jooste *et al.*, 1988). Because only one SADHS has been conducted thus far, it is not possible to determine whether an increase in overweight among young adults is occurring at a national level. In the USA the NHANES studies have, however, indicated that obesity prevalence among young females (20-29 years of age) has increased from 8.9% during NHANES II to 14.6% during NHANES III (Flegal & Troiano, 2000). Overweight prevalence among white American college female students has been reported to be 7.9% and obesity prevalence 6.0% (DiGioacchino DeBate *et al.*, 2001). Another study also reported that 20% of female students at a USA university were overweight (BMI>27.3) (Douglas *et al.*, 1997). Although the prevalence of obesity among young South African women seems to be on the rise, the figures are still lower than what has been reported for the same age group in America, especially regarding obesity. Figures reported for a European student population, namely a prevalence of overweight of 8% and obesity of 1%, is more in line with the South African situation (Bellisle *et al.*, 1995).

It is well known that obesity is a risk factor for the development of chronic diseases of lifestyle (Laquatra, 2000: 493; Lee & Nieman, 2003: 2). However, the development of these diseases does not only depend on obesity, but is also influenced by the location of excess body fat (Hill *et al.*, 2000: 442). Visceral fat as is indicated by the waist circumference and WHR is associated with a higher risk of the development of these diseases (Lee & Nieman, 2003: 182). In our study population, as was the case in 1988 (Senekal, 1988b: 154), the mean waist circumference and WHR were below the cut-off point for increased risk. Based on waist circumference (7%) and on WHR, only 4.4% of our sample could be classified in the high-risk categories. This is much lower than figures reported for South African females aged 15 to 24 years for waist circumference (11.3%) and WHR (13.1%) (SAHDS, 1998). The WHR for black South African FYFS was the same as our population, but more had a waist circumference (13.1%) indicative of increased risk. When compared to the figures reported for all South African women older than 15 years, the risk of the development of chronic diseases of lifestyle was much higher among the older women according the prevalence in high-risk categories of the waist circumference (40.5%) and WHR (32.0%) (SAHDS, 1998). The figures for young adults and university students are much lower and not a cause for concern at this stage.

Weight-related practices

The results clearly indicate that many students are not realistic about their own weight, but the situation seems to have improved over the past 15 years. Only a third of the FYFS in the current study perceived themselves as being overweight, while only a tenth were actually overweight. During 1988 Senekal (1988b: 257) reported that 71.3% of FYFS perceived themselves as overweight, while only 7.7% were actually overweight or obese. A similar trend seems to have occurred internationally. In 1989 Baily and

Goldberg (1989) reported that 85% of American college students perceived themselves to be overweight. In 1990 Adame *et al.* (1990) reported that 38% of American female college students perceived themselves to be overweight, while only 0.5% were actually overweight. In 1991 Sciacca *et al.* (1991) reported that 16.7% of American female students were overweight or obese, yet 40.2% described themselves as moderately or very overweight. In 1999 44% of Australian students perceived themselves to be overweight, although actual overweight prevalence was not reported (Stephens *et al.*, 1999). The situation among black FYFS in South Africa is completely different, with only 17% perceiving themselves as overweight, while 21,8% were actually overweight or obese (Senekal *et al.*, 2001). This situation has been linked to the fact that non-Westernised women and some groups of Westernised black women adopt a larger ideal body size, report greater body image satisfaction, are more accepting of being overweight and do not necessarily equate over-fatness with being unattractive (Cogan *et al.*, 1996; Greenberg & La Porte, 1996; Toriola *et al.*, 1996; Wilfley *et al.*, 1996).

What is a matter for concern is that a third of the normal weight students in the current study think they are overweight and almost all the underweight students think that their weight is normal. This problem is confirmed by the fact that the mean BMI of those students who think that they are overweight was in the normal BMI range, although significantly higher than the mean BMI of students who think that their weight is normal. A similar situation was described by Sciacca *et al.* (1991), who found that the mean BMI of American students who perceive themselves as overweight was 23.2. The BMI of FYFSs in our study who thought that their weight was normal (BMI=20.8) was in the lower normal range as was reported by Sciacca (1991) for American students (BMI=20.4). This low mean BMI could be explained by the fact that almost all underweight students perceived their weight as normal. The implications of these results are, first, that underweight students might not want to gain weight, but rather remain underweight, which is also associated with negative health outcomes, and second, that normal weight students may engage in unnecessary weight reduction practices to "normalize" their weight.

As far as weight goals and satisfaction with weight are concerned, the results clearly indicate that most students, especially normal and overweight students, are not satisfied with their weight. British female students (37.3%) (Page & Fox, 1998) and American undergraduates (45.7%) (Georgiou *et al.*, 1997) seem to be far more satisfied with their weight than our total sample (15.8%). Despite the fact that the students who wished to lose weight had significantly higher mean BMIs than those who were satisfied with their weight, their mean BMI was still within the normal BMI ranges. A similar situation was reported for British undergraduates (Page & Fox, 1998). Almost none of the overweight students in our sample were satisfied with their weight and the majority (87.2%) wanted to lose more than four kilograms. Black overweight students are more inclined to be satisfied with their weight (26.7%) and less inclined to want to lose ≥4 kg (66.6%). These results point to the fact that overweight students are justified in being dissatisfied with their weight and in setting weight loss goals. However, it is important that weight goals are realistic and that acceptable weight loss methods be used to prevent weight cycling and possible further weight gain. What is of concern is that very few of the normal weight students were actually satisfied with their weight and the majority still wanted to lose weight. Furthermore, a quarter of the

underweight students wanted to lose weight. This could be a reflection of the obsession that Western women have with the very thin beauty ideal.

Fifty-five percent of our study population attempted weight reduction in the two years preceding the study. This is in line with the 45.9% reported for students from the same university in 1988 (Senekal *et al.*, 1988b: 256), the 64.5% (Striegel-Moore *et al.*, 1989) and 43.5% (Cogan *et al.*, 1996) reported for American students, the 51.6% reported for a British undergraduate sample (Page & Fox, 1998), and the 42% for black South African students (Senekal *et al.*, 2001). In this study overweight students were the most likely to engage in weight loss practices during the two years preceding the study. Although overweight students seemed to be equally successful in achieving weight losses, they seemed to be the least successful in maintaining these weight losses if compared to normal and underweight students. These students could therefore be a high-risk group for weight cycling with its associated negative effects.

Body shape

Another reason why students may engage in dieting behaviour involves dissatisfaction with body shape in general or with specific body parts. This dissatisfaction might not necessary be linked to actual overweight. Most students in our population (ranging from 42.0% to 70.8%) were dissatisfied with the shape and size of their stomach, buttocks, thighs, middle and hips. Overweight students were most inclined to be dissatisfied, but it was also prevalent among the normal and underweight groups. It is evident that a higher BMI is indicative of being more dissatisfied with all body parts.

The dissatisfaction with body parts should also be reflected in the BSQ score, reflecting body shape concerns. Almost a quarter of our study population had a BSQ score indicative of body image problems. This is much higher than the 11.1% reported for black university FYFS (Senekal *et al.*, 2001). The mean BSQ score of our study population (87.4) and other similar groups including British undergraduate female students 85 (Evans & Dolan, 1993), undergraduate American female students 96.3 (Rosen *et al.*, 1996) and 95.5 (Akan & Grilo, 1995) and Black university FYFS (71.8) indicate that, on average, students do not seem to be inclined to have body shape concerns. This seems to be in contrast with the fact that the students in this study and other studies were generally inclined to be dissatisfied with their weight, to be dissatisfied with specific body parts and to set weight loss goals. The question could be asked whether the BSQ score reflects these issues effectively or possibly whether the cut-off points which were established for the identification of bulimics, obese dieters or body image therapy patients are sensitive enough to reflect body image concerns in a general population sample. However the fact that the mean score reported for black FYFS, who have been found to be more realistic about and satisfied with their weight, is substantially lower than the mean score for groups who seem to be very dissatisfied with and unrealistic about their weight, provides evidence that the BSQ does reflect body image concerns in student populations. The fact that both in this study and in the work by Senekal *et al.* (2001) the BSQ score was significantly correlated with GHQ scores (high score = decreased psychological well-being), EAT-26 score (high score = abnormal eating attitudes and behaviour) and self-concept (negative

correlation), provides further evidence for this notion. However, it is suggested that the formulation of additional cut-off points for body shape concerns in non-clinical young female groups should be investigated.

Eating attitudes and behaviours

The mean EAT-26 score of 8.5, which is well within the normal range, is lower than the 15.4, reported for first- and second-year Canadian university students (Garner *et al.*, 1982), 11.3 (Nelson *et al.*, 1999) or 10.6 (Brookings & Wilson, 1994) reported for undergraduate American female students and 10.6 for Australian female university students (Stephens *et al.*, 1999). It was, however, somewhat higher than was reported 15 years ago at the same university for female students in their second (7.8), third (7.8) and fourth (6.9) year. Disordered eating attitudes also seem to be more prevalent among black South African FYFS. A mean score of 12.1 and a prevalence of 13.3% for those classified in the high EAT score category was reported for the latter group (Senekal *et al.*, 2001). In our sample the prevalence of EAT-26 scores indicative of abnormal eating attitudes and behaviours (8.4%) was higher than reported 15 years ago for students in their second (6.3%), third (6.3%), and fourth (7.2%) year of study. The current prevalence in our study population is still below figures reported for female students from other university samples, namely 9% (Smead & Richert, 1990), 20% (Nelson *et al.*, 1999), 21.9% (Stephens *et al.*, 1999), 18% (Brookings & Wilson, 1994) and 17% (Prouty *et al.*, 2002). Possible negative or abnormal eating behaviours that were found in our study population involve eating for various reasons other than hunger. Those who were inclined to eat because others do, a lack of self-control and to eat too much had a higher mean BMI, but were not necessarily overweight. Overweight students were more inclined to eat when problems arise, due to a lack of self-control, because others do and to eat too much. Senekal (1994: 342) indicated that students who maintained a constant weight during their university career were less inclined to eat too much, to eat owing to tension, to eat owing to problems and to eat owing to frustration.

These results do indicate that disordered eating is present among students when they start their studies at tertiary institutions. However, research indicates that the university environment may also serve as the place where an eating disorder may develop, on the one hand (Martz *et al.*, 1997), and that the disordered eating attitudes and behaviours that develop may become lifelong habits, on the other hand. A longitudinal study of women's eating patterns showed that subclinical disordered eating in college-aged women was positively correlated with disordered eating in later adulthood (Heatherton *et al.*, 1997). A two-year follow-up of American female college students revealed that during their first year 18.6% of the students were classified as being disordered eaters, according to the EAT-26. Over the course of two years 10.1% of the high EAT scores returned to normal, 8.6% remained eating disordered and 2.9% developed disordered eating attitudes in college. All together the prevalence of disordered eating decreased from 18.6% in their first year to 11.4% two years later in their senior year of college (Hesse-Biber, 1992). However, Hesse-Biber (1992) argued that non-continuum measures such as the EAT-26 mask the range of college women's problems with food and may present an overly optimistic picture of their eating disorders over time, while the continuum measures revealed that the majority of female students experienced chronic eating problems. Thus it seems important to prevent the development of

disordered eating practices among students or to prevent the exacerbation of existing disordered eating when female students start their university careers (Martz *et al.*, 1997).

In our study population the FYFS with higher EAT-26 scores had lower self-concepts, were more dissatisfied with their body shape and experienced more psychological distress. Previous studies also indicate that those with high EAT scores had a significantly lower self-concept (Abrams *et al.*, 1993; Nelson *et al.*, 1999), were more dissatisfied with their body shape, and had poorer psychological well-being (Abrams *et al.*, 1993; Nelson *et al.*, 1999).

Psychological well-being

Psychological distress is definitely a problem amongst university students. It has also been found to be higher for university students than for the general population (Adlaf *et al.*, 2001; Roberts *et al.*, 1999). The mean GHQ score of our study population (9.1) is well above the threshold indicative of compromised psychological well-being and 81.1% of the total sample had scores above this threshold. This was much higher than the prevalence reported for students 15 years ago in their second (mean score=5.7, above threshold=41.4%), third (mean score=5.3, above threshold=39.6%) and fourth (mean score=5.9, above threshold=45.1%) year (Senekal, 1994: 305). Poor mental health also characterised female undergraduate students from 16 Canadian universities (Adlaf *et al.*, 2001) and first-year British university students (Roberts *et al.*, 1999). However, our prevalence is much higher than the reported 35.2% for female students in Canada (Adlaf *et al.*, 2001), 17.6% for first-year medical, 8.3% for first-year economics and 25.0% for first-year physical education (male and female) students in Turkey (Aktekin *et al.*, 2001), 36% for first-year students (male and female) in England (Humphris *et al.*, 2002), 28.7% for university students (male and female) in Spain (Martinez *et al.*, 1999) and the 57% for first-year medical and 47.3% for first-year law students at a Singapore university (Ko *et al.*, 1999). Different versions of the GHQ have been used in these studies. Roberts *et al.* (1999) also reported that the GHQ score (GHQ-12 version) of 29% of British university students was in excess of 1 SD above the mean.

Adlaf *et al.* (2001) reported that first-year students had the worst psychological health and that advanced year of study is associated with a decreased prevalence of high scorers. Despite the general tendency towards a decrease found by Adlaf *et al.* (2001), still more than a quarter of the final-year students who had the lowest prevalence were found to have high scores. Although the psychological well-being of female students at the University of Stellenbosch was not assessed during the students' first year 15 years ago, and the study population of the current study were not assessed beyond their first year, a similar trend can be observed if these two data sets are considered together. The psychological well-being of the FYFS seems to be seriously compromised at the beginning of their university career (current study) and seems to improve in subsequent years (1988-1990) (Senekal, 1994). The number of high scorers was almost halved in the second year (41.4%), after which a decreased to 39.6% in the third year, but an increase to 45.1% in the fourth year, was evident (Senekal, 1994: 305)

The lack of relationship between the GHQ score and other variables such as self-concept, BMI, eating attitudes and indicators of physical activity in the current study population may point to the possibility that these factors do not contribute to the psychological distress experienced by female students. Senekal (1994: 305) also reported no significant difference in psychological well-being between students who gained weight continuously, who were weight cyclers, whose weight was not constant and those who maintained a constant weight over a four-year period at university. However, Senekal (1994: 313) speculated that female students may go through experiences and emotions that could be of a distressing nature. These experiences and emotions may include constant struggles with weight, frustration, studies, tests, exams, personal problems, personal relationships, inadequate problem-solving abilities, adaptation to the residence and university environment, poor self-esteem and body-image, academic and social disappointment, and isolation (Senekal, 1994: 313).

Self-concept

In our study population 19% had a low self-concept and 36.7% a high self-concept, which is better than was reported for black South African FYFS, of whom 28.2% had a low self-concept and only 6.3% had a high self-concept (Senekal *et al.*, 2001). The mean self-concept of black students (65.5±9.5) (Senekal *et al.*, 2001) was also much lower than for our study population (72.0±12.6). It has been found that the transition from high school to college is associated with a decrease in the self-concept ratings of female students (Hesse-Biber & Marino, 1991). Furthermore, most students do not appear to make positive changes in their self-concept evaluations beyond their pre-college ratings (Hesse-Biber & Marino, 1991). Hesse-Biber and Marino (1991) also reported that female students whose eating patterns became or remained abnormal during college are inclined to experience a decrease in self-concept over time compared with students whose eating patterns remained good or improved. Thus, decreases in self-concept could be related to the development or worsening of eating problems. In our sample a lower self-concept was significantly associated with a higher BMI, a higher dissatisfaction with body shape, having more disordered eating attitudes and behaviours, being less active during leisure times and doing less sport. Similar relationships were reported by Nelson *et al.* (1999), namely that problem eaters had lower self-concepts and viewed themselves more negatively. These results point to the importance of addressing the self-concept of FYFS to contribute to effective weight management during their university career.

Dietary intake

White South Africans typically consume a Western diet which is high in fat, meat and refined cereals, and low in fibre and vegetables (Vorster *et al.*, 1997: 117). It has also been indicated that the diet of black South African female students from urban areas is more in line with aspects of the Western diet such as high intakes of refined, sugar-based foods and low intakes of legumes, while rural students consumed more traditional diets (Steyn *et al.*, 2000). Although our dietary data do not necessarily represent a 24-hour intake, the gram intake from the nine food groups and the comparison with the American Food

Guide Pyramid (USDA, 1992) shows that this pattern might be true for the FYFS, except for the relatively high fruit and vegetable intake.

The number of portions our population consumed from the starch group was in the range recommended by the American Food Guide Pyramid (USDA, 1992). However, more than half of these portions were supplied by foods in the "other" food group, which included mainly high fat, refined and sugar-based foods such as sugar, sweets, doughnuts, rusks, cake and muffins. As part of the dietary goals it is recommended that the intake of these foods should be less than 10% (SASA, s.a.), which was definitely not the case in our population.

With potatoes included as a vegetable as recommended by the American Food Guide Pyramid (USDA, 1992), our study population consumed almost the recommended minimum of three vegetables per day. The intake of fruit portions was more than the recommended 2-4 portions. As was mentioned, the relatively high fruit and vegetable intake is not a typical characteristic of the intake of white South Africans (Vorster *et al.*, 1997). As the dietary intake assessment covered the students' first three weeks in residence, it could reflect adequate availability of these items during this period, but might not reflect usual intake before coming to university or necessarily indicate that this pattern will continue.

Our study population consumed inadequate portions from the milk and cheese group (diary products) when compared to the recommendations of the American Food Guide Pyramid (USDA, 1992). Such a low intake of foods from dairy products may result in inadequate calcium intake and other diseases such as osteoporosis later in life (Anderson, 2000: 627). In line with our findings that only half of the recommended portions is consumed from dairy products, it has been shown that the calcium intakes for South African females between the ages of 16 to 24.9 years ranges between 335-618 mg/day (Vorster *et al.*, 1997: 91), which is half of the RDA of 1200 mg/day .

The mean portion intake from the meat, fish, poultry, legumes and nuts group was just above the recommended 3 portions per day (USDA, 1992), using a 60 g meat/fish/poultry or 1 cup cooked legumes as 1 portion, by the American Food Guide Pyramid (USDA, 1992). Furthermore, most of the protein seemed to be of animal origin, which is a typical characteristic of Western diets (Vorster *et al.* 1997: 117).

In the fat group, most of the portions came from the "other" food group as well as from high fat choices from the meat/fish/poultry group, such as fried chicken or fish, schnitzels, high-fat meat cuts, chicken with skin, fried or scrambled eggs. High-fat meat choices are a major contributor to increased saturated fat intake. Furthermore, the fat typically used to make foods consumed in the "other" food groups such as cake, doughnuts, cookies, is rich in trans-fatty acids and/or saturated fat. The intakes of these types of fats increase the risk for development of chronic diseases of lifestyle. Therefore it seemed that our population consumed a relatively high fat intake and that the fat is not necessarily supplied by healthy fat choices.

Alcoholic beverages account for more than half of the total intake of drinks consumed in our population. Hendricks and Herbold (1998) also indicated that the alcoholic beverage consumption of tertiary students is high and noted that this may contribute substantial energy to the diet.

Concerning the nutritional adequacy of the dietary intake of our study population, the results are in line with research done on American college females as summarized by Hendricks and Herbold (1998), which indicates that the dietary intake of female students reflects inadequate fibre, calcium and iron intake and high total fat and saturated fat intake. It was also found that female students who reside on campus tend to have higher protein and fat intakes, lower physical activity levels, higher serum triglyceride and total cholesterol levels, and lower HDL cholesterol levels than those residing off campus (Brevard & Ricketts, 1996).

The fact that no relationship was found between BMI and the dietary intake of the first three weeks in residence is not surprising. The weight status of the students at this point could most probably be explained by dietary intake and physical activity levels during the months before they came to university. If the relatively high intake of fats, foods from the "other" group and alcohol persists in subsequent months and levels of physical activity change, a relationship with weight status (BMI) might be detected. The availability of a variety of fast-food restaurants, convenience stores and grocery stores within walking distance from the residences, and the presence vending machines or small shops in residences, could explain the high amount eaten from the "other" group.

Finally, when interpreting the results of a food frequency questionnaire, it must be borne in mind that one of the disadvantages of this questionnaire is the possibility of unrepresentative estimation of usual food consumption (Nelson & Bingham, 1997: 136). This possibility could have contributed to the relatively high reported intake from the meat, fish and poultry group as well as the fruit group. However, the fact that the questionnaire was found to be highly reliable reduces this possibility.

Physical activity

More than a quarter (27.2%) of our study population did not participate in any physical activity that is performed for the purpose of conditioning the body, improving or maintaining health and improving or maintaining physical fitness. This is higher than the 22% (Suminski *et al.*, 2002) or 12.3% (Haberman & Luffey, 1998) of American college women who reportedly did not engage in any physical activity. The results of our study population do indicate that students with a normal BMI do more exercise (higher sport index) than those in either the underweight or overweight BMI categories. This trend was also highlighted in a review by Hendricks and Herbold (1998) regarding health-related behaviours of college women, which indicated that increases in inactivity are associated with increases in weight. In the long run the low levels of physical activity could contribute to an increase in mortality (Pate *et al.*, 1995).

CONCLUSIONS AND RECOMMENDATIONS

The weight of most of the students who enrol at the University of Stellenbosch for the first time is normal, with only a small number being either underweight or overweight. The weight status (BMI) of the FYFS was found to be related to perception of weight, weight goals, weight loss efforts, maintenance of weight loss, dissatisfaction with body parts, body shape concerns, eating attitudes, self-concept, reasons for eating, physical activity and previous smoking habits. It was found not to be related to socio-demographic variables, self-reported diseases prevalence and medicine use, current smoking habits, dietary intake and general psychological well-being.

Students who perceive themselves as overweight had the highest mean BMI, while those who perceive themselves as underweight, the lowest. Higher mean BMIs were found for students who are more dissatisfied with their weight and who want to lose more weight in the future. Those with higher mean BMIs were also more inclined to be on a weight loss diet at the time of the survey and more inclined to have attempted to lose weight in the two years before entering university. Although all students were equally successful in achieving weight loss, regardless of BMI, those who were not able to maintain this weight loss had a higher mean BMI. Students who indicated that they are dissatisfied with a specific body part had higher BMIs than those who were satisfied, except in the case of the calves. All students, regardless of BMI, had decreased psychological well-being. However, students with a low self-concept, disordered eating attitudes and behaviours, and problems with body shape always had higher mean BMIs. It was also found that students who indicated that they did smoke before entering university but are not currently smoking had higher mean BMIs. These "higher" mean BMIs, however, were always in the normal weight range, indicating that the problems do not only exist among overweight students. It is therefore also important to consider the differences between underweight, normal and overweight students regarding the above-mentioned variables.

The majority of underweight students are characterised by perceiving their own weight as being normal and being satisfied with their weight, although a quarter still want to lose between 1-3 kg and a fifth tried to lose weight during the two years before entering university. Underweight students were the most satisfied with all body parts (except calves) compared to normal and overweight students. The highest number of those who was dissatisfied with a body part were dissatsified with the buttocks. With regard to psychological well-being, most underweight students had decreased psychological well-being, a good self-concept, were satisfied with their body shape and had normal eating attitudes and behaviours. Most underweight students differ from their normal and overweight counterparts in that they do not eat because others do, when not hungry, when problems arise, due to a lack of self-control and they are also not inclined to eat too much. The dietary intake of the underweight students at the time of the survey was not different from that of the normal and overweight students. Underweight students are less likely to participate in physical activity than normal weight students.

Normal weight students are characterized by perceiving their weight as normal or as overweight and very few are satisfied with their weight. Most normal weight students want to lose weight in the range of 1-3 kg, while, a third want to lose ≥4 kg. Most also attempted to lose weight during the two years before entering university and were successful in losing weight, but less than half were able to maintain the new weight. They are dissatisfied with most of their body parts, especially their stomach, buttocks and thighs. Almost all normal weight students had compromised psychological well-being, most had normal eating attitudes and behaviours, many had a low to medium self-concept and dissatisfaction with body shape was evident in at least a fifth. Many indicated that they would eat when they are bored, when not hungry, while studying, because others eat and that they are inclined to eat too much. Normal weight students seemed to do more physical activity (sport index) than underweight or overweight students.

The overweight students were characterized by being dissatisfied with their weight, but also with being the most realistic about their weight in that they perceive their weight correctly as overweight. Most overweight students wanted to lose ≥4 kg and tried to lose weight during the two years before entering university. However, although it was indicated that many were able to lose weight, most regained the weight. Overweight students were the most dissatisfied with their body parts, if compared to normal weight and underweight students. The majority were dissatisfied with their stomach, thighs, hips, buttocks and middles. Almost all overweight students had compromised psychological well-being, most had normal eating attitudes and behaviours, most did not have a high self-concept and were dissatisfied with their body shape. Most overweight students acknowledge that they eat too much and eat when they are bored. Other circumstances associated with eating indicated by more than half was that they will eat because others do, when not hungry, when frustrated, when stressed, and due to a lack of self-control. They also seemed to do less physical activity in the form of exercise than normal weight students.

It is therefore clear that FYFS are inclined not to be realistic about their weight status and that they experience numerous problems affecting their weight status. There has been very little improvement regarding this situation among students at the University of Stellenbosch since 1987, emphasizing the need for preventive intervention.

If large populations (such as university students) could learn healthful behaviours early in life, it would not only have a positive effect on the health of a particular student and her possible family later in life, but it could also decrease the economic burden on South African health services. The results of this research support the recommendation by Prouty *et al.* (2002) that universities must provide interdisciplinary teams specializing in eating disorders and students' education focusing on body image, healthful eating, exercise, and the types of mental health and medical services available. Our results also indicate that, because many students in the normal and underweight categories experience these weight-related problems, interventions aimed at correcting these behaviours and problems should target *all* students, regardless of their BMI. The characteristics of FYFS identified in this study should be borne in mind when developing and implementing weight-management programmes for university students.

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CHAPTER 4

ARTICLE 2

Impact of a multidimensional self-help weight-management manual on the weight status and associated factors of first year female students.

INTRODUCTION

Research among adult populations indicates that unintended weight gain can occur at any age but the greatest increases in weight are found among young adults between the ages of 18 to 34 years. (Braddon *et al.*, 1986; Rothacker & Blackburn, 2000; Williamson *et al.*, 1990). In this age group young women are twice more likely than young men to experience large increases in their weight and the highest increases were found among young overweight females (Rothacker & Blackburn, 2000; Williamson *et al.*, 1990). It has also been documented that female students studying at tertiary institutions (e.g. university, technikons or college), especially first-years, are prone to gain weight (Hovell *et al.*, 1985; Megel *et al.*, 1994; Graham *et al.*, 2002; Senekal 1988a; Senekal 1988b). In South Africa 58.8% of non-first-year female students retrospectively reported that they had gained weight, ranging from 1-25 kg during their first year (Senekal, 1988a), while a prospective study found that 72% of first-year female students (FYFS) gained between 2-13 kg within the first three months at university (Senekal, 1988b). Names such as "Freshman 10" and in more recent years "Freshman 15" have been ascribed to the notion that female tertiary students in the United States gain an average of 15 pounds (6.8 kg) during their first year of college (Hodge *et al.*, 1993). Weight gain during an individual's career at a tertiary institution does not necessarily cause obesity at that point. However, systematic increases in weight during early adulthood could result in the manifestation of obesity later in adulthood (Braddon *et al.*, 1986; Williamson *et al.*, 1990; Rothacker & Blackburn, 2000). This is also illustrated by the South African Demographic and Health Survey, which indicates that 2.7% of males and 9.6% of females between the ages of 15 to 24 years are obese. However, data for all adult South Africans older than 15 years of age revealed obesity prevalence to be 9.1% among males and 29.4% for females (SADHS, 1998; SAHR, 2002).

The prevalence of obesity is rapidly increasing in both developing and developed countries world-wide (SAHR, 2002; WHO, 2003: 8, 61) and has become an increasingly important public health issue. This is also true in South Africa, especially among females, as the statistics indicate. Obesity presents a major risk to health and increases the risk of developing other non-communicable diseases such as coronary heart disease, hypertension, dyslipidaemia, non-insulin-dependent diabetes mellitus (NIDDM), certain cancers and gallbladder disease (Wadden *et al.*, 2002; WHO, 1998). Obese persons also experience conditions such as endocrine disturbances, osteoarthritis, pulmonary diseases, hyperuricaemia and gout (WHO, 1998). The obese state may also have detrimental effects on a persons' psychological health indicators such as self-concept, self-confidence, psychological well-being, and dissatisfaction with their body shape and size (Stunkard & Sobal, 1995: 418-419). The obese are stigmatized in many societies and they are considered by the public and consequently themselves to be ugly, awkward, weak, sad, unsuccessful and lacking in control (Rothblum, 1990). They must also contend with discrimination, for instance, in the job market (Stunkard & Sobal, 1995: 417-418). The psychological impact of obesity may

decrease the ability of the obese to manage their weight effectively (Senekal *et al.*, 1999), which could result in further weight gain or the inability to decrease current weight and maintain a new healthier weight.

Treatment options for obesity, including weight loss diets, physical activity, medications or surgery, are abundant but largely ineffective (Glenny *et al.*, 1997; NIH, 1998). Long-term follow-up of participants who lost weight on different types of weight-loss programmes indicated that most are unlikely to maintain their weight losses over two to five years (Nawaz & Katz, 2001; NIH, 1998). Because of the poor outcomes of obesity interventions, more emphasis is currently being placed on the importance of development and evaluation of strategies to prevent unnecessary weight gain and the eventual development of obesity (ADA, 2002; St Jeor, 1997).

Weight gain or obesity prevention for first-year female students can be classified as a primary prevention approach or selective prevention programme (Thomas, 1995: 159; WHO, 1998: 169). The stated goal of primary prevention is to decrease the number of new cases (incidence) of a disease and for obesity this may entail the prevention of weight gain to prevent the consequent development of obesity (James, 1995; Mrazek & Haggerty, 1994: 20; Thomas, 1995: 153). However, the primary/ secondary/ tertiary prevention classification system was originally developed for acute conditions with an identifiable, unifactorial cause (Mrazek & Haggerty, 1994: 20). Braddon *et al.* (1986) emphasized that preventive methods should not just be restricted to at-risk groups, such as overweight young adults, as suggested by the primary and secondary prevention approach (Klem *et al.*, 2000), because many of those who did become obese later in life were not overweight during early adulthood (Rothacker & Blackburn, 2000). The need for an alternative classification system for the prevention of multifactorial conditions such as obesity thus emerged. The system put forward by Gordon (1987) suggests three levels of prevention. First, universal prevention directed at everyone in an eligible population or community. Second, selective prevention directed at subgroups of the population with an above-average risk of developing obesity and, third, indicated prevention directed at high-risk individuals who may have a detectable amount of excess weight but who are not yet obese (Mrazek & Haggerty, 1994: 20; Thomas, 1995: 159; WHO, 1998: 169). Given the fact that young female students are at risk of gaining large amounts of weight during their first year and are unable to reduce their weight to original levels in the following years of study (Senekal, 1994), it appears that they are ideal candidates for weight-gain prevention based on the principle of a selective obesity-prevention intervention.

Only a limited number of programmes aiming at weight-gain prevention in children, students or adults have appeared in the literature (Hardeman *et al.*, 2000; Glenny *et al.*, 1997). The two weight-gain-prevention programmes that target adults that were traced include the two Pound of Prevention studies (Forster *et al.*, 1988, Jeffery & French, 1997, 1999). Both studies used a low-intensity self-help intervention approach in the form of monthly posted newsletters, targeted to change the diet and exercise habits for a 12-month (Forster *et al.*, 1988) or 36-month (Jeffery & French, 1997) intervention period. Although the initial study found a significant difference in weight between the control and intervention

groups (Forster *et al.*, 1988), the more recent of the two programmes found no significant difference between the two intervention groups or the control group regarding their weight changes after a period of one year (Jeffery & French, 1997) or three years (Jeffery & French, 1999).

The only published weight-gain-prevention programme aimed at female students (freshman or sophomore year) used a one-semester college nutrition science course composed of lectures, classroom and laboratory exercises to empower students to manage their weight (Matvienko *et al.*, 2001). The intervention group (n=21) had a significantly better knowledge of nutrition in general as well as knowledge of energy metabolism and physiological mechanisms of energy balance at four and 16 months follow-up than the control group (n=19). However, no significant differences in the weight status between the two groups were found at the four- or 16-month follow-up. The intervention was effective among students with a BMI>24, of whom the intervention students had been able to maintain their baseline weight after the 16-month follow-up but not the control students. The small sample size was a major limitation in this study (Matvienko *et al.*, 2001).

When planning prevention programmes it is important to bear in mind that the format of the programme has definite effects on compliance (Klem *et al.*, 2000). The collection of data that describes the acceptability of the programme format to the target population should therefore be emphasized (Klem *et al.*, 2000). A low-intensity approach to weight gain prevention is effective in that it seems to sustain interest over a lengthy time period in comparison with group meetings and has been associated with positive behaviour change (Jeffery & French, 1999; Klem *et al.*, 2000). However, such programmes may not be strong enough to significantly reduce weight gain (Jeffery & French, 1999; Klem *et al.*, 2000). Jeffery and French (1999) reported that face-to-face education classes were offered to the individuals in the intervention groups twice every year during the three years of intervention, but fewer than 10% eligible subjects attended these classes. Furthermore, a college nutrition course (Matvienko *et al.*, 2001), may not be the ideal model to reach all first-year female students.

Because the etiology of weight gain and obesity is multifactorial and group specific, prevention programmes should be based on the specific needs of a particular target population to improve chances at success (Rossi *et al.*, 1999). Therefore to facilitate the development of an appropriate programme to empower first-year female students to prevent weight gain the unique weight management needs of female students at the University of Stellenbosch were determined in a four-year longitudinal study (Senekal, 1994). The results of this research indicate that only 20.7% were able to maintain a constant weight over the period, 31.6% continued to gain weight, 18% were clear weight cyclers and the weight of 29.7% was not constant (Senekal, 1994: 254). Students who were unable to maintain a stable weight over the four-year period were characterized by the following during their first year: higher levels of total energy intake, inclination to eat due to homesickness, frustration, boredom, stress, lack of self-discipline, just because others eat and social events, problems with adaptation to residence life, a better knowledge of nutrition and finally significant weight gain (Senekal, 1988b). Results of the total four-year period indicated that these students were also inclined to be less realistic about their body weight and size; to be

more inclined to have abnormal eating attitudes, compromised psychological well-being, high scores for dietary restraint; to experience problems with external and emotional eating and disinhibition; to perceive their eating attitudes as poor; to be more susceptible to factors that could have an adverse effect on eating habits; to be less able to handle small weight changes successfully, and to be less likely to be physically active (Senekal, 1994).

The integration of these results with an extensive search and assessment of the weight management literature led to the development of a multidimensional weight-management paradigm which could be applied in the development of weight-management interventions (Senekal *et al.*, 1999). Subsequently a self-help weight-management manual which follows the multidimensional approach proposed in the mentioned paradigm was developed to address the unique weight-management needs of female students.

The aim of this study was to evaluate the impact of this multidimensional self-help weight-management manual on the weight status and associated factors of FYFS at a South African university.

METHODS

Study design

A non-randomized quasi-experimental study design was used (Figure 4.1). With this type of design comparisons can be made between an experimental group created out of targets that have been selected by the researcher and are exposed to an intervention and checked against a control group. The control group is not exposed to the intervention, but is comparable to the experimental group and is also selected by the researcher (Rossi *et al.*, 1999).

Data were obtained from the experimental and control group (both groups) at three different time points over an eight-month period. Baseline data were obtained over a three-week period during the students' first month at university (February 2002). Follow-up evaluations took place three months (Follow-up 1) and eight months (Follow-up 2) after Baseline data collection.

As is indicated in Figure 4.1, BMI was used to assess the overall impact of the intervention on the weight status of the FYFS. Additional anthropometric measures as well as a number of other factors associated with the weight status of the FYFS were also assessed over the eight-month period. The latter factors were selected to reflect the issues addressed in the different chapters in the Manual.

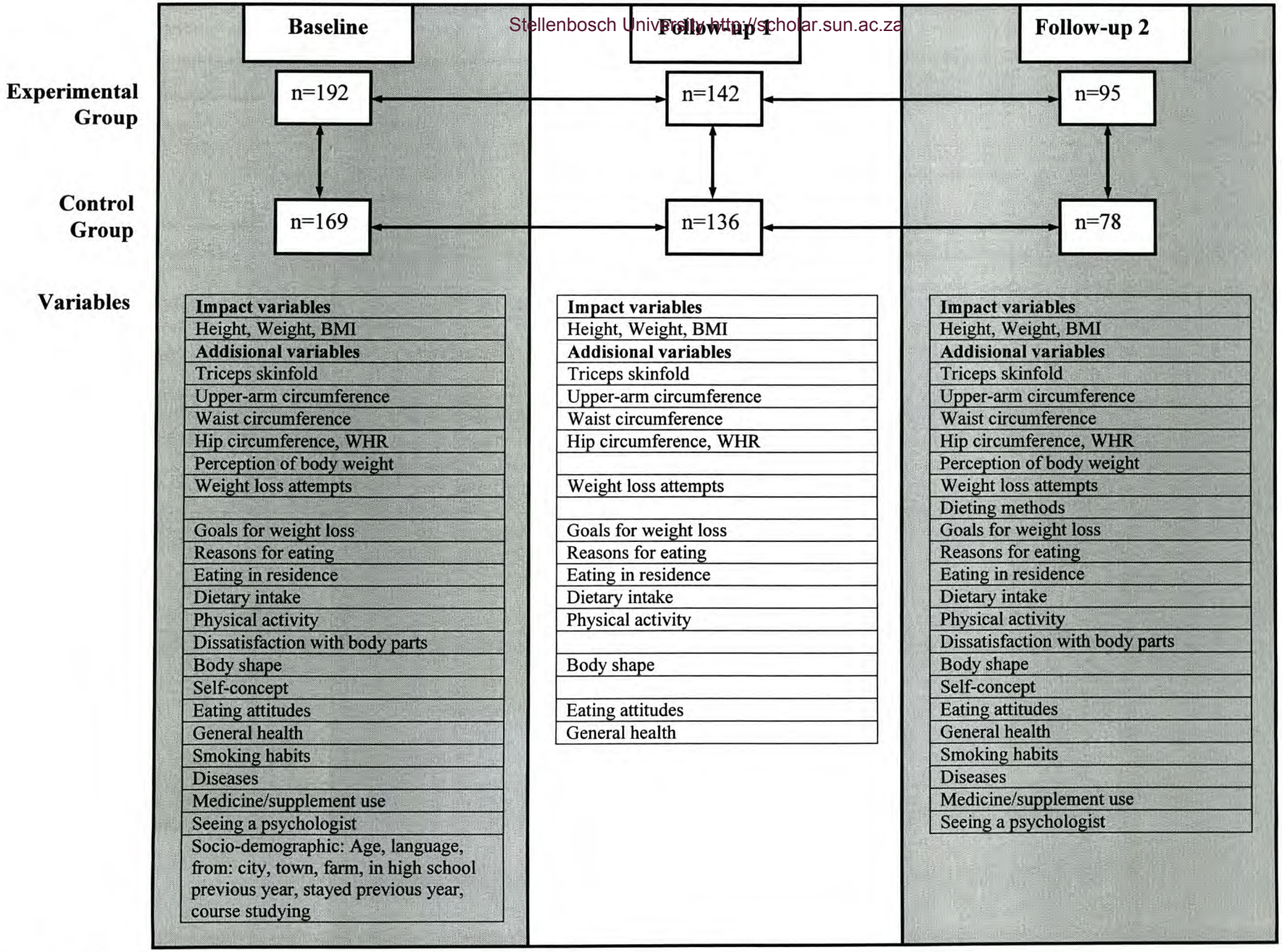

FIGURE 4.1: Study design, sample sizes, and variables

Study population and sample

The total study population consisted of all first-year female students (n=883) living in residences, exclusively for female students, on the campus of Stellenbosch University in South Africa.

The random selection of students from the total study population as well as the random assigning of students to the experimental and control groups was not feasible, as this could result in both experimental and control subjects being drawn from one residence. This type of situation could result in serious contamination of the control group with the intervention. It was therefore decided to view a total residence as a sampling unit. As a student is randomly assigned to a residence by the university's administration, no differences in mean BMI and other variables between the FYFS from the different residences were expected.

From the 12 residences available for exclusively female accommodation in 2002, the researchers selected four residences to serve as an experimental group and three to serve as a control group. The groupings of chosen residences ensured geographical separation to decrease the possibility of contamination between the experimental and control groups. The total number of potential participants in the four experimental residences was n=298 and in the three control residences n=211.

For subject recruitment purposes, an evening meeting for all FYFS was organized with the help of the student bodies at each of the seven residences. In an introductory PowerPoint-based presentation the students in the experimental residences were informed about weight-management problems experienced by FYFS, the aim of the study as well as what would be expected of them if they chose to participate. The students in the control residences were informed that the aim of the study was to monitor the health of students at South African universities. After the presentation the students could volunteer for participation in the study. The final baseline sample included n=191 (64%) of the FYFS in the experimental residences and n=169 (80%) of the FYFS in the control residences.

Intervention

The intervention programme consisted of a self-help weight-management manual (referred to as the Manual from this point forward). A summary of the content of the Manual is presented in Table 4.1.

All students in the experimental group received the Manual at Baseline and kept this throughout the eight-month study period. Because this was a low-intensity intervention programme, no further contact was made with either group during the study period, except for the evenings when Follow-up 1 data were obtained.

TABLE 4.1: Content of the self-help weight management manual (The Manual)

CHAPTERS IN MANUAL		CONTENT
1	Perspectives on women, first-year female students and weight	
2	Causes of weight problems	
3	What is weight management?	
4	Reasonable weight goals and diagnosis of your weight-management needs	Provides guidelines and activities to help the reader to identify a reasonable, attainable and maintainable weight goal
5	Weight maintenance	Provides guidelines and activities to enable the reader to maintain her weight, if necessary
6	Weight loss when necessary	Provides guidelines and activities to guide the reader to lose weight, if necessary
7	Being overweight	Provides guidelines and activities to accept an overweight or obese physique, if necessary
8	Healthful eating	Provides guidelines and activities to ensure healthful eating
9	Determining your energy needs and controlling your energy intake	Provides detailed guidelines and activities to determine actual energy needs for weight reduction and the planning and execution of a weight-reduction diet
10	Physical activity for health	Provides guidelines and activities to ensure optimal levels of physical activity
11	Essential personal characteristics: body shape and self-concept	Provides guidelines and activities to contribute to optimal body shape perception and self-concept
12	Essential life skills: • Formulation of goals • Stress management • Self-knowledge and personal growth • Communication • Conflict management • Problem solving and decision making • Assertiveness and management of peer pressure • Management of your environment • Self-motivation • How to change behaviour • Constructive thinking • Visualization	Provides guidelines and activities to contribute to optimal life skills.

Anthropometric and health measures

The anthropometric measurements, which were taken at all three time points, included weight, height (only at baseline), triceps skinfold, upper-arm circumference, waist circumference and hip circumference. The same two standardized field workers who completed a Level 1 anthropometry course took all the measurements, using the techniques described by Lee and Nieman (1996).

Weight was measured in light clothing without shoes using an electronic scale (BW-150 from You-We Scales) to the nearest 0.1 kg. Height was measured with a stadiometer to the nearest 0.1 cm. Body mass index (BMI) was computed as weight (kg)/ height $(m)^2$ (Bastow, 1982) and categorized according to the World Health Organization guidelines, namely BMI<18.5 = underweight; BMI ≥18.5 and <25 = normal; BMI ≥25 and <30 = overweight and a BMI≥30 = obese (WHO, 1998). For statistical analysis the obese and overweight subjects were grouped into one category, namely BMI≥25, because there was only one subject in the obese category. The triceps skinfold, which gives an indication of body fat stores, was taken to the nearest 0.2 mm using a calibrated Harpenden calliper. The percentiles (for females aged 18 to 24.9 years) published by Frisancho (1990) were used to classify the student's triceps skinfold as underweight (under the 5^{th} percentile; <9.5 mm), normal weight (>5^{th} and <95^{th} percentile) or overweight (above the 95^{th} percentile; >33.5 mm) (NCHS). The upper-arm, waist and hip circumferences were measured to the nearest 0.1 cm using a non-stretchable measuring tape. The mid-upper-arm circumference (MAC) was taken at the same mark which was use to measure the triceps skinfold. The waist circumference (WC) was taken at the level of the narrowest point between the lower rib border and the iliac crest after normal expiration. The hip circumference (HC) was taken at the level of the greatest posterior protuberance of the buttocks. The subject stands relaxed with feet together, while the measurer ensures that the measuring tape is on the same horizontal plane when these sites are measured. The Waist-to-Hip ratio (WHR) was calculated by dividing WC by HC and then categorized as low risk (<0.8) or increased risk (≥0.8) of development of chronic diseases of lifestyle (Hammond, 2000: 372). The WC was also categorized as low risk (<0.8 cm), increased risk (80-87.9 cm) or substantial risk (≥88 cm) of development of chronic diseases of lifestyle (SASSO, 2003: 4; WHO, 1998: 12).

Instruments

The instruments used to assess the other weight-management-associated factors indicated in Figure 4.1 include the following: a 90-item Semi-quantified Food Frequency Questionnaire; the Baecke Questionnaire of Habitual Physical Activity (Baecke *et al*, 1982); the 34-item Body Shape Questionnaire (Cooper *et al*., 1987); the Adolescent Self-Concept Scale (Vrey & Venter, 1983); the 26-item Eating Attitudes Test (Garner *et al*., 1982) and the 30-item General Health Questionnaire (Goldberg *et al*., 1976). A detailed description of the instruments or techniques used for the different assessments is described in Chapter 3. All instruments and techniques were developed or selected to measure the difference in the change over time between the control and experimental groups for selected outcome variables.

Additional questions concerning socio-demographic variables, perception of current weight, weight goals, whether currently on a weight-reduction diet, weight loss attempts past two years or past year, weight loss methods, smoking habits, chronic diseases, medicine use were also included in the questionnaires. Questions on smoking habits, chronic disease prevalence and medicine use were included as "health" outcomes to foster the perception among the control group students that the study involved is a health survey.

As part of the final assessment, during Follow-up 2 the following questions were included to assess the perceptions of the Manual among the FYFS in the experimental group: whether they had used the Manual; whether they thought the Manual was a good idea; motivation for their answer on whether they thought it was a good idea; whether they felt that other methods could work better; suggestions on other methods that could work better; whether they felt FYFS wanted to be helped with weight management; whether they wanted/needed to be reminded to use the manual; if it was not used, reasons why not and any other comments.

Data collection

After recruitment of FYFS at baseline, they completed a battery of questionnaires and their anthropometric measurements were taken in a secluded area. For both follow-up evaluations all subjects received a notice beforehand to remind them of the time and place in their residence where these evaluations would take place. This notice also reminded them that each student would receive an information sheet (Addendum B) containing information on anthropometric measurements taken at the previous assessment as well as for certain questionnaires such as the BSQ, GHQ, EAT-26 and ASCS. This was done to increase interest in the study and to reduce the attrition rate. At the follow-up occasions the researchers were available for a period of three hours in each residence so that students could chose which time during the specific evening they wanted to come for evaluations. During these follow-up evaluations FYFS again completed a battery of questionnaires and their anthropometric measurements were taken in a secluded area.

Data processing and statistical analysis

After data collection all questionnaires were checked for completeness by the primary researcher. Incomplete and incorrectly completed questionnaires were returned to students for corrections. However, for the following reasons some variables still contain missing values: students who could not be reached shortly after data collection for corrections, students who refused to fully complete questionnaires and students who still left out questions after the corrections had been done. The complete food frequency questionnaires of 31 students were excluded from data analysis, because they had been either poorly or incorrectly completed. If one of the nine food group sections was incomplete, but the rest of the food frequency questionnaire was correctly completed, only that particular food group was excluded from analyses. This resulted in the number of time points (n) for each of the nine food groups not necessarily being the same for all food groups.

Data were entered in Microsoft excel spreadsheet and cleaned. The scores for the different questionnaires were computed using Microsoft Excel. Subsequently all data were then transferred to an SPSS data editor. The different anthropometric indices or measures were computed and applicable data were categorized according to the indicated cut-off points. Dietary intake data were processed on SPSS, as was described in the section on the food frequency questionnaire.

All data were analyzed using SPSS computer software (SPSS/PC, Version 11.0, 2003) (Brace *et al.*, 2003). The data analysis involved the following comparisons:

- Between-group differences at the three different time points;
- Within-group change over time;
- Between-group differences in mean change within each group over time.

Firstly, the **between-group differences** for the different variables **at each time point** was determined. For each continuous variable the mean±SD of the control and experimental groups were compared using the Independent Samples t-test. For the comparison of categorical variables cross-tabulations were constructed with treatment (control vs. experimental) as classification variable. The Pearson's Chi-square or Fishers' exact test (in cases of 2×2 tables with cells with an expected count less than five) was then used to detect significant differences in group profiles. The Independent Samples t-test[7] was also used to determine the baseline differences between drop-outs and non-drop-outs.

Secondly, the **within-group change over time** was determined for each variable. For continuous variables the One-way ANOVA test was used for these purposes. If the test was significant, it was followed by the Bonferroni post hoc test to determine which time points differed significantly from each other. A limitation of the use of the One-way ANOVA test in this study is that it only compares the values of FYFS who participated at all three time points. For some students in the study only Baseline and Follow-up 2 data were obtained. Because of the fact that their Follow-up 1 data were missing, they are excluded totally from the One-way ANOVA calculations. For categorical variables cross-tabulations were constructed separately for the experimental and control groups with time point (Baseline vs. Follow-up 1 vs. Follow-up 2) as classification variable. The Pearson's Chi-square or Fishers' exact (in cases of 2×2 tables with cells with an expected count less than five) was then used to detect significant differences over time.

Thirdly, the **between-group differences** in the **mean change** in continuous variables **within each group over time** were determined. The change within the control and within the experimental groups between time points was computed by subtracting mean Baseline values from Follow-up 1 and from Follow-up 2

[7] Equality of variance is a requirement for using a Independent Sample t-test. The Levene's Test is used to determine equality of variances. SPSS, however, carries out two versions of the Independent groups t-test, namely one for when there is equality of variance (Levene's test: $p>0.05$) and one for when the variances are unequal (Levene's test: $p<0.05$). In cases where variances were unequal, it is indicated in the results tables.

values and Follow-up 1 from Follow-up 2. The three resulting values were then compared between the control and experimental groups using the Independent Sample t-test. Note that due to the mentioned missing values at Follow-up 1, the total number of data points (n) is lower in any calculations where Follow-up 1 is involved. Therefore, tabulated changes from Baseline to Follow-up 2 do not necessarily add up.

Because some of the BMI values were found to be outliers, the impact of the Manual on BMI was also assessed in terms of median BMI values, which are more robust in this regard (Personal communication, 2002, Dr C Lombard, MRC, Tygerberg). Furthermore, it was also deemed important to control for the fact that students in a residence form a cluster, which could result in a specific change in one cluster but not found in the other clusters. For these purposes, the mean and median baseline BMIs of all seven residences were first calculated and compared using the Independent Samples t-test. Second, the mean and median baseline BMIs of the three control residences combined and that of the four experimental residences combined were also compared with each other using the Independent Samples t-test. Third, the mean and median change in BMI over the eight-month period (Baseline subtracted from Follow-up 2) was computed for each of the seven residences. Subsequently the mean and median changes in BMI were compared between the three control residences as well as between the four experimental residences using the Independent Samples t-test. The mean and median changes in BMI for the total control group were then compared to the values for the total experimental group, using the Independent Samples t-test.

In all statistical analyses a p-value of <0.05 was designated to be statistically significant.

Ethical issues

Permission to conduct this study was obtained from the Faculty of Science Ethical Committee as well as the Dean of Student Affairs of the University of Stellenbosch. After being thoroughly informed of the nature of the study, each volunteer signed a consent form in the presence of two witnesses. Students could not participate anonymously because of the longitudinal design of the intervention trial. They were, however, assured that data would be handled confidentially and only published within group context.

RESULTS

Socio-demographic information

There were no significant differences between the experimental and control groups as far as baseline socio-demographic information is concerned (Table 4.2). In both groups the majority of students were Afrikaans speaking and had been in school and resided with their parents the previous year. The mean±SD age of the control group was 18.6±0.42 and 18.7±0.35 for the experimental group (p=0.745).

TABLE 4.2: Column % of socio-demographic information of FYFS by treatment group at Baseline.

		Baseline		
		Control (n=78)	Experimental (n=95)	p-value*
Home language	Afrikaans	75.6	86.3	0.158 (df=2)§
	English	20.5	12.6	
	Other	3.8	1.1	
Origin previous year	City	24.4	29.5	0.709 (df=2)
	Farm	15.4	12.6	
	Town	60.3	57.9	
In school previous year‡		94.9	93.7	0.502 (df=1)†
Accommodation previous year	With parents	73.1	86.3	0.076 (df=2)§
	In a school hostel	17.9	10.5	
	Private	9.0	3.2	

*Pearson's Chi-Square test unless otherwise indicated; df = degrees of freedom

‡% who reported Yes, the remainder not indicated answered No

†Fisher's exact test

§One or more cells have expected counts less than 5: interpret p-value with caution.

Weight status

There were no significant differences between the two groups for mean weight, height or BMI at Baseline and for weight and BMI at Follow-up-1 (Table 4.3). Both groups experienced a non-significant initial (during the first three months of the intervention) increase in mean weight and BMI. However, during the last five months, the mean weight and BMI of the control group continued to increase, while a decrease was evident in the experimental group. Consequently, at Follow-up-2 the mean BMI of the control group was significantly higher than that of the experimental group (Figure 4.2, Table 4.3). The mean within group change in weight and BMI over time (from Baseline to Follow-up-2) was also significantly higher in the control group (Table 4.4).

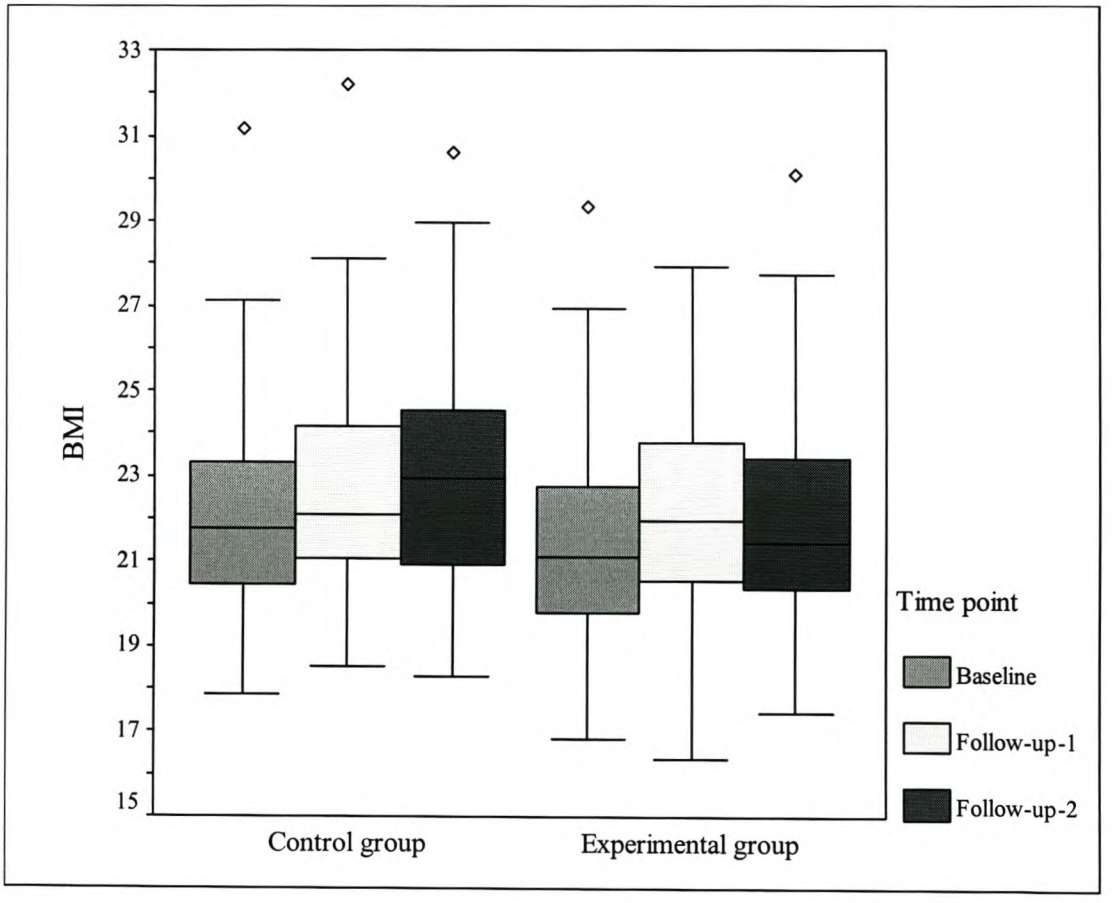

FIGURE 4.2: Boxplots of BMI of the control and experimental groups at each time point.

TABLE 4.3: Between group differences in mean±SD of anthropometric measurements at each time point as well as the within group change over time.

	Group:	Between group differences at†...			Within group change
		Baseline	Follow-up 1	Follow-up 2	
		C: n=78; E: n=95	C: n=71; E: n=81	C: n=78; E: n=95	P-value*
BMI	Control	22.1±2.5[a]	22.7±2.7[a]	23.0±2.7[a]	0.098
	Experimental	21.4±2.4[a]	22.1±2.4[a]	22.0±2.6[a]	0.115
		p=0.078	*p=0.158*	***p=0.018***	
Weight	Control	61.3±8.9[a]	63.2±9.6[a]	63.8±9.6[a]	0.231
	Experimental	59.5±7.8[a]	61.7±8.5[a]	61.2±8.2[a]	0.175
		p=0.167	*p=0.325*	*p=0.056*	
Height‡	Control	1.665±0.067	-	-	-
	Experimental	1.667±0.065	-	-	-
		p=0.784	-	-	
Triceps	Control	19.6±5.7[a]	21.7±6.0[a]	21.2±5.7[a]	0.062
	Experimental	18.6±5.5[a]	21.2±6.3[b]	19.7±6.0[a,b]	**0.018**
		p=0.271	*p=0.580*	*p=0.111*	
MAC	Control	27.1±2.6[a]	27.2±2.6[a]	27.3±2.8[a]	0.884
	Experimental	26.3±2.6[a]	26.9±2.5[a]	26.6±2.5[a]	0.370
		p=0.046	*p=0.415*	*p=0.091*	
WC	Control	71.1±6.7[a]	71.7±6.8[a]	72.4±7.2[a]	0.505
	Experimental	67.7±5.7[a]	70.5±6.0[b]	69.9±5.4[b]	**0.003**
		p=0.000	*p=0.279*	***p=0.011***[§]	
HC	Control	99.1±6.5[a]	99.2±6.1[a]	100.3±6.3[a]	0.458
	Experimental	96.0±6.4[a]	98.4±6.2[b]	98.8±6.5[b]	**0.005**
		p=0.002	*p=0.410*	*p=0.149*	
WHR	Control	0.718±0.05[a]	0.722±0.04[a]	0.722±0.05[a]	0.867
	Experimental	0.706±0.04[a]	0.717±0.04[a]	0.708±0.03[a]	0.120
		p=0.063	*p=0.513*	***p=0.026***[§]	

* One-way ANOVA for the within-group change overtime, means with the same letter do not differ significantly using Bonferroni post-hoc tests

† Independent sample t-test to calculate difference between the two groups

§ Levene's Test for equality of variances was $p<0.05$; t-test where equal variances are not assumed, was used.

‡ Height was not measured at Follow-up-1 and Follow-up-2

C = Control group

E = Experimental group

MAC = Mid-upper-arm circumference,

WC = Waist circumference,

HC = Hip circumference,

WHR = Waist-Hip-Ratio

TABLE 4.4: Between group differences in mean±SD change in anthropometric measurements within each group between time points.

	Group:	Mean±SD change between time points*		
		From Baseline to Follow-up-1	From Follow-up-1 to Follow-up-2	From Baseline to Follow-up-2
		C: n=71; E: n=81	C: n=71; E: n=81	C: n=78; E: n=95
BMI	Control	0.71±0.70	0.17±0.70	0.89±0.95
	Experimental	0.64±0.78	-0.05±0.70	0.59±0.95
		p=0.571	*p=0.061*	***p=0.039***
Weight	Control	1.98±1.99	0.46±1.97	2.48±2.70
	Experimental	1.79±2.20	-0.14±1.93	1.63±2.59
		p=0.587	*p=0.058*	***p=0.036***
Triceps	Control	2.41±3.46	-1.0±4.4	1.6±3.9
	Experimental	2.53±3.00	-1.2±4.1	1.1±3.5
		p=0.806	*p=0.708*	*p=0.393*
MAC	Control	0.10±0.94	0.1±1.3	0.2±1.4
	Experimental	0.43±0.91	-0.1±0.9	0.3±1.1
		p=0.028	*p=0.237*	*p=0.577*
WC	Control	0.52±3.74	0.8±3.1	1.3±3.4
	Experimental	2.61±3.26	-0.4±2.9	2.2±3.2
		p=0.000	***p=0.017***	*p=0.075*
HC	Control	0.38±3.08	0.8±2.6	1.2±3.6
	Experimental	2.08±2.89	0.8±2.3	2.8±3.1
		p=0.001	*p=0.951*	***p=0.001***
WHR	Control	0.002±0.037	0.002±0.029	0.004±0.030
	Experimental	0.012±0.035	-0.010±0.031	0.002±0.030
		p=0.104	***p=0.022***	*p=0.691*

*Independent sample t-test to calculate difference between the two groups

E = Experimental group

C = Control group

MAC = Mid-upper-arm circumference,

WC = Waist circumference,

HC = Hip circumference,

WHR = Waist-Hip-Ratio

When the median within-group change in mean BMI overtime is computed, the difference between the two groups is even more significant (Table 4.5). No significant differences were found between the mean or median BMIs of any of the seven residences at Baseline (Table 4.5). There were also no significant differences between the three control group residences for Baseline and Follow-up-2 mean or median BMI values or for the mean change from Baseline to Follow-up-2. This was also true for the four experimental group residences (Table 4.5).

TABLE 4.5: Mean±SD and median±SD BMI at Baseline and Follow-up-2 of each of the seven residences and the between group differences in mean±SD and median±SD change in BMI within each group between Baseline and Follow-up 2.

		Baseline		Follow-up-2		From Baseline to Follow-up-2	
Residences:	**n**	**Mean±SD**	**Median**	**Mean±SD**	**Median**	**Mean±SD change**	**Median change**
Control							
Residence 1	25	22.8±2.8	22.1	23.7±2.8	23.3	0.88±0.90	0.90
Residence 2	27	21.8±2.6	21.1	22.9±3.0	22.3	1.04±1.04	1.00
Residence 3	26	21.4±1.9	21.2	22.2±2.1	22.3	0.73±0.90	0.90
All 3 residences						0.88±0.16[a]	0.93±0.06[b]
Experimental							
Residence 4	26	21.6±2.6	21.2	22.2±2.8	21.6	0.59±0.80	0.45
Residence 5	23	21.3±1.8	21.5	21.8±2.1	21.1	0.50±0.99	0.40
Residence 6	28	21.4±2.5	20.7	22.1±2.6	22.2	0.65±1.17	0.70
Residence 7	18	20.9±2.8	20.6	21.6±2.8	21.0	0.63±0.84	0.55
All 4 residences						0.59±0.07[a]	0.53±0.13[b]

[a] Independent Samples t-test: significant difference (p=0.020) between the two groups for the within each group change in mean±SD BMI from Baseline to Follow-up-2 (95% Confidence Interval = 0.069 - 0.513).

[b] Independent Samples t-test: significant difference (p=0.004) between the two groups for the within each group change in median BMI from Baseline to Follow-up-2 (95% Confidence Interval = 0.195 - 0.622).

No significant differences were found between the two groups at any time point or within either of the two groups for the change over time for BMI classification according to cut-off points (Table 4.6). The BMI of the majority of students in the control and experimental groups could be classified as normal at Baseline. However, a non-significant decrease in the number of normal weight and an increase in the number of overweight FYFS occurred in both groups over time.

From Baseline to Follow-up 2, 7.7% (n=6) of the control group and 6.4% (n=6) of the experimental group moved from the normal to the overweight category by gaining a mean of 5.7±1.3 kg or 6.3±2.8 kg respectively. All the students in both groups who were classified as overweight at Baseline remained overweight for the duration of the study, except for one student in the experimental group, who became obese by gaining 1.7 kg. The only student in the control group who was classified as obese at Baseline remained obese for the duration of the study and no new cases of obesity occurred in this group. There were no obese students present in the experimental group at Baseline. All the students in the control group who were underweight at Baseline gained weight and moved to the normal weight category. The one student in the control group who was underweight at Follow-up-2 had a normal weight at Baseline, but lost 1.8 kg. Six of the seven students in the experimental group who were underweight at Baseline remained underweight. The seventh student moved to the normal weight category after gaining 0.9 kg.

TABLE 4.6: Column % for the categories of different anthropometrical measurements by treatment group at each data point

	Between group differences* at...						Within group change
	Baseline		Follow-up-1		Follow-up-2		
	C	E	C	E	C	E	Chi-square
	n=78	n=95	n=71	n=81	n=78	n=95	P-value*
BMI							
<18.5	3.8	7.4	0	4.9	1.3	6.3	
18.5-24.9	83.3	84.2	84.5	81.5	78.2	78.9	C: p=0.533 (df=6)§
25-29.9	11.5	8.4	14.1	13.6	19.2	13.7	E: p=0.697 (df=6)§
≥30	1.3	0	1.4	0	1.3	1.1	
	p=0.464 (df=3)§		p=0.195 (df=3)§		p=0.318 (df=3)§		
Triceps skinfold							
<9.5	0	2.1	0	2.5	0	1.1	C: p=0.798 (df=2)§
9.5-33.5	97.4	97.9	95.8	95.1	97.4	96.8	E: p=0.598 (df=4)§
>33.5	2.6	0	4.2	2.5	2.6	2.1	
	p=0.130 (df=2)§		p=0.348 (df=2)§		p=0.650 (df=2)§		
WC							
<0.80 cm	93.6	96.8	87.3	92.6	85.9	91.6	C: p=0.368 (df=4)§
80.0-87.9cm	2.6	3.2	9.9	6.2	10.3	8.4	E: p=0.315 (df=4)§
≥88cm	3.8	0	2.8	1.2	3.8	0	
	p=0.153 (df=2)§		p=0.536 (df=2)§		p=0.138 (df=2)§		
WHR							
<0.8	93.6	97.9	94.4	98.8	93.6	98.9	C: p=0.975 (df=2)§
≥0.8	6.4	2.1	5.6	1.2	6.4	1.1	E: p=0.815 (df=2)§
	p=0.149 (df=1)†		p=0.145 (df=1)†		p=0.066 (df=1)†		

*Pearson's Chi-Square test unless otherwise indicated; df = degrees of freedom

§ One or more cells have expected counts less than 5: interpret p-value with caution.

†Fisher's exact test

E = Experimental group

C = Control group

WC = Waist circumference

WHR = Waist-Hip-Ratio

Other anthropometric measurements

No significant differences were found between the two groups for mean triceps skinfold at any time point (Table 4.3). The mean triceps skinfolds of both groups increased initially and then decreased toward the end of the study, but remained above Baseline levels in both groups. The triceps skinfold of almost all the students in both groups fell into the normal weight category based on triceps percentiles (Table 4.6). No significant changes in this regard were found within the groups over time (Table 4.6).

The control group had a significantly higher mean MAC at Baseline, but this difference disappeared thereafter (Table 4.3). The mean MAC of both groups increased initially, but between the groups this change was significantly higher in the experimental group (Table 4.4). Thereafter, from Follow-up-1 to Follow-up-2 a decrease in mean MAC was experienced by experimental students, while a further increase was evident for control students, resulting in a similar increase in both groups for the total intervention period (Table 4.4).

At Baseline the control group had a significantly higher mean WC and HC than the experimental group (Table 4.3). These differences disappeared at Follow-up-1, but reappeared at Follow-up 2 for WC. The experimental group initially experienced a significantly larger increase in WC than the control group, but the opposite is true for the last five months of the intervention (Table 4.4), although the final WC of the experimental group was significantly higher at Follow-up-2 than at Baseline (Table 4.3). The mean within group change in WC overtime did not differ significantly between the two groups (Table 4.4). The HC increased consistently overtime within both groups (Table 4.3), but the change within each group was significantly higher in the experimental than the control group (Table 4.4)

The mean WHR was not significantly different between the two groups at Baseline and Follow-up-1, but was significantly higher in the control group at Follow-up-2 (Table 4.3). A non-significant increase in the WHR occurred in the control group while an increase followed by a decrease occurred in the experimental group (Table 4.3). Consequently the within-group change over time did not differ significantly between the two groups initially (from Baseline to Follow-up-1), or over the total intervention period (from Baseline to Follow-up-2) but did differ significantly during the last five months (from Follow-up-1 to Follow-up-2). Most students in both groups fell in the low-risk category for both WHR and WC (Table 4.6), with no significant between-group differences at each time point or within group differences over time.

Weight-related issues

At Baseline about two-thirds of the FYFS in both groups felt that their weight was normal with the remainder feeling that they were overweight (Table 4.7). Although more FYFS from both groups perceived themselves as overweight at Follow-up-2, this change within each group was not significant over time. There were also no significant differences between the two groups at any time point.

The weight goals of both groups were similar at Baseline, with more than 80% wanting to lose some weight (Table 4.7). At Follow-up-1 a trend was already noticeable that fewer control students and more experimental students were satisfied with their weight than at Baseline. This difference became significant at Follow-up-2. The number of students who wanted to lose between 1 and 3 kg remained almost the same throughout the year in both groups, but the number wanting to lose ≥4 kg increased in the control group and decreased in the experimental group. These within-group changes over time were however non-significant.

Only a few students from both groups indicated that they were on a weight-reduction diet when data were collected at Baseline (Table 4.7). No significant between-group differences were found at any time point and only a non-significant increase is evident within both groups at overtime.

Approximately half the students in both groups had tried to lose weight in the two years before coming to university. However, only a fifth in both groups attempted to lose weight during the first three months at university. This figure was more than doubled by the end of the study. Although the experimental group tended to be less inclined to attempt to lose weight at Baseline and Follow-up-2, these differences were non-significant.

Students in both groups seemed to be equally unsuccessful with their weight-loss attempts during the intervention period, as 14.3% of control students and 20.0% of experimental students ($p=0.535$) indicated at Follow-up-2 that they did actually lose weight with their weight-reduction attempts.

TABLE 4.7: Column % for weight-related issues by treatment group at each time point. [Γ]

	Between group differences at...*						Within group change
	Baseline		Follow-up-1		Follow-up-2		
	C	E	C	E	C	E	P-value*
Perception of current weight	*n=77*	*n=94*	‡	‡	*n=78*	*n=95*	
Underweight	1.3	0	-	-	1.3	0	C: p=0.466 (df=2)[§]
Normal	61.0	73.4	-	-	51.3	60.0	E: p=.0.051 (df=1)
Overweight	37.7	26.6	-	-	47.4	40.0	
	p=0.148 (df=2)[§]				*p=0.310 (df=2)*[§]		
Weight goals							
	n=78	*n=95*	*n=70*	*n=81*	*n=78*	*n=94*	
Satisfied	15.4	16.8	14.3	22.2	11.5	21.3	
Lose 1-3 kg	46.2	52.6	41.4	49.4	43.6	52.1	C: p=0.776 (df=6)[§]
Lose ≥4 kg	38.5	30.5	42.9	28.4	44.9	26.6	E: p=0.893 (df=4)
Weight gain	0	0	1.4	0	0	0	
	p=0.546 (df=2)		*p=0.158 (df=3)*[§]		***p=.028 (df=2)***		
Currently on weight reduction diet	*n=78*	*n=95*	*n=70*	*n=81*	*n=78*	*n=95*	
Yes	2.6	1.1	5.7	6.2	5.1	5.3	C: p=0.605 (df=2)[§]
No	97.4	98.9	94.3	93.8	94.9	94.7	E: p=0.175 (df=2)[§]
	p=0.426 (df=1)[†]		*p=0.591(df=1)*[†]		*p=0.622(df=1)*[†]		
Tried to lose weight...							
	...past two years		*...since baseline*		*...since baseline*		
	n=78	*n=95*	*n=71*	*n=79*	*n=78*	*n=95*	Not applicable
Yes	57.7	43.2	19.7	20.3	50	43.2	
No	42.3	56.8	80.3	79.7	50	56.8	
	p=0.057 (df=1)		*p=0.935 (df=1)*		*p=0.369 (df=1)*		

[Γ] n varies due to missing values

*Pearson's Chi-Square test unless otherwise indicated; df = degrees of freedom

[§] One or more cells have expected counts less than 5: interpret p-value with caution.

[†] Fisher's exact test

‡ Question was not included in questionnaires at Follow-up 1

E = Experimental group

C = Control group

Weight-loss methods

The different weight-loss methods used by the FYFS during the intervention period are summarized in Table 4.8. The majority of students who did try to lose weight used either a balanced slimming diet, increased physical activity, eating less or nothing between meals and/or skipping one or more meals as weight loss methods. Significantly more students in the experimental group used a balanced slimming diet than those in the control group. Almost all students from both groups who tried to lose weight used increased physical activity as a weight-loss method, with more students in the experimental group indicating that this method was successful. Although not significant, more students in the control group skipped one or more meals in order to lose weight, with the experimental group tending to find this method more successful. More than three quarters of students from both groups attempted eating less or nothing between meals in order to lose weight, with the experimental group also tending to find this method more successful. Very few FYFS (< 3 in a group) used other methods such as fasting, slimming clubs, ketogenic diets, fad diets, appetite suppressants, vomiting, diet formulas, milkshakes, powders or herbal mixtures and machines or apparatus which break down fat. Significantly more students in the experimental group indicated that they found these other methods to be successful or partially successful. Weight-loss methods that were not used by any of the FYFS include diuretics, laxatives and injections.

TABLE 4.8: Row %‡ of the weight-loss methods used during the total intervention period and self-reported success with the particular weight-loss methods by treatment group at Follow-up-2.

Number of students that were on a weight-loss diet: C=39 and E=40		% students using a methods		Successful with weight-loss method					
				Yes		Partially		No	
Weight-loss method	**Group**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Balanced slimming diet	C	10	25.6	2	20.0	7	70.0	1	10.0
	E	20	50.0*	3	15.0	14	70.0	3	15.0
		***p=0.026** (df=1)*				*p=0.894 (df=2)*§			
Increased physical activity	C	35	89.7	8	22.9	25	71.4	2	5.7
	E	31	77.5	15	48.4	13	41.9	3	9.7
		p=0.142 (df=1)				*p=0.052 (df=2)*§			
Skip one or more meals	C	16	41.0	3	18.8	11	68.8	2	12.5
	E	10	25.0	5	50.0	3	30.0	2	20.0
		p=0.130 (df=1)				*p=0.143 (df=2)*§			
Eat less or nothing between meals	C	29	74.4	4	13.8	20	69.0	5	17.2
	E	32	80	10	31.3	17	53.1	5	15.6
		p=0.550 (df=1)				*p=0.263 (df=2)*§			
Slimming clubs	C	1	2.6	0	0	0	0	1	100
	E	2	5.0	1	50	1	50	0	0
		p=0.510 (df=1)†				*p=0.223 (df=2)*§			
Low carbohydrate/ High protein diet	C	0	0	-	-	-	-	-	-
	E	2	5.0	2	100	0	0	0	0
		p=0.253 (df=1)†				-			
Other methods: Fasting, fad diet,	C	12	30.8	0	0	6	50.0	6	50.0
appetite suppressants, vomiting, diet	E	11	27.5	6	54.5	4	36.4	1	0.09
formulas, milkshakes, herbal mixtures		*p=0.749 (df=1)*				***p=0.007** (df=2)*§			

‡ % who reported Yes, the remainder not indicated answered No

*Pearson's Chi-Square test unless otherwise indicated; df = degrees of freedom

§One or more cells have expected counts less than 5: interpret p-value with caution.

†Fisher's exact test

E = Experimental group

C = Control group

Reasons for eating

Prevalence for eating due to reasons other than hunger ranged from 25% to 75%, with no significant differences or even non-significant trends between the two groups at any time point or within each group over time (Table 4.9). The most prominent reasons for eating other than hunger included being bored, while studying, when not hungry, due to a lack of self-control, because others do and due to stress before an exam or test. More than half of the students in both groups also felt that they usually ate too much.

TABLE 4.9: Column %‡ for the reasons why FYFS eat by treatment group at each time point.*

	Baseline		Follow-up-1		Follow-up-2	
	C	E	C	E	C	E
Inclined to eat...	***n=78***	***n=95***	***n=70***	***n=81***	***n=78***	***n=95***
While studying	53.8	65.3	67.1	71.6	67.9	64.2
When frustrated	44.9	38.9	42.9	40.7	47.4	44.2
Because others do	52.6	49.5	48.6	44.4	57.7	52.6
When not hungry	66.7	66.3	55.7	61.7	60.3	62.1
When bored	76.9	78.9	77.1	76.5	64.1	71.6
When stressed	39.7	32.6	47.1	37.0	37.2	36.8
When problems arise	30.8	25.3	27.1	22.2	34.6	27.4
Lack of self-confidence	51.3	47.4	58.6	48.1	56.4	45.3
Stress before exam/tests	42.3	48.4	42.9	39.5	47.4	42.1
Too much	58.4	58.5	56.3	61.7	55.1	61.1

‡ % who reported Yes, the remainder not indicated answered No

*Pearson's Chi-square test was p>0.05 for all between- and within-group analysis (p-values not included in table)

Dietary intake from food groups

At Baseline the experimental group had a significantly higher mean intake from the grains group than the control group (Table 4.10). The food items responsible for this difference included a higher intake of bread (p=0.005), pasta (p=0.004) and potatoes (p=0.007) by experimental group. The difference in mean grains intake between the two groups disappeared over time. However, the mean within group change in grains intake over time was significantly different between the two groups (Table 4.11). This is attributable to the fact that the experimental group significantly decreased their intake of starch over time, while the intake of the control group did not change significantly over time (Table 4.10).

No significant differences were found between the two groups for mean fruit and vegetable intake at any time point (Table 4.10). Within both groups a non-significant decrease in mean vegetable intake and a highly significant decrease in mean fruit intake were found over time (Table 4.10). However, the mean within-group changes in vegetable and fruit intake over time was not significantly different between the two groups (Table 4.11).

TABLE 4.10: Between-group differences in mean±SD of gram intake of specific food groups at each time point as well as the within-group changes over time. †

Food group	Group	Between-group differences‡ at...						Within-group change
		Baseline		Follow-up-1		Follow-up-2		
		n	Mean±SD	n	Mean±SD	n	Mean±SD	P-value*
Grains	C	71	188.0±102.4	64	196.0±108.4	77	190.7±146.8	p=0.927
	E	81	240.3±120.2[a]	75	217.1±110.3[a,b]	89	195.8±114.0[b]	**p=0.044**
			p=0.005		*p=0.259*		*p=0.799*	
Vegetables	C	73	190.5±181.0	67	164.0±118.3	77	144.7±97.1	p=0.123
	E	89	206.8±139.3	77	167.3±118.4	89	167.0±131.3	p=0.071
			p=0.518		*p=0.868*		*p=0.220*	
Fruit	C	71	521.1±376.8[a]	67	416.0±323.6[a,b]	76	354.7±263.7[b]	**p=0.008**
	E	90	564.8±440.0[a]	76	494.6±433.6[a,b]	89	394.3±257.8[b]	**p=0.013**
			p=0.507		*p=0.227*		*p=0.332*	
Milk &	C	72	236.4±188.3	67	210.5±148.3	77	224.1±164.4	p=0.663
Cheese	E	85	230.0±143.9	76	250.7±161.1	89	237.9±159.6	p=0.695
			p=0.810		*p=0.124*		*p=0.586*	
Meat, Fish	C	67	132.6±104.3	66	129.3±72.0	77	124.1±76.3	p=0.883
& Chicken	E	85	163.7±100.1	75	148.1±214.1	89	121.3±78.5	p=0.129
			p=0.064		*p=0.496*		*p=0.814*	
Fats	C	72	14.3±17.1	67	11.6±10.7	77	14.3±13.9	p=0.427
	E	89	18.5±19.0	75	15.7±20.0	89	14.1±14.0	p=0.249
			p=0.147		*p=0.125*§		*p=0.946*	
Fast foods	C	71	56.5±34.0	68	55.6±48.6	77	52.1±41.1	p=0.796
	E	89	58.1±50.4	76	59.1±115.3	89	52.7±56.7	p=0.847
			p=0.819		*p=0.818*		*p=0.939*	
Beverages	C	48	188.7±166.2	67	158.1±188.1	77	168.3±173.7	p=0.657
	E	89	207.0±201.7[a]	76	126.9±174.7[b]	89	143.8±142.3[b]	**p=0.008**
			p=0.592		*p=0.306*		*p=0.318*	
Other	C	68	119.6±58.1	68	148.6±88.1	77	127.8±64.2	**p=0.050**
	E	83	142.8±80.1	74	141.3±118.9	88	132.8±100.5	p=0.783
			p=0.041§		*p=0.680*		*p=0.708*	

‡ Independent sample t-test to calculate difference between the two groups

* One-way ANOVA for the within-group change overtime, means with the same letter do not differ significantly using Bonferroni post-hoc tests

§ Levene's Test for equality of variances was p<0.05; t-test where equal variances are not assumed, was used.

† n vary due to missing values

E = Experimental group

C = Control group

TABLE 4.11: Between-group differences in mean±SD change in gram intake of specific food groups within each group between time points. ‡

		Mean±SD change between time points...*					
		Baseline to Follow-up 1		Follow-up 1 to Follow-up 2		Baseline to Follow-up 2	
		n	mean±SD	n	mean±SD	n	mean±SD
Grains	Control	59	5.6±94.8	63	-2.6±144.5	70	9.7±156.6
	Experimental	67	-24.2±90.1 *p=0.073*	72	-23.9±106.5 *p=0.326*	76	-49.2±118.9 *p=0.011*
Vegetables	Control	63	-26.3±136.0	66	-21.5±92.7	72	-44.8±132.8
	Experimental	75	-30.4±106.5 *p=0.844*	74	-13.8±95.6 *p=0.627*	84	-40.3±121.3 *p=0.823*
Fruit	Control	61	-100.6±395.6	65	-46.6±339.6	69	-189.3±387.9
	Experimental	75	-65.4±489.0 *p=0.651*	73	-100.9±438.3 *p=0.421*	85	-169.0±436.1 *p=0.764*
Milk & Cheese	Control	62	-23.4±170.2	66	12.1±181.3	71	-0.3±218.2
	Experimental	71	22.3±185.6 *p=0.144*	73	-7.4±176.1 *p=0.521*	80	5.7±172.0 *p=0.851*
Meat, Fish & Chicken	Control	56	-9.4±92.7	65	-4.4±53.7	66	-9.9±90.6
	Experimental	71	-7.5±227.8 *p=0.953*	72	-6.8±52.7 *p=0.797*	80	-42.1±82.9 *p=0.027*
Fats	Control	62	-2.2±18.4	66	3.1±13.2	71	0.86±20.2
	Experimental	73	-1.9±23.4 *p=0.932*	71	-1.7±14.8 ***p=0.049***	84	-4.4±18.6 *p=0.092*
Fast foods	Control	62	-0.96±50.4	67	-3.9±41.8	70	-4.6±43.2
	Experimental	74	9.5±122.0 *p=0.529*	72	0.14±38.4 *p=0.577*	84	-5.8±47.1 *p=0.872*
Beverages	Control	40	-29.6±197.0	66	5.7±135.6	47	-55.7±146.4
	Experimental	74	-56.7±125.5 *p=0.372*	72	11.0±162.9 *p=0.836*	84	-64.4±176.6 *p=0.776*
Other	Control	60	21.2±69.4	67	-18.9±85.7	67	1.7±56.8
	Experimental	68	-1.3±95.8 *p=0.136*	70	-16.6±122.3 *p=0.897*	77	-9.3±94.1 *p=0.406*

‡ n vary due to missing values

*Independent Sample t-test to calculate difference between the two groups

No significant differences were found between the two groups for mean milk and cheese intake at any time point (Table 4.10). There was also no significant change in mean intake within the two groups over time (Table 4.10).

The experimental group had a non-significant higher Baseline intake from the meat, fish and chicken group. This difference disappeared because a non-significant decrease in intake occurred within each

group over time (Table 4.10). This decrease over time within each group was significantly higher in the experimental than in the control group (Table 4.11).

No significant differences were found between the two groups for mean fat intake at any time point, although the fat intake of the experimental group tended to be higher than that of the control group at Baseline (Table 4.10). The fat intake of the control group initially decreased non-significantly but subsequently increased to reach baseline levels at Follow-up-2. The fat intake of the experimental group continued to decrease non-significantly throughout the intervention period (Table 4.10). The tendency for mean fat intake to remain stable in the control group, but decrease in the experimental group over time, led to a significant difference in the mean change from Baseline to Follow-up-1 between the two groups (Table 4.11).

No significant differences were found between the two groups for mean fast food and beverage intake at any time point. No significant change in mean fast food intake over time was found for either of the two groups (Table 4.10). The mean intake of beverages by the control group did also not change over time. However, a highly significant decrease in mean beverage intake occurred in the experimental group (Table 4.10). Despite the latter, the mean within-group change in either fast food or beverage intake over time was not significantly different between the two groups (Table 4.11).

At Baseline the experimental group had a significantly higher mean intake from the "other" food group, but this difference disappeared over time. This was due to a non-significant decrease in mean intake from this food group by the experimental group over time and a significant increase in mean intake by the control group over time (Table 4.10). These within-group changes over time did not differ significantly between the two groups (Table 4.11).

Physical activity

The control group had a significantly higher mean score for the work index (WI) at Baseline (Table 4.12). This difference disappeared over time because the control group experienced an initial significant decrease in the score of the WI, while the mean WI score of the experimental group remained similar over time (Table 4.12). The mean within-group changes in WI score initially and over time was also significantly different between the two groups (Table 4.13).

No significant differences were found between the two groups for the mean scores of the sport index or leisure-time index at any time point (Table 4.12). A non-significant decrease within the control group for mean sport index score was evident initially, while the experimental group had an initial non-significant increase (Table 4.12). Consequently, the mean within group change in sport index score from Baseline to Follow-up-1 was significantly different between the two groups (Table 4.13). Although these within group changes occurred, both groups returned to their respective Baseline physical activity levels at

Follow-up-2. Although there were no significant differences found for the mean leisure-time index score, both groups seemed to have become less physically active during leisure time over time.

TABLE 4.12: Between-group differences in mean±SD scores of the three categories (work index, sport index and leisure-time index) of the Baeke physical activity questionnaire at each time point as well as the within-group changes over time.

		Between-group differences‡ at...						Within-group change
		Baseline		Follow-up 1		Follow-up 2		
		n	Mean±SD	n	Mean±SD	n	Mean±SD	P-value*
Work index	Control	78	2.67±0.39[a]	70	2.37±0.42[b]	78	2.47±0.51[b]	0.000
	Experimental	93	2.40±0.41 *p=.000*	81	2.43±0.63 *p=.544*	93	2.41±0.40 *p=.450*	0.922
Sport index	Control	76	2.49±0.59	67	2.36±0.63	77	2.50±0.65	0.327
	Experimental	91	2.32±0.70 *p=.090*	75	2.36±0.64 *p=.987*	86	2.33±0.79 *p=.143*	0.936
Leisure-time index	Control	78	3.37±0.53	70	3.26±0.54	78	3.27±0.49	0.353
	Experimental	94	3.32±0.49 *p=.549*	81	3.22±0.65 *p=.671*	93	3.19±0.57 *p=.345*	0.247

‡ Independent Sample t-test to calculate difference between the two groups

*One-way ANOVA for the within-group change overtime, means with the same letter do not differ significantly using Bonferroni post-hoc tests

TABLE 4.13: Between-group differences in mean±SD change, in the scores of the three categories (work index, sport index and leisure-time index) of the Baecke physical activity questionnaire, within each group between time points.

		Mean±SD change between time points...*					
		Baseline to Follow-up 1		Follow-up 1 to Follow-up 2		Baseline to Follow-up 2	
		n	Mean±SD	n	Mean±SD	n	Mean±SD
Work index	Control	70	-0.31±0.45	70	0.10±0.47	78	-0.20±0.53
	Experimental	79	0.05±0.67 ***p=.000***	80	-0.02±0.68 *p=.209*	91	0.03±0.45 ***p=.003***
Sport index	Control	66	-0.16±0.55	66	0.18±0.49	75	-0.01±0.54
	Experimental	71	0.08±0.50 ***p=.010***	69	0.03±0.86 *p=.198*	82	0.05±0.84 *p=.589*
Leisure-time index	Control	70	-0.13±0.50	70	0.04±0.47	78	-0.10±0.51
	Experimental	80	-0.11±0.55 *p=.856*	80	-0.01±0.61 *p=.595*	92	-0.13±0.51 *p=.697*

*Independent Sample t-test to calculate difference between the two groups

Dissatisfaction with body parts

At Baseline and Follow-up-2 the control group were significantly more dissatisfied with the shape and size of their arms than the experimental group (Table 4.14). No other significant differences were observed between the two groups at any time point or for the within-group change over time. However, a non-significant increase in dissatisfaction with body parts was evident in both groups over time.

TABLE 4.14: Column %‡ of FYFS who are dissatisfaction with the shapes and sizes of different body parts by treatment group at Baseline and Follow-up 2.*

	Baseline		Follow-up-2	
	Control n=78	**Experimental n=94**	**Control n=78**	**Experimental n=94**
Dissatisfied with				
Arms	33.3	19.1	44.9	27.7
	p=0.034 (df=1)		*p=0.019 (df=1)*	
Stomach	57.7	52.1	70.5	56.4
Middle	44.9	30.9	48.7	39.4
Hips	42.3	30.9	51.3	43.6
Buttocks	66.7	59.6	59.0	63.8
Thighs	71.8	67.0	71.8	67.0
Calves	24.4	21.3	20.5	26.6

‡ % who reported Yes, the remainder not indicated answered No

* Pearson's Chi-square test only significant for those indicated, for all the other between- and within-group analysis p>0.05 (p-values not included in table)

Psychological well-being

The control group was significantly more concerned about their bodies at all three time points, as is indicated by mean BSQ scores (Table 4.15). A non-significant increase in mean BSQ scores over time for the control group and a non-significant decrease for the experimental group were evident. At Baseline significantly more experimental group students were "satisfied with their body shape", according to BSQ categories (BSQ<112) (Table 4.17). This difference between the two groups became more significant at Follow-up 2, because the percentage of students classified in the low BSQ category decreased non-significantly in the control group, but increased non-significantly in the experimental group over time.

No significant difference was found between the two groups for mean ASCS score at Baseline (Table 4.15). At Follow-up 2 the control group had a significantly lower self-concept than the experimental group. The mean within-group change in ASCS score over time was not significantly different between the two groups (Table 4.16). There were also no significant differences between the two groups for ASCS classification according to cut-off points at Baseline (Table 4.17). At Follow-up 2 this difference

between the two groups became significant as more students in the control group and fewer students in the experimental group were classified in the low ASCS category.

The difference between the two groups for mean EAT-26 scores (Table 4.15) and categories of the EAT-26 (Table 4.17) were non-significant at any time point. Although the control group experienced an increase and the experimental group a decrease in mean EAT-26 scores over time, these within-group changes were non-significant between the two groups (Table 4.16). At Baseline the majority of students from both groups were classified in the normal EAT-26 category. This number declined non-significantly in both groups over time (Table 4.17).

TABLE 4.15: Between-group differences in mean±SD scores of the ASCS, BSQ, EAT, GHQ at each time point as well as the within-group changes over time.

		Between-group differences[‡] at...			Within-group
		Baseline	Follow-up-1	Follow-up-2	Change
		C=78; E=95	C=70; E=81	C=78; E=95[†]	P-value*
BSQ	Control	91.0±33.5	92.6±32.9	92.7±35.3	*0.946*
	Experimental	80.3±25.7 *p=0.021*[§]	79.0±25.1 *p=0.010*[§]	79.6±25.1 *p=0.007*[§]	*0.982*
ASCS[Γ]	Control	71.6±12.2	-	71.2±14.1	*0.846*
	Experimental	73.8±10.3 *p=0.194*	-	75.0±10.4 *p=0.048*[§]	*0.431*
EAT	Control	7.9±8.9	8.4±9.2	8.4±9.2	*0.912*
	Experimental	7.2±8.3 *p=0.575*	6.7±7.8 *p=0.199*	6.7±7.8 *p=0.186*	*0.901*
GHQ	Control	9.9±4.2	9.3±5.0	8.2±5.6	*0.111*
	Experimental	9.2±3.8[a] *p=0.243*	8.5±4.4[a,b] *p=0.279*	7.5±4.3[b] *p=0.356*[§]	***0.025***

[‡] Independent sample t-test to calculate difference between the two groups

* One-way ANOVA for the within-group change overtime, means with the same letter do not differ significantly using Bonferroni post-hoc tests

[†] One student in experimental group did not complete the ASCS, EAT and GHQ and another one did not complete ASCS at Follow-up-2, therefore the n=94 for EAT and GHQ, n=93 for ASCS at Follow-up-2

[§] Levene's Test for equality of variances was p<0.05; t-test where equal variances are not assumed, was used.

[Γ] ASCS was not included in the battery of questionnaires at Follow-up-1

No significant differences were found between the two groups for mean GHQ scores (Table 4.15) and the number of students classified in different GHQ categories according to cut-off points (Table 4.17) at any time point. Although both groups experienced a decrease in the mean GHQ scores over time, this within-group change was only significant for the experimental group (Table 4.15). However, the mean within-group change in GHQ score over time did not differ significantly between the two groups (Table 4.16). In both groups the majority of students were classified in the high GHQ category at all three time points

(Table 4.17). Both groups experienced a significant within-group increase in the number of students classified in the normal GHQ categories over time, but this effect was more significant in the experimental group.

TABLE 4.16: Between-group differences in mean±SD change in the scores of the ASCS, BSQ, EAT, GHQ within each group between time points.

		Mean±SD change between time points...*		
		Baseline to Follow-up 1	**Follow-up 1 to Follow-up 2**	**Baseline to Follow-up 2**
		C=70; E=81	**C=70; E=81**	**C=78; E=95†**
BSQ				
	Control	1.59±20.9	0.06±20.0	1.6±26.3
	Experimental	0.85±16.0	-2.3±14.3	-0.7±19.9
		p=0.808	*p=0.402*	*p=0.509*
ASCS‡				
	Control	-	-	-0.4±7.7
	Experimental	-	-	1.3±6.9
				p=0.128
EAT				
	Control	0.51±5.99	0.1±5.0	0.5±5.8
	Experimental	-0.46±4.33	-0.5±5.7	-0.5±6.2
		p=0.262§	*p=0.485*	*p=0.251*
GHQ				
	Control	-0.94±4.61	-0.9±5.0	-1.6±4.8
	Experimental	-0.59±4.73	-1.2±4.9	-1.7±4.8
		p=0.647	*p=0.718*	*p=0.980*

* Independent Sample t-test to calculate difference between the two groups

† One student in experimental group did not complete the ASCS, EAT and GHQ and another one did not complete ASCS at Follow-up-2, therefore the n=94 for EAT and GHQ, n=93 for ASCS at Follow-up-2

‡ ASCS was not included in the battery of questionnaires at Follow-up 1

§ Levene's Test for equality of variances was $p<0.05$, t-test where equal variances not assumed was used.

BSQ=Body Shape Questionnaire

ASCS=Adolescent Self-Concept Scale

EAT=Eating Attitude Test

GHQ=General Health Questionnaire

TABLE 4.17: Column % for the categories of the BSQ, ASCS, EAT, GHQ by treatment group at each data point.

		Between-group differences* at...						Within-group Change
		Baseline		Follow-up 1		Follow-up 2		
		C	E	C	E	C	E	
		n=78	n=95	n=70	n=81	n=78	n=95[Γ]	P-value*
BSQ								
<112	Low	70.5	86.3	74.3	87.7	67.9	90.5	C: p=0.649 (df=4)
112-128	Medium	16.7	8.4	10.0	7.4	12.8	6.3	E: p=0.921 (df=4)[§]
>128	High	12.8	5.3	15.7	4.9	19.2	3.2	
		p=0.037 *(df=2)*		*p=0.064 (df=2)*		***p=0.000*** *(df=2)*		
ASCS[‡]								
<63	Low	19.2	13.7	-	-	25.6	11.8	C: p=0.392 (df=2)
63-78	Medium	46.2	44.2	-	-	35.9	51.6	E: p=0.597 (df=2)
>78	High	34.6	42.1	-	-	38.5	36.6	
		p=0.479 (df=2)		-		*p=**0.032** (df=2)*		
EAT								
<21	Normal	92.3	94.7	87.1	95.1	91.0	91.5	C: p=0.549 (df=2)
≥21	High	7.7	5.3	12.9	4.9	9.0	8.5	E: p=0.547 (df=2)
		p=0.365 (df=1)[†]		*p=0.084 (df=1)*		*p=0.915 (df=1)*		
GHQ								
<6	Normal	15.4	15.8	24.3	33.3	33.0	35.9	C: **p=0.013** (df=2)
≥6	High	84.6	84.2	75.7	66.7	67.0	64.1	E: **p=0.009** (df=2)
		p=0.942 (df=1)		*p=0.222 (df=1)*		*p=0.688 (df=1)*		

* Pearsons Chi-square unless otherwise indicated

[§] One or more cells have expected counts less than 5: interpret p-value with caution.

[†] Fisher's exact test

[‡] ASCS was not included in the battery of questionnaires at Follow-up 1

[Γ] One student in experimental group did not complete the ASCS, EAT and GHQ and another one did not complete ASCS at Follow-up-2, therefore the n=94 for EAT and GHQ, n=93 for ASCS at Follow-up-2

E = Experimental group

C = Control group

BSQ=Body Shape Questionnaire

ASCS=Adolescent Self-Concept Scale

EAT=Eating AttitudeTest

GHQ=General Health Questionnaire

Non-communicable diseases and the use of medications and supplements

No significant differences were found between the two groups for the prevalence of non-communicable diseases at Baseline and Follow-up-2 or within each group over time (Table 4.18). The self-reported prevalence of diseases such as coronary heart disease, high blood pressure, diabetes mellitus and high blood cholesterol was either zero or less than 2.1%. Only one student in the control group reported suffering from anorexia nervosa at Baseline, but did not indicate this again at Follow-up-2. In the experimental group one student reported that she was anorexic and bulimic at Baseline and Follow-up-2.

TABLE 4.18: Column %‡ of self-reported prevalence of certain non-communicable diseases by treatment groups at Baseline and Follow-up 2.*

	Baseline		Follow-up-2	
	Control n=78	Experimental n=95	Control n=78	Experimental n=94
Coronary heart disease	0	1.1	0	0
High blood pressure	0	1.1	0	1.1
Diabetes Mellitus	0	0	0	0
High blood cholesterol	1.3	0	0	2.1
Constipation	10.3	4.2	9.0	6.4
Anorexia Nervosa	1.3	1.1	0	1.1
Bulimia Nervosa	0	1.1	0	1.1
Other chronic diseases	9	5.3	6.4	4.3

‡ % who reported Yes, the remainder not indicated answered No

*Pearson's Chi-square test was $p>0.05$ for all between- and within-group analysis (p-values not included in table)

No significant differences were found between the two groups for the self-reported use of medicines at Baseline (Table 4.19). The reported use of insulin, hypoglycaemic substances and sleeping tablets was very low and remained stable during the study period. At Follow-up-2 significantly more students in the control group used anti-depressants. The control group also showed a significant within-group increase in the intake of tranquillisers over time. The experimental group showed a significant within-group increase in the use of oral contraceptives over time. A non-significant increase in the use of vitamins and minerals over time was evident within both groups. Almost two-thirds of the total sample indicated at Follow-up 2 that they had used such supplements.

No differences were found between the two groups for the number of students seeing a psychologist at Baseline and Follow-up-2. At baseline 1.3% (n=1) in the control group and 0% (n=0) in the experimental group indicated that they were currently receiving therapy from a psychologist. This percentage increased non-significantly to 5.1% (n=4) in the control group and 2.1% (n=2) in the experimental group at Follow-up-2.

TABLE 4.19: Column %‡ of self-reported prevalence of the use of medicines by treatment groups at Baseline and Follow-up 2.

	Between-group differences* at...				Within-group Change
	Baseline		Follow-up-2		
	C n=78	E n=95	C n=78	E n=94	P-value*
Tranquillisers	0	2.1	6.4	3.2	C: **p=0.029** (df=1)†
	p=0.300 (df=1)†		*p=0.262 (df=1)*†		E: p=0.495 (df=1)†
Anti-depressants	3.8	1.1	9.0	1.1	C: p=0.191 (df=1)
	p=0.240 (df=1)†		***p=0.017** (df=1)*†		E: p=0.495 (df=1)†
Oral contraceptives	17.9	11.6	24.4	25.5	C: p=0.327 (df=1)
	p=0.236 (df=1)		*p=0.860 (df=1)*		E: **p=0.014** (df=1)
Vitamins and minerals	59	51.6	62.8	62.8	C: p=0.623 (df=1)
	p=0.331 (df=1)		*p=0.994 (df=1)*		E: p=0.120 (df=1)

‡% who reported Yes, the remainder not indicated answered No

*Pearson's Chi-Square test unless otherwise indicated; df = degrees of freedom

†Fisher's exact test

Smoking

The prevalence of smoking among control group participants was 7.7% (n=6) at Baseline. Two of these FYFS (2.6%) stopped smoking during the study period, while a further 5.1% (n=4) started smoking. Similar figures were found for the experimental group, namely 7.4% (n=7) smoked at Baseline, while 1.1% (n=1) stopped and a further 5.4% (n=5) started smoking during the study period. No significant differences were found between the groups or within a group over time. The number of students who did not smoke at all during their first eight months at university was 87.2% (n=68) in the control group and 87.1% (n=82) in the experimental group.

Drop-outs

No significant differences between the drop-outs (n=187, 52%) and FYFS who completed the study (n=173, 48%) were found at Baseline for BMI, weight, height, middle circumference, hip circumference, waist-hip-ratio, triceps skinfold, mid-upper arm circumference, scores of the ASCS, BSQ, GHQ. The drop-outs had a significantly higher mean EAT score (p=0.031). No significant differences were found between the drop-outs (n=91, 54%) and non-drop-outs (n=78, 46%) in the control group at Baseline for any of the variables, except the GHQ, for which the score was significantly higher in the non-drop-out group. As far as the experimental group is concerned, the drop-outs (n=96, 50%) had a significantly higher waist circumference, triceps skinfold and BSQ score and a significantly lower ASCS score than the non-drop-outs (n=95, 50%).

TABLE 4.20: Comparisons of the mean±SD between the baseline data of drop-out vs. non-drop-outs in the control and experimental groups

	Control group			Experimental group		
	Drop-out	Non-drop-out	p	Drop-out	Non-drop-out	p
BMI	21.8±3.0	22.1±2.5	0.463	21.9±2.5	21.4±2.4	0.130
Weight	60.0±9.0	61.3±8.9	0.339	61.0±8.2	59.5±7.8	0.218
Height	1.660±0.064	1.665±0.067	0.667	1.666±0.064	1.667±0.065	0.883
WC	71.0±6.1	71.1±6.7	0.912	69.5±6.3	67.7±5.7	0.040
HC	99.1±7.5	99.0±6.5	0.971	97.2±6.5	96.0±6.4	0.197
Triceps	19.6±6.2	19.6±5.7	0.987	20.4±5.6	18.6±5.5	0.027
MAC	26.8±2.8	27.1±2.6	0.518	26.8±2.6	26.3±2.6	0.166
BSQ	86.7±35.5	91.0±33.5	0.415	92.0±33.0	80.3±25.7	0.006
ASCS	72.7±10.7	71.6±12.2	0.540	69.9±16.0	73.8±10.3	0.046
EAT	9.7±8.8	7.9±8.9	0.199	9.4±9.8	7.2±8.3	0.086
GHQ	8.1±3.8	9.9±4.1	0.005	9.4±3.9	9.2±3.8	0.683

* Independent Sample t-test to calculate difference between the drop-outs and non-drop-outs.

Evaluation of the Manual

Most of the students (86.7%) in the experimental group did indicate that they feel that female students want to be helped with the prevention of weight gain. Forty percent (n=38) indicated that they did use the Manual, 49.5% (n=47) did not use it and 10,5% (n=10) did not give an answer. The mean within group change in BMI from Baseline to Follow-up-1 (first three months of study) was similar (p=0.977, Independent Sample t-test) for those students in the experimental group who indicated that they had used the Manual (n=31, mean BMI change = 0.72 kg/m^2) and those who indicated that they had not used the Manual (n=42, mean BMI change = 0.73 k/m^2). However, those who did not use the manual went on to gain a further mean of 0.13 kg/m^2 (n=42) over the last five months of the study. On the other hand, those who did use the manual lost a mean of 0.26 kg/m^2 (n=31) over the last five months. The mean within-group change in BMI for the total duration of the study (Follow-up-2 – Baseline) was therefore significantly higher (p=0.004, Independent Sample t-test) in the group who did not use the Manual (n=47; mean BMI change = 0.89 kg/m^2) than in the group who did use the Manual (n=38; mean BMI change = 0.37 kg/m^2.

A fifth of the students who indicated that they did not read the Manual, however, did indicate that they did sometimes page through it, but did not use it thoroughly (Table 4.21). The most frequently indicated reasons why the FYFS did not use it was that they had no time or did not feel it was necessary, since they were not worried about their weight or were not interested in such information (Table 4.21). The mean within-group change in BMI over time (from Baseline to Follow-up-2) was significantly (Independent Sample t-test: p=0.004) higher in the group that did not use the Manual (n=BMI change = 0.89) than among those who did use it (n=38; BMI change = 0.37).

TABLE 4.21: Reasons why the Manual was not used (Multiple answers; n=47).

Reasons	n	%
No time, to busy with studies, social activities, sport, others things to do	29	59.2
Uninterested, no problems with weight, happy with weight	17	36.2
Read it sometimes, not thoroughly	10	21.3
Forgot about it	9	19.1
Know all the information	4	8.5
Lazy to read it	3	6.4
Do not want to become more aware of weight; already conscious of weight	3	6.4
Too much information in book	2	4.3

More than half of the students (53.9%) thought that they should have been reminded to use the Manual during the course of the year. On a scale of 1-10 a mean±SD score of 5.9±2.4 was recorded for whether they thought the Manual was a good idea as an intervention. Motivation supplied by the students for their answer indicates that most thought it was a good idea, mostly because it supplies guidelines, suggestions and solutions to help them manage their weight (Table 4.22). Only 20.5% indicated that there might be other methods that could work better, many of which involve face-to-face or group contact (Table 4.23). Other comments regarding the intervention are indicated in Table 4.24.

TABLE 4.22: Motivation for answer to "Do you think the Manual was a good idea?" (Multiple answers; n=86)

	n	%
Good idea	51	59.3
address problems, gives good guidelines, suggestions and solutions, reminds to eat healthy, to exercise (n=13)		
helps to manage weight (n=7)		
help those who are desperate, who have eating disorders, who have problems with weight (n=10)		
indicate why weight is gained, what to do about it, put weight gain in perspective (n=7)		
no reason (n=14)		
Not interested, happy with weight	9	10.5
No time	6	7.0
Too much information	5	5.8
Should explain it more	5	5.8
Already know everything	3	3.5
Makes one more aware of weight, makes one worry	3	3.5
No reason indicated	20	23.5

TABLE 4.23: Other methods that can work better to address weight management (Multiple answers; n=16)

Proposed methods	n	%
Talks, course or day session on weight management, information sessions, seminars, PowerPoint talks as introductory talk	5	31.3
Information on what food to eat, diet methods, drinks that make you fat	4	25.0
Exercise programmes, exercise groups	3	18.8
More healthy food from residence	3	18.8
Buddy system, seniors to motivate and guide us	2	12.5
More motivation	1	6.3

TABLE 4.24: Other comments (Multiple answer question; n=20)

Other comments	n	%
Good idea, project, interesting,	9	45.0
Questionnaire takes too long to complete	6	30.0
Too much information in book, rather give less at several times, small booklets from which one can choose	4	20.0
Give more practical information: diet plan, healthy food to keep in room, what must be excluded	3	15.0
Tell more what is in book, explain better how to use it in longer session, advertise it more	3	15.0

DISCUSSION

The use of the self-help weight management manual (the Manual) over a period of eight months had a significant positive effect on the weight status of FYFS at the University of Stellenbosch. The control group experienced almost a full unit change in BMI (0.93 kg/m^2), while the intervention over eight months limited this change to 0.53 kg/m^2 among the experimental group. This represents a mean weight gain of 2.48 kg for the control group and 1.63 kg for the experimental group. The effect of the Manual was confirmed even further by the fact the FYFS in the experimental group who did not use the manual had a significantly higher change in BMI than the FYFS in the experimental group who did use the manual. This change in BMI (0.89 kg/m^2) among those in the experimental group who did not use the Manual was also more comparable to the change in BMI experienced by the control group. The change in BMI found for control group students was similar to what was expected, if compared to results reported by Senekal (1988b; 1994), who reported on a longitudinal follow-up of female students from their first to their fourth year in 1987 to 1990 at the same university. Senekal (1994: 237) found that the FYFS (n=111) who participated for the full four-year period also experienced a one unit increase in BMI from 20.9 to 21.9 during their first three months at university. The students who participated in the study for the first three months (n=316), but eventually dropped out in the follow-up of the study also experienced a 1.1 kg/m^2 increase in BMI during the first three months (Senekal, 1994: 237). The mean

weight gain reported for the first three months was 2.91 kg for those students (n=111) who participated for the full four-year period and 3.05 kg for the group (n=316) who only participated in the first year of the survey (Senekal, 1994: 231). Although slightly higher, these levels of weight gain were definitely more similar to that experienced by the control group than the experimental group in the current study. The four-year longitudinal follow-up also revealed that the mean BMI of the students always remained above the level of what it was in the beginning of their first year (Senekal, 1994: 237).

When compared to international trends the weight gained by the FYFS during 1987 and the control FYFS in this research seems to be slightly higher than the figures reported for American students. Although popular beliefs in the USA would like to ascribe higher weight gains to FYFS (between 10 -15 lb), actual figures are much lower, although often based on small sample sizes. Anderson *et al.* (2003) reported a mean increase in weight of 1.7 kg over a nine-month period during the first year of male and female students (n=46). Graham and Jones (2002) found the mean change in weight among male and female students (n=49) during their first year at college to be a loss of 0.7 kg, while 59% of the sample gained a mean of 2.1 kg. Both these studies did not differentiate between genders, although Anderson *et al.* (2003) reported that gender had no effect. Hodge *et al.* (1993) reported a mean weight gain of 0.4 kg for FYFS (n=61) over the first six months at university. These authors also reported that 30% of the sample had gained >1.8 kg and this sub-group's mean weight gain was 3.3 kg. Eighteen percent had lost >1.8 kg and this sub-group's mean change in weight was a loss of 2.5 kg, while the weight of 52% of the sample did not change (Hodge *et al.*, 1993). In a recent large cohort study it was found that the weight gain experienced by women between the ages 20 to 30 years over a five-year period was 11 kg (Rothacker & Blackburn, 2000). Although this is much higher than was experienced by our control group, the period of time must be taken into account. The duration of our study was approximately one year, while the study by Rothacker & Blackburn (2000) was conducted over a five-year period. Therefore, if the weight gain of 11 kg is divided by five, it represents a gain of 2.2 kg per year, which is actually lower than the increase in weight (2.48 kg) of the control group. This argument is further supported by the fact that in the longitudinal follow-up of FYFS by Senekal (1994) it was found that the mean weight gain of the total group (n=111) was 2.85 kg, while a third of the group (n=35) gained a mean of 7.3 kg over the four-year period.

The only other published weight-gain-prevention study that could be traced that involved students studying at a tertiary institution was a four-month intervention for FYFS in the form of a college nutrition science course (Matvienko *et al.*, 2001). The mean BMI of the intervention group (n=21) remained at 24.6 during the four months and was similar (24.5) 16 months after Baseline (n=18). The mean BMI of the control group increased from 23.7 to 24.1 after four months (n=19) and then to 25.2 after 16 months (n=15). This represents a weight gain of 1.8 kg at four months and 3.2 kg at 16 months for the control group. However, these changes were not significant and, although the increase in BMI among the control group is higher than that experienced in our study, the small initial sample size (n=40) and attrition over the 16-month period could be the reason why the tests were not significant. The authors did, however, report that among students with a BMI>24 (n=17), those in the intervention group (n=11) were able to

maintain their Baseline weight, while those in the control group (n=6) gained a significantly higher weight of 9.2±6.8 kg after the 16-month period (Matvienko *et al*, 2001).

The two Pound of Prevention studies focussed on the prevention of weight gain among adults with the use of low-intensity monthly newspapers. The first Pound of Prevention study found a significant difference in weight after 12 months intervention with programme participants experiencing a mean change in weight of -0.95 kg compared to -0.14 kg for the no treatment control group (Forster *et al.*, 1988). For the second Pound of Prevention study, however, Jeffery and French, (1997, 1999) found no significant difference between the two intervention groups or the control group regarding their weight changes after one year or three years. The increase in weight experienced by the different intervention groups ranged from 0.23 kg to 1.47 kg, while the increase in weight among the control group ranged from 0.59 kg to 0.63 kg.

In contrast to the findings of Matvienko *et al.* (2001), the patterns in weight change experienced during the eight-month period of this study revealed that both groups experienced a similar increase in weight for the first three months at university. This was also true for those students in the experimental group who indicated that they had used the Manual. However, after the initial three months and more specifically those who had used the Manual, the experimental group were able to decrease their weight during the last five months of the intervention, while the control group and those in the experimental group who did not use the Manual, continued to gain weight, which reflects the significant overall impact of the Manual. It could be possible that the change from high school to university, with its associated decreases in psychological well-being (Page & Fox, 1998; Sax, 1997), self-concept and other related effects (Hesse-Biber & Marino, 1991), is initially so traumatic that the FYFS were unable to manage their weight effectively during the first few months at university, despite the implementation of the intervention. However, after that initial phase, during which they had time to adapt to their new environment, the effect of the Manual is reflected in the decrease in BMI that was evident in the experimental group. The initial tendency to gain weight should not be overlooked and it may be possible that a more high-intensity approach should be considered for the implementation of the Manual during the first three months. High-intensity intervention involving face-to-face consultations, a computerised intervention and a workbook was found to be more effective in helping older (±50 years) subjects to lose weight than the workbook (based on self-help principles) alone in a study conducted by Wylie-Rosett *et al.* (2001). However, these authors pointed out that the self-help approach was cheaper and that the amount of staff time devoted to training and clinical supervision exceeded the level potentially available in most managed care settings (Wylie-Rosett *et al.*, 2001). The large FYFS numbers (n=2021) at the University of Stellenbosch and the limited opportunities available to access these students personally or even in groups, especially during their first six weeks on campus (Personal communication, 2001, Prof PG Du Plessis, Dean of Student Affairs, University of Stellenbosch, South Africa) could have a negative effect on the feasibility of a high-intensity option, even if only for the first three months.

Jeffery and French (1999) speculated on reasons why their low-intensity intervention in the form of monthly newsletters (a self-help approach) was not effective in creating a difference in weight change between the intervention and control group as was found for the first Pound of Prevention study. These authors indicate that strong incentive manipulation (where money was subtracted from an intervention group participant if weight gain was experienced) and the characteristics of the sample, who were from high socio-economic status (SES), may have contributed to the success found in the first Pound of Prevention programme. It was, however, indicated that a monthly newsletter is cost effective and that these letters were reportedly read for long periods of time. They recommended that attention could be given to increase the effectiveness of the delivery format, for example, by increasing the frequency of messages (biweekly and not only monthly). Similar recommendations were put forward by the FYFS in the experimental group of the current study as methods to improve the effectiveness of the Manual. They suggest that, instead of supplying the complete Manual at the beginning of the year, sections could be supplied throughout the year. This may be effective if the complete Manual is introduced at the beginning of the year and then made available chapter by chapter as per request of the students or that chapters should, for example, be supplied on a biweekly bases.

Changes in BMI could have an effect on body composition, with weight gain usually associated with increased fat stores if physical activity levels remain constant or decrease (Laquatra, 2000: 504). However, the results of this study do not clearly illustrate this possibility. Both groups experienced weight gain during the first three months accompanied by increases in triceps skinfold, MAC, WC and HC, which are all indicators of fat stores or body fat distribution. The increases in some of these indicators were significantly higher in the experimental group, although they gained less weight. This phenomenon can most probably not be explained by the possibility that the larger weight gains experienced by the control group were due to increased lean body mass, which in turn is linked to increased physical activity levels. Results of the Baecke questionnaire showed that the control students were more inclined to reduce their physical activity levels during the initial period, while the experimental group tended to experience an increase in physical activity.

During the last five months of the study the control group continued to gain weight, while the mentioned indicators of fat stores/ distribution either remained constant (MAC), or decreased (triceps), although never to levels below Baseline values, or they increased (WC and HC). On the other hand, the experimental group lost weight during this period, while all the indicators of fat stores/ distribution, except HC also seemed to decrease. The control group eventually ended up with a non-significantly higher within-group increase in triceps skinfold for the entire period, but with a significantly lower within-group increase in HC for the same period than the experimental group. The experimental group also experienced a significant within-group increase in WC and HC over the entire period. Due to these changes and the fact that the WC and HC of the control group were significantly higher than those of the experimental group at Baseline, the reliability of the HC and WC measures should possibly be questioned. In contrast to the findings of this study, Senekal (1988b) found significant increases in

triceps skinfolds, WC and HC for the 72.8% of FYFS who had gained weight during their first three months at university, indicating that the total body fat levels of the students had increased.

As was the case in the study by Senekal (1988b), the mean WHR of both groups in this study was not indicative of increased risk for the development of chronic diseases of lifestyle at any time point. The mean WC, which is currently considered to be a better predictor of disease risk, especially among women (Rankinen *et al.*, 1999; Turcato *et al.*, 2000), was also below the cut-off point of 0.8 cm, which is indicative of low risk, for both groups at all time points. For both groups only a small number of students had an increased risk for the development of diseases according to the categories of the WHR and WC, which also did not change after weight gain had been experienced. The self-reported prevalence of diseases also indicated that almost none of the students suffered from chronic diseases of lifestyle such as diabetes mellitus, heart disease, hypertension and hypercholesterolemia at the time of the intervention. This was expected, as research indicates that the increases in weight will not immediately result in the development of chronic diseases of lifestyle, but that this will rather occur later in adulthood (Krummel, 2000: 597).

The WHO recommends that, for the evaluation of obesity-prevention programmes, it is important not only to consider the mean changes in BMI, but also the changes in obesity prevalence (WHO, 1998: 189). The weight of most of the FYFS was normal throughout the study and the weight gain experienced did not necessarily cause overweight and definitely not obesity. Although the increases in the number of students classified as overweight did not differ significantly between the two groups, it tended to be higher in the control group. It is also evident that there was a continuous rise in the number of overweight students in the control group throughout the intervention, while the increase occurred only in the first three months for the experimental group, after which the number classified as overweight stabilised. This also reflects positively on the impact of the Manual on the weight-management efforts of FYFS during the last five months as no increases in the percentage of students classified as overweight or obese occurred during this period in the experimental group. Senekal (1988b) found an increase in overweight FYFS after their first three months at University from 6.7% to 15.2% and in obese students from 0.95% to 1.6%. This increase of 8.5% in the percentage of overweight students is more in line with the 7.7% increase in overweight students found in the control group of our study than with the 5.3% increase found in the experimental group. Large cohort studies indicate that weight gain during young adulthood does not necessarily cause obesity at that time point, but that continued increases in weight will rather cause obesity later in adulthood (Rothacker & Blackburn, 2000; Braddon *et al.*, 1986; Williamson *et al.*, 1990). Senekal (1994) also found no changes in the number of obese students during the four-year follow-up of the FYFS. Therefore, longer follow-up periods will be needed to determine the effect of the Manual on overweight or obesity incidence later in life.

Although only about 10% of the FYFS from both groups were classified as overweight according to BMI categories at Baseline, a third perceived themselves as overweight, more than 80% wanted to lose weight and about half indicated that they tried to lose weight in the two year before entering university. In both

groups a rise in the number of students who perceived themselves as overweight occurred, which could be related to the weight gain experienced by both groups during the initial intervention period. However, after the total intervention period students in the experimental group were more satisfied with their weight and were less inclined to want to lose ≥4 kg. It can therefore be said that the Manual had a positive effect on the weight goals of the experimental students, which could be attributable to smaller rises in BMI at all time points and their success in decreasing their initial weight gain. The emphasis that is placed in the Manual on formulating reasonable weight goals could also have played an important role. The more extreme weight loss goals of the control students could also possibly be linked to their higher body shape concerns as is reflected by the results of the body shape questionnaire (BSQ). However, the fact that BSQ scores remained reasonably constant in both groups over the entire intervention period, despite being significantly lower in the control group from the onset, does put some doubt on the possible link between BSQ and weight dissatisfaction and weight goals. The fact that the students from both groups seemed to be equally dissatisfied / satisfied with different body parts and that no changes occurred in these perceptions over time also supports the possibility that the link between body shape concerns and weight goals was not strong in our study population. This is in contrast with findings among black FYFS in South Africa, which indicate that significantly more students who were concerns about their body shape (according to the medium and high BSQ categories) were inclined to set future weight loss goals of ≥4 kg than students in the low BSQ category.

As far as weight reduction attempts are concerned, the literature indicates that when female samples are assessed at a specific point in time, the general trend that emerges is for between 42% and 64.5% of them to have attempted weight reduction in the recent past or to be on a diet at that time point (Cogan *et al.*, 1996; Page & Fox, 1998; Senekal, 1988b; Senekal *et al.*, 2001; Striegel-Moore *et al.*, 1989). The results of the previous work done among FYFS at the University of Stellenbosch followed a similar pattern with 59.5% attempting to lose weight during their second year, 50.5% during their third year and 41.4% during their fourth year (Senekal, 1994: 273). However, the initial figures for both control and experimental groups that emerged from this study are considerably lower. Only about a fifth of the students in both groups indicated that they had attempted to reduce their weight during the first three months of the study. These figures did rise during the last five months, especially in the control group. Senekal (1994: 272) found that the ability of a female student to maintain a constant weight throughout her university career was associated with being less inclined to attempt weight reduction when compared to students who gained weight continuously, who were weight cyclers or whose weight did not remain constant. The results of the current study support this notion, because the FYFS in the control group were more inclined to attempt weight reduction, which can be linked to their pattern of weight gain. On the other hand, the FYFS in the experimental group were less inclined to attempt weight reduction, which could be linked to the fact that the mean weight of the group was more constant over the total period.

The experimental group was more inclined to be successful when they attempted to lose weight, which is reflected in the fact that they were able to decrease their weight after the initial weight gain that was experienced during the first three months. Significantly more FYFS in the experimental group used a

balanced slimming diet as a weight loss method. Increased levels of physical activity and eating less or nothing between meals were other methods used to lose weight by most students from both groups, but the number of students who reported that the methods were successful always tended to be higher in the experimental group. These results could be seen as a reflection of the impact of the Manual, as in-depth guidelines are provided for the planning of a well-balanced weight-reduction diet, the increase of physical activity as well as behavioural techniques to facilitate the implementation of the necessary changes. The weight reduction methods used by the experimental group also seemed to be better than was reported for other student groups (Douglas *et al.*, 1997; Hendricks *et al.*, 1998; Kurtzman *et al.*, 1989; Page & Fox, 1998; Striegel-Moore *et al.*, 1989), which further supports the possible value of the Manual. However it may also be possible that students at this university may not be inclined to use extreme methods as low frequencies were also reported by Senekal (1994: 276). Senekal (1994: 276) did, however, indicate that students who gained weight continuously during their university career were more inclined to use such methods.

The changes in weight status experienced by the students may also be related to observed changes in the intake from the different food groups. First, the intake from the starch food group remained unchanged for the control group, but decreased significantly for the experimental group. The fruit intake decreased significantly in both groups, while the vegetable intake decreased non-significantly in both groups. No major changes were observed for the intakes of fats, fast foods or milk and cheese food groups for either of the two groups. The intake of food items from the meat, fish and chicken food group remained unchanged for the control group, but decreased non-significantly for the experimental group. A significant increase in the intake of food from the "other" food group, which mostly contains high-fat, energy-dense and sugar-based foods (such as doughnuts, cookies, cake, energy bars, ice cream, chocolate, muffins), and a non-significant increase in the intake of beverages (such as wine, cider, beer, soft drinks, energy drinks) were evident for the control group. However, the experimental group was characterised by a significant decrease in beverage intake and a non-significant decrease in foods from the "other" food group. Although the food frequency data do not necessarily represent a complete 24-hour intake, the observed changes strongly point to the possibility that the control group maintained a higher energy intake over the study period than the experimental group. Intake from the grains; meat, fish and chicken; "other" and beverage groups was most probably the most important contributor to this difference. These findings are in accordance with the findings of Senekal (1988b: 222) that the weight gain experienced by FYFS is related to increased total energy intake; increased intake of bread, rusks, cheesecake, sweets and chocolates; added sugar, milk powder and total fat. Matvienko *et al.* (2001), found that after four months the intervention group also consumed fewer kilojoules (due to changes in carbohydrate and protein intake) than the control group, but this difference disappeared at the 16-month follow-up. Jeffery and French (1999) reported that declines found for energy and fat intake over a three-year period tended to be higher among the intervention groups.

The decrease in fruit and vegetable intake in both groups is a matter for concern. It is not clear at this point whether this decrease is, for example, due to a decrease in availability of fruits and vegetables,

preparation methods for vegetables that are different from what the students were used to, a general deterioration in eating patterns or over-reporting at Baseline. As the dietary sections in the Manual emphasize the need to consume at least the minimum recommendation from each food group, the low fruit and vegetable intake by the experimental group could indicate that this message was either not emphasised strongly enough or that the type of factors mentioned above made it difficult for the students to implement the guidelines.

Although students were inclined to eat for various reasons other than hunger – such as while studying, when bored and because others eat – no significant differences were found between the two groups and no changes seemed to have occurred over time. Previously it was shown that FYFS who gained more weight during their first three months at university did eat more often while studying, due to problems, because others eat, when not hungry, due to tests and examinations, and felt that they usually eat too much (Senekal, 1988b: 203-213). The author indicated that these habits could have contributed to an increase in total energy intake and could therefore be associated with the weight gain of the FYFS (Senekal, 1988b: 203-228). The lack of relationship between adverse eating habits and the weight status of FYFS in the current study could indicate that it is not so important to address this particular type of issue in prevention interventions. However, we would not recommend this type of action at this stage.

As far as physical activity is concerned, the levels of the control group tended to be higher during Baseline than those of the experimental group. However, the experimental group did manage to maintain the same level of physical activity throughout the year, while that of the control group decreased during the first three months. The control group seemed to increase their physical activity levels towards the end of the year and in the end these levels even tended to be slightly higher than those of the experimental group. These changes are definitely not in line with the weight changes that were experienced by the FYFS. The initial weight gain experienced by the experimental group, despite maintaining their initial levels of physical activity, could indicate that increases in energy intake occurred which were not countered by increased physical activity. On the other hand, if the fact that the physical activity levels of FYFS (both recreational and participation in competitive sport) have been shown to decrease significantly from the period before they come to university to their first three months at university (Senekal; 1988b) is considered, it can be speculated that the Baseline physical activity levels of the FYFS in this study were much lower than before and that this could have contributed to the initial weight gain experienced by both groups. The fact that the experimental group managed to reduce their weight during the last five months of the study, despite the fact that their physical activity levels remained relatively constant, indicates that these students were able to reduce their total energy intake, which is reflected in the changes that occurred in the dietary intake.

Senekal, (1988a,b) was also not able to link the weight change patterns by FYFS experienced during the first three months at university to the changes that occurred in physical activity levels. The longitudinal follow-up of these FYFS indicated that the physical activity levels of those students who continued to gain weight continued to decrease over the four-year period, while the levels of those students whose

weight remained constant seemed to maintain the highest level of physical activity over the years (Senekal, 1994). These results may also imply that the physical activity questions used by Senekal (1988b) or the Baecke questionnaire used in the current study were not sensitive enough and that lack of physical activity should not be discarded as a possible cause of weight gain, but rather be investigated with more sensitive methods. However, validity testing of the Baecke questionnaire in similar and other age groups indicates that it is a reliable and valid method (Albanes *et al.*, 1990; Baecke *et al.*, 1982; Cauley *et al.*, 1987; Jacobs *et al.*, 1993; Miller *et al.*, 1994; Pols *et al.*, 1995; Richardson *et al.*, 1995). It is suggested that these tests could be repeated using FYFS at the University of Stellenbosch to confirm their suitability for this type of study population.

It is well recognised that dissatisfaction with weight and unsuccessful weight loss attempts could contribute to the development of a poor self-concept (Foreyt *et al.* 1995). It can be argued that the weight gain experienced by FYFS and the inability of some to rectify the situation could have had a similar effect. The results of this research support such a possibility. Although the self-concept of the two groups were similar at Baseline, that of the control group declined over time while that of the experimental group improved. Consequently, the control group had a significantly lower self-concept at the end of the study period. Hesse-Biber and Marino (1991) indicated that the transition from high school to university is accompanied by a decline in self-concept among FYFS. Although we did not measure the self-concept of the students before they entered the university, the possibility that Baseline levels were already decreased due to the transition they experienced could also be a reason why both groups initially experienced an increase in weight.

Hesse-Biber and Marino (1991), who investigated eating patterns and eating disorders among college women over a two-year period, reported that a decline in self-concept was associated with the worsening of eating-related problems over time. Others also indicated that high EAT scores had a significantly lower self-concept (Abrams *et al.*, 1993; Nelson *et al.*, 1999), more body shape concerns and decreased psychological well-being (Abrams *et al.*, 1993; Nelson *et al.*, 1999). The mean EAT score for both groups in this study was in the normal range and the prevalence of high scorers between 7-12.9% at the different time points, which was slightly higher than that reported for female students who participated in a four year follow-up study (6.3-7.2%) (Senekal, 1994: 298). The prevalence of abnormal eating attitudes and behaviour (EAT-26) among the students in this study was somewhat lower than data reported for similar groups where prevalences range from 20% (Nelson *et al.*, 1999), 21.9% (Stephens *et al.*, 1999), 18% (Brookings & Wilson, 1994) to 17% (Prouty *et al.*, 2002). The relationship found by Senekal (1994) between the EAT score and weight-management abilities, namely that more of the students who gained weight were inclined to have higher EAT-scores than those who were able to maintain their weight, was not evident from the current study. There were no significant differences between the two groups at any time point and the scores were also constant for the duration of the study. The low self-reported prevalence of eating disorders in the present study supports the possibility that abnormal eating behaviour

and attitudes and eating disorders are not a major cause for concern in the study population, not even after weight gain has occurred.

The lack of general psychological well-being of the FYFS who participated in this study is definitely a matter for concern. Decreased levels of psychological well-being are expected among university students, first because they are in the socio-demographic age span in which the rates of psychological distress and disorders such as depression are more elevated than the rest of the adult population (Adlaf *et al.*, 2001; Robert *et al.*, 1999); second, the transition from high school, which is especially problematic for some, could also be a cause of elevated levels of distress (Adlaf *et al.*, 2001; Rolfes *et al.*, 1998: 321). Several authors have reported on a high prevalence, ranging from 17.6% to 57%, among first-year students studying at tertiary institution being classified as having poor psychological well-being (Adlaf *et al.*, 2001; Aktekin *et al.*, 2001; Humphris *et al.*, 2002; Martinez *et al.*, 1999; Ko *et al.*, 1999). The mean GHQ score of the current study population was above the threshold indicative of poorer psychological well-being at Baseline and this score remained above the threshold during the entire study period in both groups. It did, however, decrease significantly in the experimental group and tended to decrease in the control group. This notion is also supported by the decrease in the number of students classified as high scorers (indicative of poorer psychological well-being) over time. This decrease was significant in the experimental group. The tendency of the control group to have a poorer psychological well-being is also reflected by the fact that at the end of the study period it was evident that the control group was more inclined to use tranquillisers and anti-depressants. It can be speculated that the sections in the Manual on stress management, problem solving and decision making, conflict management, assertiveness and management of peer pressure, and management of the environment, contributed to the ability of the experimental group to improve their psychological well-being more effectively than the control group could. Effective stress-management skills are important for effective weight management, as those who are unable to cope with stress could overeat in order to alleviate their stress (Senekal *et al.*, 1999). This could have been the situation in the control group and provide a possible explanation as to why the weight of these students continued to increase. It can also be speculated that the weight gain experienced by the control group could have contributed to their poorer psychological well-being at the end of the study.

It has also been reported that the psychological well-being of students is the poorest during their first year and the best during their final year of study (Adlaf *et al.*, 2001). Although the psychological well-being of female students at the University of Stellenbosch was not assessed during the students' first year 15 years ago, and the study population of the current study were not assessed beyond their first year, a similar trend can be observed if these two data sets are considered together. The psychological well-being of the FYFS seems to be seriously compromised at the beginning of their university career (current study); it seems to improve over the course of their first year (current study) and to continue improving in subsequent years (1988-1990) (Senekal, 1994). Although the number of high scorers in the current study decreased over time (84% at Baseline for total group), Senekal (1994) reported a much lower prevalence in the second year (41.4%) , after which it decreased further to 39.6% in the third year, but an increase to

45.1% in the fourth year was evident (Senekal, 1994: 305). Although psychological well-being might improve in subsequent years of study as indicated by this argument, it is important to bear in mind that almost half of the students still suffer from poor psychological well-being in their fourth year. This was also reported by Adlaf *et al.* (2001).

Individual assessment of the Manual by the experimental group shows that there is definitely a need among FYFS to be helped with their weight-management-related problems. The Manual was used extensively by 40% of the experimental students, was rated as an acceptable idea, but more than half of the experimental students indicated that they should have been reminded to use the Manual during the year. This supports the possibility mentioned earlier that it would perhaps be more effective if the Manual is rather supplied chapter by chapter. This will also decrease the possibility that FYFS will forgot about it in the first place, as many of the FYFS indicated "forgetting" as a reason why they did not use the Manual. Other reasons why students indicated that they did not use the Manual focussed on time constraints (too much studying and social activities), the fact that some were already satisfied with their weight and were thus not interested in the Manual, unwillingness to be made more aware of their weight and the perceived volume of information that had to be read. Another point that was made by some is that they just paged through he Manual now and then and did not use it thoroughly.

A fifth of the students indicated that they felt that other methods could work better than the Manual. These proposed methods included mainly presentations or talks throughout the year to make them aware of weight management related topics. The possible use of presentations or talks is, however, not supported by the fact that time constraints were the reason indicated by most of the students as to why they did not use the Manual. The buddy-system, which refers to the strategy where second-year students in the residence provide FYFS with weight-management information in group sessions and work with them to achieve their goals, was also suggested as a possible alternative method. We feel that such a method could work effectively to implement the Manual, especially during the first few months at university, to motivate FYFS to ensure healthful eating and the maintenance of adequate levels of physical activity. However, the use of second-year students would require intensive training of such students on the weight-management-related aspects included in the Manual in order to enable them to support the FYFS effectively. Further investigation on this possibility should be considered. The fact that a few of the FYFS in the experimental group indicated that other methods that should be considered included information on healthy foods, high energy drinks, personal food plans points to the possibility that they either did not understand or did not read the Manual properly because all these topics were addressed. Providing healthy meals in the residence's cafeteria as a weight-management method was also mentioned. However, Senekal (1988b), found that the meals supplied by the residences were not related to the weight gain experienced by FYFS, but rather what was eaten between meals. The Manual was therefore generally well accepted by the experimental group and effectively used by a subgroup of the experimental group.

Finally, it is important to consider the fact that there was a large drop-out of 52% during the study period of eight months. This could have led to bias in the data, although most weight-management intervention studies have to contend with the same problem (Pratt, 1990; Yeh *et al.*, 2003). One of the possible reasons for this situation in our study is that FYFS in the experimental group who completed the individual assessment of the intervention mentioned that many of their friends did not come to the follow-up evaluations because the questionnaires were too long and not "nice" to complete. However the final sample in both the experimental and control groups (n=173) was much larger than was included in the one other prevention intervention aimed at students studying at tertiary institutions, namely n=40 (Matvienko *et al.*, 2001). The bias in our study was possibly limited as comparisons of the baseline data of drop-outs with non-drop-outs revealed no significant differences regarding key variables. Therefore, despite the limitations imposed by the attrition rate, we feel that the results of this study make an important contribution to knowledge in the field of self-help manuals for weight management as very little has been published on selective obesity-prevention interventions, with the Manual most probably being the first of its kind.

CONCLUSIONS AND RECOMMENDATIONS

Although a low-intensity intervention, the self-help weight management manual was effective in limiting weight gain among FYFS. Furthermore, it is feasible method to address weight-management-related issues within the context of the number of students that need to be reached and the time framework of FYFS available for intervention initiatives. Factors that are possibly linked to success attained with the Manual (positive predictors of weight gain prevention, successful weight reduction) include more reasonable weight goals, the use of sound weight-reduction methods such as a balanced diet and physical activity; improvements in self-concept; maintenance of physical activity, especially during the first three months at university; improvement in general psychological well-being, decreased intake of foods from the "other", beverage and grains food groups, and possibly the less body shape concerns from the start. Factors for which no link with weight management success could be established (non-predictors of weight gain prevention, successful weight reduction) include change in body composition, perceptions of weight, weight loss attempts, reasons for eating, foods from the vegetables; fruit; milk and cheese; meat, fish and chicken; fast foods and fats food groups; physical activity over the total eight-month period, dissatisfaction with body parts, eating attitudes and behaviour, and body shape perceptions. However, this does not mean that these issues should not receive attention in selective obesity-prevention interventions.

It is recommended that the implementation of the Manual on the campus of the University of Stellenbosch to prevent weight gain of FYFS should be considered. Alternative strategies for the improvement of the implementation of the Manual such as chapter-by-chapter provision of the Manual and buddy systems should be considered in the execution of the implementation. Although the assessment of the Manual involved only students in residence on the Stellenbosch campus, it can also be

targeted at the wider student population. The implementation of the Manual to address the weight-management needs of non-student adult populations could also be investigated.

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CHAPTER 5

GENERAL DICUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL DISCUSSION

Obesity is increasing at an alarming rate world-wide and has been described by the World Health Organization as one of the most neglected public health problems of our time (WHO, 1998). Obesity prevalence among South African adult women from all ethnic groups is very high (SADHS, 1998; SAHR, 2002). Due to this rise in obesity prevalence, the associated adverse effects of obesity on health and the limited success experienced with treatment options, more emphasis is currently being placed on the development of strategies or programmes **to prevent** the development of overweight and obesity in the first place (Müller *et al.*, 2001). Prevention strategies can be implemented at three different levels, of which one is selective obesity-prevention interventions which targets high-risk groups who are not yet obese (Thomas, 1995: 159; WHO, 1998: 169). It is known that two thirds of obese adults become obese due to gradual increases in weight during adulthood (Braddon *et al.*, 1986; Dietz, 1994; IOM, 2003: 58). Large prospective cohort studies indicate that unwanted weight gain most commonly occurs between the ages of 18 to 34 years in both men and women (Braddon *et al.*, 1986; Burke *et al.*, 1996; Rothacker & Blackburn, 2000; Williamson *et al.*, 1990). First-year female students studying at the University of Stellenbosch have also been identified as a high-risk group in this regard (Senekal, 1988a; Senekal, 1988b; Senekal, 1994). A similar trend has been reported for FYFS in the USA. However, only one published weight-gain-prevention programme (selective obesity-prevention intervention) that aimed to address this problem among students could be traced (Matvienko *et al.*, 2001).

A four-year longitudinal follow-up of female students at the University of Stellenbosch revealed that a large percentage experienced weight fluctuations throughout their university careers (Senekal, 1994). Factors which might contribute to their inability to manage their weight effectively, such as a lack of realism about body weight, unnecessary and unsound weight-loss attempts, unrealistic weight goals, body image problems, abnormal eating attitudes, high levels of compromised psychological well-being, high levels of restrained emotional and external eating, poor eating habits and decreased levels of physically activity, were identified (Senekal, 1994: 359). It was recommended that a weight-management programme addressing these unique needs of the female students to prevent weight gain and to establish effective weight-management practices should be developed, implemented and evaluated (Senekal, 1994). The integration of the results of the four-year follow-up survey with an extensive search and assessment of the weight-management literature led to the development of a multidimensional weight-management paradigm which can be applied in the development of weight-management interventions (Senekal *et al.*, 1999). Subsequently, a self-help weight-management manual which follows the multidimensional approach proposed in the mentioned paradigm was developed to address the unique weight-management needs of female students.

The aim of the current study therefore was to evaluate the impact of the multidimensional self-help weight-management manual (the Manual) on the weight status and associated factors of FYFS at the University of Stellenbosch over an eight-month period. For this purpose a non-randomized quasi-experimental design was used, including purposively selected experimental and control groups. Data

were obtained from the experimental and control groups during February (Baseline), May (three months after baseline = Follow-up 1) and October 2002 (eight months after baseline = Follow-up 2). All students in the experimental group received the Manual at Baseline for use throughout the eight-month study period. Because this was a low-intensity intervention programme, no further contact was made with either group during the study period, except when Follow-up 1 data were obtained.

The baseline characteristics of the FYFS involved in this study, which did not differ between the experimental and control groups for all key variables, identified them as a typical group of young female adults (Anderson et al., 2003; Schulken et al., 1997; Schwitzer et al., 1998; Senekal, 1988b) who are healthy but are usually dissatisfied with their weight, inclined to perceive their weight as heavier than it actually is, have a desire to lose weight and have a history of past weight-loss attempts, which resulted in weight loss that was rarely maintained. Despite these indicators of dissatisfaction with weight and so forth, the eating attitudes and behaviours (EAT-26) and body shape perceptions (BSQ) tended to be normal. It is possible that these indicators may still change for the worse in the coming months and years, as was indicated in previous research (Hesse-Biber, 1992). Almost a fifth of the students had a poor self-concept (ASCS), while the majority of students seemed to be experiencing psychological distress (GHQ). This is also not unexpected, as it is well known that a change such as the transition from high school to a tertiary institution is associated with a decrease in self-concept and the development of psychological distress/ problems (Hesse-Biber & Marino, 1991; Page & Fox, 1998; Sax, 1997).

The baseline dietary intake of our study population seems to reflect that of female students at tertiary institutions (Hendricks & Herbold, 1998), including a high total fat and saturated fat intake as was reflected by the high intake of foods from the "other" food group and high-fat meat, fish and chicken food choices. Low intakes from the milk and cheese food group were also evident. However, their intake of fruit and vegetables was surprisingly high, which is not typical of student populations. The majority of the FYFS in this study had a normal BMI, which was also the case when the weight status of FYFS at the University of Stellenbosch was assessed in 1987. However, over the 15-year period the prevalence of overweight amongst FYFS increased from 6.7% to 10.0%, thus almost doubled. The results of the current study also indicate that weight-status-related problems affect students in the underweight, normal and overweight BMI categories. Therefore, interventions aimed at empowering these FYFS to manage their weight effectively should target all students, regardless of their BMI.

The implementation of the Manual was found to be significantly effective in limiting weight gain among the FYFS in the experimental group. The control group experienced almost a full unit change in BMI (0.93 kg/m^2), while the change found for the experimental group was 0.53 kg/m^2. This represents a mean weight gain of 2.48 kg for the control group and 1.63 kg for the experimental group. The change in mean BMI and weight experienced by the control group over the eight-month period was comparable to the change reported for FYFS who were not exposed to an intervention and who were assessed 15 years ago at the same university (Senekal, 1988b; 1994). The changes experienced by the control group in this study also correspond to the changes experienced by young females (ages 20-30 years) in the general

population (Rothacker & Blackburn, 2000). The impact of the Manual is further illustrated by the fact that the FYFS in the experimental group who indicated that they did use the Manual extensively experienced a significantly lower rise in their weight (change in BMI over study period = 0.37 kg/m^2) than those FYFS in the experimental group who indicated that they did not use the Manual (change in BMI over study period = 0.89 kg/m^2). In actual fact, the weight gain by the latter students was in line with that of the FYFS in the control group. These results clearly indicate that compliance plays an important role in the success of an intervention, as was indicated in the literature review.

The pattern of weight change over the intervention period revealed that both groups experienced a similar increase in weight for the first three months. After that the weight of the control group continued to increase, while the experimental group was able to decrease their weight during the last five months of the intervention. However, the initial tendency to gain weight and the fact that 49.5% of the experimental students indicated that they did not use the Manual should not be overlooked and a higher-intensity approach for the implementation of the Manual should be considered. The experimental students suggested that methods such as face-to-face presentations/ seminars/ courses and the buddy system could be used to improve the delivery of weight-management information. However, the fact that time constraints was the reason indicated by most of the students as to why they did not use the Manual, is a matter of concern if higher-intensity approaches are to be considered. The buddy system, which refers to a strategy where second-year students in residences could discuss the weight-management-related information in the Manual with FYFS in group sessions and work with them to achieve their goals, is a very viable option that should be investigated. However, the use of second-year students would require intensive training of such students on the weight-management-related aspects included in the Manual in order to enable them to support the FYFS effectively. Other implications of such an approach, such as time and financial aspects e.g. payment of second-year students, will also have to be investigated or need to be considered

According to the WHO, it is important not only to base the evaluation of the success of a weight-management programme on changes in weight status, but also to acknowledge changes in other weight-status-related factors influencing weight management (WHO, 1998: 189). To address this issue in the evaluation of the Manual, specific weight-status-related factors were selected based on the content of the Manual, which in turn was based on the unique weight-management needs of female students at the University of Stellenbosch (Senekal, 1994) and the key components that should be included in a weight-management programme, namely the formulation of reasonable weight goals, a healthful eating component, a physical activity component and a behavioural and psychological component. Indicators of these factors were monitored for the duration of the intervention, using appropriate published instruments or instruments developed specifically for this study.

The indicators of the component related to the formulation of reasonable weight goals indicate that the Manual had a positive effect on the weight goals of the experimental students. They were more satisfied with their weight and they were less inclined to want to lose weight, especially towards the end of the

intervention period, when compared to the control group. The smaller rises in BMI, the success in decreasing initial weight increases and the lower concern with body shape experienced by the experimental group, which are all issues that are addressed in different sections in the Manual, could have contributed to this result.

Although there was a distinct difference between the control and experimental groups as far as weight goals and satisfaction is concerned, this is not clearly reflected by the results relating to body shape concerns (BSQ). The control group was more concerned with their body shape throughout the study period. This could be linked to the more extreme weight loss goals of the control students, which are typically expected from young females and also FYFS (Senekal *et al.*, 2001). However, the BSQ scores remained reasonably constant in both groups over the entire intervention period and both groups seemed to be equally dissatisfied / satisfied with different body parts, despite the fact that the weight goals of the control students became more extreme (loss of ≥4 kg) and those of the experimental students improved. Therefore, the link between weight goals and body shape concerns did not seem as conclusive as had been reported by others. However, the possibility that the BSQ cut-off points which were applied in this study possibly need revision for application in general population samples should not be overlooked. It is therefore not clear at this point to what extent the section in the Manual concerning body image (part of the behavioural and psychological component) had an effect on the body shape concerns of the experimental students.

Actual weight reduction attempts can also be seen as a reflection of adherence to reasonable weight goals. If normal-weight individuals indulge in weight-reduction attempts, this could be seen as indicative of unreasonable weight goals. The same number of students in both groups tried to lose weight during the year. In both groups the number of students who tried to lose weight before they came to University and during their first year was much higher than the number who were actually overweight or obese at all times, indicating that many of the weight-reduction attempts are unnecessary. Weight-reduction prevalence was lower during the first three months of the study but more than doubled during the last five months, which could be due to the realization by the students that weight gain was experienced during the first three months. The number of students in both groups who tried to lose weight over the total study period was similar to that reported for female students 15 years ago at the same university and for female students from other universities (Cogan *et al.*, 1996; Page & Fox, 1998; Senekal, 1988b; Senekal *et al.*, 2001; Striegel-Moore *et al.*, 1989). It was also similar to the number of students who tried to lose weight in the two years before entering university. It is important to note that the experimental group was more inclined to be successful when they attempted to lose weight, which is reflected in the fact that they were able to decrease their weight after the initial weight gain that was experienced during the first three months. These results could therefore be seen as a reflection of the impact of the Manual, as in-depth guidelines are provided for the planning of a well-balanced weight-reduction diet, the increase of physical activity as well as behavioural techniques to facilitate the implementation of the necessary changes.

A further factor that might affect success with weight reduction is a history of weight loss attempts, which could predict failure with weight management (Thomas, 1995: 121). However, in our study both groups had similar histories regarding weight-loss attempts, indicating that the success of the experimental students was not negatively affected by their prior weight-loss attempts. It is also evident that the Manual had a positive effect on the weight-loss methods used (part of the dietary component), because more students in the experimental group used a balanced slimming diet to lose weight. Increased levels of physical activity and eating less or nothing between meals were other methods used to lose weight by most students from both groups, but the number of students who reported that the methods were successful always tended to be higher in the experimental group. The extreme weight-reduction methods used by the experimental group also seemed to be better than was reported for other student groups (Douglas *et al.*, 1997; Hendricks & Herbold, 1998; Kurtzman *et al.*, 1989; Page & Fox, 1998; Striegel-Moore *et al.*, 1989), which further supports the possible value of the Manual. However, it may also be possible that students at this university may not be inclined to use extreme methods as low frequencies were also reported by Senekal (1994: 276). Senekal (1994: 276) did, however, indicate that students who gained weight continuously during their university career were more inclined to use such methods.

As far as the dietary component is concerned, changes in the amount of food eaten from the nine food groups did occur in both groups during the year. Although the food frequency data do not necessarily represent a complete 24-hour intake, the observed changes strongly point to the possibility that the control group maintained a higher energy intake over the study period than the experimental group. The intake of items from the starch; fruit; meat, fish and chicken; and beverage food groups by the experimental group decreased significantly and food intake from the vegetable and "other" food groups tended to decrease. The control group only experienced a decrease in fruit intake and a non-significant decrease in vegetable intake, while their intake of foods from the starch and meat, fish and chicken food groups remained unchanged. However, their food intake from the "other" food group, which consists mostly of high-fat, energy-dense and sugar-based foods (such as doughnuts, cookies, cake, energy bars, ice cream, chocolate, muffins) increased significantly and their intake of beverages (such as wine, cider, beer, soft drinks, energy drinks) tended to increase. No major changes were observed for the intakes of fats, fast foods or milk and cheese food groups for either of the two groups. Therefore the changes in intake experienced by the control group seemed to be more similar to the findings of Senekal (1988b: 222), which indicated that the weight gain experienced by FYFS is related to increased total energy intake; increased intake of bread, rusks, cheesecake, sweets and chocolates; added sugar, milk powder and total fat. The continued use of a low fat diet is predictive of weight maintenance during and after participation in a weight management program (Klem *et al.*, 1997). It could therefore be speculated that the changes in the dietary intake of control students contributed to their inability to manage their weight effectively and the ability of the experimental group to be more effective weight managers. It is therefore possible that the section in the Manual on healthful dietary intake was especially effective in decreasing the intake of foods from the "other" food group as well as the intake of beverages. However, despite the emphasis in the Manual on consuming at least the minimum recommendation from each food group, a decrease in

fruit and vegetable consumption occurred during the year. Factors such as availability and acceptability of fruit and vegetables provided in the residences should be investigated as well as promoting fruit as healthy snack foods instead of items in the "other" food group.

Physical activity is deemed to be one of the most important components of weight-management programmes. It has been shown to be one of the best predictors of weight maintenance and of compliance with weight-management programmes (Bild *et al.*, 1996; Klem *et al.*, 1997; Sherwood *et al.*, 2000). The experimental group in this study did manage to maintain the same level of physical activity throughout the year, while that of the control group decreased during the first three months, but increased again during the last five months. These changes were not in line with the weight changes that were experienced by the FYFS. The initial weight gain experienced by the experimental group, despite maintaining their initial levels of physical activity, could indicate that increases in energy intake occurred which were not countered by increased physical activity. On the other hand, if the fact that the physical activity levels of FYFS (both recreational and participation in competitive sport) have been shown to decrease significantly from the period before they come to university to their first three months at university (Senekal; 1988b) is considered, it can be speculated that the Baseline physical activity levels of the FYFS in this study were much lower than before and that this could have contributed to the initial weight gain experienced by both groups. The fact that the experimental group managed to reduce their weight during the last five months of the study, despite the fact that their physical activity levels remained relatively constant, indicates that these students were able to reduce their total energy intake, which is reflected in the changes that occurred in the dietary intake. These results could be interpreted as an indication that more emphasis should be placed on energy restrictions than on increasing physical activity levels. However, due to possible limitations of the questionnaire that was used to assess physical activity levels, we feel that this type of conclusion is not warranted at this stage. It is also not completely clear whether the section in the Manual on physical activity had an effect on the physical activity levels of the experimental students, although it can be speculated that it helped them to maintain a constant level of activity throughout the intervention period.

As far as the behavioural and psychological component is concerned, it can be said that the ability of the experimental students to maintain their levels of physical activity, to consume less food from the "other" food group, which are mostly high-fat, energy-dense and sugar-based foods such as doughnuts, cookies, cake and rusks, and to reduce their weight effectively reflects better behavioural management. This ability could have been introduced or strengthened by the different sections in the Manual that focus on techniques for effective behaviour change. Furthermore, the self-concept of the experimental group tended to improve during the year, while that of the control group tended to become worse. Consequently, the experimental group had a significantly better self-concept at the end of the study period. The lower self-concept of control students could be related to the dissatisfaction with weight and unsuccessful weight-loss attempts as was experienced by this group, as has also been reported in the literature (Foreyt *et al.*, 1995). On the other hand, it is possible that the section in the Manual on

maintenance and improvement of self-concept contributed to the improvement of the self-concept experienced by the experimental students.

The eating attitudes of the students in both groups were similar and did not change during the intervention. The number of student classified as having disordered eating attitudes and behaviours was similar in both groups during the total study period and was lower than reported for other female students (Nelson *et al.*, 1999; Stephens *et al.*, 1999; Brookings & Wilson., 1994; Prouty *et al.*, 2002), but slightly higher than was reported 15 years ago for female students at the same university. The self-reported prevalence of anorexia nervosa (0.6%) and bulimia nervosa (0.6%) in our total study population is in line with the international figures of 0.3% for anorexia nervosa and 1.0% for bulimia nervosa (Hoek & Van Hoeken, 2003). This could indicate that disordered eating attitudes and behaviours are less of a problem among female students at the University of Stellenbosch than among students at American universities. These results may indicate that abnormal eating attitudes and behaviours and eating disorders are not a cause for concern in our study population, not even after weight gain has occurred. However, despite the low mean EAT-scores, students from both groups did seem to indulge in less acceptable eating behaviours, especially when being bored, while studying, when not hungry, due to a lack of self-control, because others do and due to stress before an exam or test. However, contrary to what was found in previous research (Senekal, 1994), these behaviours did not seem to be related to the weight status of the students. This is illustrated by the fact that there were no significant differences between the two groups at any time point and no changes occurred over the eight-month period. These results might lead to the conclusion that eating behaviours and attitudes need not be included in a weight-management intervention for female students. However, the concepts of healthful eating, appropriate eating behaviours and techniques to ensure appropriate behaviours are addressed as part of a number of chapters, which have been shown by some of the other results to be essential to the success of the experimental group. It may, however, be necessary to place more emphasis in the Manual on the recording of dietary intake and eating behaviour to identify triggers of less acceptable eating behaviours in order to ensure more positive results in this regard.

The lack of general psychological well-being of the FYFS who participated in this study is definitely a matter for concern. The majority of the sample seemed to experience poor psychological well-being throughout the year. The prevalence found in this study was also much higher than reported by others for student populations (Adlaf *et al.*, 2001; Aktekin *et al.*, 2001; Humphris *et al.*, 2002; Martinez *et al.*, 1999; Ko *et al.*, 1999). The psychological well-being did, however, improve significantly in the experimental group and tended to improve in the control group. The tendency of the control group to have poorer psychological well-being is also reflected by the fact that at the end of the study period it was evident that the students in the control group were more inclined to use tranquillisers and anti-depressants. It is therefore possible that the Manual could have contributed to the improvement in the psychological well-being of the experimental students. The sections on stress management, problem solving and decision making, conflict management, assertiveness, management of peer pressure, and management of the

environment may have been of specific value in this regard. It is also possible that the better weight status of the experimental group and their success with weight-loss attempts could have contributed to the improvements in psychological well-being. Previous research found that stress may contribute to ineffective weight management (Senekal *et al.*, 1999; Thomas, 1995: 121) and both these factors were found among control group students.

Finally, if the value of the total Manual is considered, the experimental students definitely felt a need to be helped with their weight-management-related problems. The Manual was rated as an acceptable idea and almost half of the experimental group indicated that they used it during the year. However, more than half of the students indicated that they should have been reminded to use the Manual, indicating that some form of additional interaction (=higher-intensity intervention) during the year might increase the impact of the manual even further. The possibility of considering higher-intensity strategies such as face-to-face sessions or the buddy system were also mentioned by students as ways of increasing the effectiveness of the Manual.

5.2 CONCLUSIONS AND RECOMMENDATIONS

From the results of this research it can be concluded that many factors influence the weight status of female students and that the weight gain typically experienced by FYFS indicates that they are not able to address these issues "unaided". An aid in the form of a self-help weight management manual (low-intensity selective obesity-prevention intervention) was effective in limiting weight gain among FYFS. Such a low-intensity approach is feasible to address weight-management-related issues within the context of the large number of FYFS who need to be reached and the time framework of FYFS available for intervention initiatives.

Factors that are possibly linked to the success (positive predictors of weight gain prevention, successful weight reduction) attained with the Manual include more realistic weight goals, the use of sound weight-reduction methods such as a balanced diet and physical activity; improvements in self-concept; maintenance of physical activity during the first three months at university; improvement in general psychological well-being, decreased intake of foods from the "other", beverage and grains food groups, and possibly less body-shape concerns from the start. Factors for which no link with weight-management success (non-predictors of weight gain prevention, successful weight reduction) could be established include change in body composition, perceptions of weight, weight-loss attempts, reasons for eating, foods from the vegetables; fruit; milk and cheese; meat, fish and chicken; fast foods and fats food groups; physical activity over the total eight-month period, dissatisfaction with body parts, eating attitudes, and body-shape concerns. However, this does not mean that these issues should not receive attention in selective obesity-prevention interventions aimed at female students.

Based on the results of this study and the comments of the FYFS in the experimental group, it can be concluded that a higher-intensity implementation strategy should be considered to attain even better results. The possibility of further refining the content of the Manual could also be considered

It is therefore recommended that:

- The implementation of the Manual on the campus of the University of Stellenbosch to prevent weight gain of FYFS should be considered;
- The content of the Manual should be revised where necessary, bearing in mind the results of the impact assessment and points raised by the experimental students;
- A higher-intensity strategy for the implementation of the Manual, such as chapter by chapter provision of the Manual and buddy systems, be considered;
- Although the assessment of the Manual involved only students in residences on the Stellenbosch campus, it can also be targeted at the wider student population, and therefore be made available to all female students at the University of Stellenbosch;
- The implementation of the Manual to address the weight-management needs of non-student adult populations could be investigated;
- The reassessment of the students who participated in the current study when they are in their third study year (the year 2004) be considered to determine the long-term success of the Manual.

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ADDENDUM A:

Questionnaires

INFORMED CONSENT

EVERY STUDENT MUST CAREFULLY READ AND SIGN THE FOLLOWING CONSENT FORM

I, the signatory agree to the following:

1. I am participating in this project on a voluntary basis.

2. It is explained to me that the goal of the project is to build up a database with relevant information of university students in South Africa, in order to identify risk factors, related to chronic diseases of the lifestyle such as diabetes mellitus, coronary heart disease, certain cancers, hypertension, high blood cholesterol etc., that could be prevented by lifestyle changes early in life.

3. I am aware that anthropometric measurements (weight, height, triceps skinfold, hip circumference, waist circumference, and upper arm circumference) as well as blood pressure will be taken on me.

4. I will complete all questionnaires, to the best of my ability, during the study. I know that all the information I give will be held confidential, but it will be used as research findings.

5. I will return for follow-up evaluations in May and August 2002.

6. It is possible that I might not personally experience any advantages during this project, although the knowledge that might be accumulated through my participation in the project might prove advantageous to others.

7. It is clear that I am free to withdraw from the project without any prejudice at any time. I am requested though not to withdraw without careful consideration since it might negatively affect amongst others the statistical reliability of the project.

8. I have read the above-mentioned information concerning the research project and declare that I understand it. I hereby declare that I voluntarily participate in the project.

Signed at: _____ Date: _____

Signature of participant _____ Signature of witness _____

INFORMED CONSENT

EVERY STUDENT MUST CAREFULLY READ AND SIGN THE FOLLOWING CONSENT FORM

I, the signatory agree to the following:

1. I am participating in this project on a voluntary basis.

2. It was explained to me that the goal of the project is to evaluate whether a manual with relevant information on healthy eating practices, physical activity and psychological well-being will help first year female students to manage their weight effectively and prevent unnecessary weight gain and/or losses.

3. I am aware that anthropometric measurements (weight, height, triceps skinfold, hip circumference, waist circumference, and upper arm circumference) will be taken on me.

4. I will complete all questionnaires, to the best of my ability, during the study. I know that all the information I give will be held confidential, but it will be used to report research findings.

5. I will return for follow-up evaluations in May and August 2002.

6. I will make my personal manual available, to the research-team, for monitoring at both occasions (May and August 2002).

7. I understand that the Manual will remain the property of the research team.

8. I understand that I am not allowed to share the manual with any other person or discuss the research with any other person

9. It is possible that I might not personally experience any advantages during this project, although the knowledge that might be accumulated through my participation in the project might prove advantageous to others.

10. It is clear that I am free to withdraw from the project without any prejudice at any time. I am requested though not to withdraw without careful consideration since it might negatively affect amongst others the statistical reliability of the project.

11. I have read the above-mentioned information concerning the research project and declare that I understand it. I hereby declare that I voluntarily participate in the project.

Signed at: _____ Date: _____

Signature of participant _____ Signature of witness _____

Code: | | | | |

SOCIO-DEMOGRAPHIC QUESTIONNAIRE: BASELINE

INSTRUCTIONS

- Please complete the following form by filling in all the blank spaces OR indicate you choice with a cross (X) in the blocks
- Please make sure that you answer all the questions

1. Name: _____ Surname: _____

2. Student number: | | | | | | | | |

3. Course: _____

4. Date of Birth: | | | | | | | | |
   d d m m y y y y

5. Home language: _____

6. Home address: _____

_____

7. Please indicate where this address is situated:

Town	
City	
Farm	

Other (specify): _____

8. Were you in matric last year?

Yes	No

9. Where did you stay in 2001?

With my parents	
In a school hostel	
Private accommodation	

Other (specify): _____

	Yes	No	n.a.
10.1 Do you currently smoke?			
10.2 If you do not smoke (10.1=No), did you smoke?			

10.3 If you did smoke (10.2=Yes), how many months ago did you stop smoking? _____ months

10.4 If you do currently smoke, please indicate how many cigarettes you smoke per day on average?

cigarettes per day:	

11. Do you/Did you suffer from any of the following conditions?

		Yes	No
11.1	Coronary heart disease		
11.2	High blood pressure		
11.3	Diabetes Mellitus		
11.4	High blood cholesterol		
11.5	Constipation		
11.6	Anorexia nervosa		
11.7	Bulimia nervosa		
11.8	Any other chronic diseases? Specify		

12. Do you currently use any of the following medicines/supplements?

		Yes	No
12.1	Insulin		
12.2	Oral hypoglycemic substances		
12.3	Sleeping tablets		
12.4	Tranquilizers		
12.5	Anti-depressants		
12.6	Oral contraceptives		
12.7	Vitamins, minerals		
12.8	Other e.g. Spirulina Specify		

13. Are you currently seeing a psychologist for any problems?

Yes	No

14. What do you think about your current weight?

I am underweight	
My weight is normal	
I am overweight	

15. Weight-loss during past two years

15.1 Have you tried to lose weight during the past 2 years?
If **No**, go to question 16

Yes	No

15.2 If **Yes**, please indicate how many times you have been on a diet during the past 2 years.

_____

Yes	No

15.3 If you did diet the past 2 years, did you lose weight?

15.4 If **Yes**, did you maintain the weight loss **OR**
did you regain all or some of the weight that you lost?

16. Are you currently on a weight reduction diet?

Yes	No

17. Which of the following describes you the best, at this moment?

I am completely satisfied with my present weight	
I would like to gain some weight	
I would like to lose 1-3 kg	
I would like to lose ≥4 kg	

18. Are you dissatisfied with any of the sizes or shapes of the following body parts?

		Yes	No
18.1	Arms		
18.2	Stomach		
18.3	Middle		
18.4	Hips		
18.5	Buttocks		
18.6	Thighs		
18.7	Calves		

19. Are you inclined to eat…

		Yes	No
19.1	while you are studying?		
19.2	when you are frustrated?		
19.3	because other people eat?		
19.4	when you are not hungry?		
19.5	when you are bored?		
19.6	when you are stressed?		
19.7	when you do have problems?		
19.8	because of a lack of self-discipline?		
19.9	because of stress before exams or tests?		
19.10	to much?		

SOCIO-DEMOGRAPHIC QUESTIONNAIRE: FOLLOW-UP-2

INSTRUCTIONS

- Please complete the following form by filling in all the blank spaces OR indicate you choice with a cross (X) in the blocks
- Please make sure that you answer all the questions

1. Name: _____ Surname: _____

2. Since February 2002, did you…(Mark 1 of the 3 options)

Start smoking?	
Stop smoking?	
NA (do not smoke)?	

3. If you do currently smoke, please indicate how many cigarettes you smoke per day on average? _____

4. Do you/Did you suffer from any of the following conditions?

		Yes	No
4.1	Coronary heart disease		
4.2	High blood pressure		
4.3	Diabetes Mellitus		
4.4	High blood cholesterol		
4.5	Constipation		
4.6	Anorexia nervosa		
4.7	Bulimia nervosa		
4.8	Any other chronic diseases? Specify		

5. Do you currently use any of the following medicines/supplements?

		Yes	No
5.1	Insulin		
5.2	Oral hypoglycemic substances		
5.3	Sleeping tablets		
5.4	Tranquilizers		
5.5	Anti-depressants		
5.6	Oral contraceptives		
5.7	Vitamins, minerals		
5.8	Other e.g. Spirulina Specify		

	Yes	No
6. Are you currently seeing a psychologist for any problems?.....		

7.	What do you think about your current weight?.....	I am underweight			
		My weight is normal			
		I am overweight			
8.	Are you currently on a weight reduction diet?.....	Yes		No	
9.	Since February 2002, did you try to lose weight?.....	Yes		No	

If **No** at Question 8 and 9: Go to Question 11,
If **Yes** at Question 8 or 9: Go to Question 10.

10.	If you did try to lose weight since February 2002, which of the following methods did you use? **Instructions:** Indicate in the first 2 columns whether you have used the method by marking Yes or No. If you mark Yes, please indicate in columns 3, 4 or 5 whether it was successful or not. *In the successful column:* **Yes** = You did lose weight and maintained the weight-loss **No** = You did not lose any weight or you did lose weight but gained it all again. **Partially** = You did lose weight, but gain some of the weight again.

		Yes	**No**	**Successful?**		
				Yes	**No**	**Partial-ly**
10.1	Balanced slimming diet					
10.2	Increase in physical activity					
10.3	Skip one or more meals					
10.4	Eat less or nothing between meals					
10.5	Fasting (one or more days)					
10.6	Weigh-less or any other slimming clubs					
10.7	Low carbohydrate and high protein diet e.g. Dr Atkin's, The Zone diet, Sugar busters, The Pharmacy diet etc.					
10.8	Fast diets e.g. lose >2kg in 3 days.					
10.9	Diuretics					
10.10	Appetite suppressants					
10.11	Laxatives					
10.12	Vomiting					
10.13	Diet formulas, milkshakes, powders e.g. Herbalife					
10.14	Herb mixtures					
10.15	Machines/apparatus which brake down fat.					
10.16	Injections which help brake down fat.					
10.17	Other (Specify):					

11. Which of the following describes you the best, at this moment?

I am completely satisfied with my present weight	
I would like to gain some weight	
I would like to lose 1-3 kg	
I would like to lose ≥4 kg	

12. Are you dissatisfied with any of the sizes or shapes of the following body parts?

		Yes	No
12.1	Arms		
12.2	Stomach		
12.3	Middle		
12.4	Hips		
12.5	Buttocks		
12.6	Thighs		
12.7	Calves		

13. Are you inclined to eat…?

		Yes	No
13.1	while you are studying?		
13.2	when you are frustrated?		
13.3	because other people eat?		
13.4	when you are not hungry?		
13.5	when you are bored?		
13.6	when you are stressed?		
13.7	when you do have problems?		
13.8	because of a lack of self-discipline?		
13.9	because of stress before exams or tests?		
13.10	Too much?		

INDICATE YOUR USUAL DIETARY INTAKE THE PAST MONTH ON UNIVERSITY WHEN YOU COMPLETE THIS QUESTIONNAIRE.

INSTRUCTIONS

STEP 1: Look at the food item list (column 1)

STEP 2: Determine your portion size (column 2)

- The standard portion size (Std portion) of each item in the list is given in column 2.
- Decide whether your usual intake of a specific item is equal to the Std portion. If it is, mark the 1×Std column with a cross (X).
- If you usually eat less than the Std portion, mark the ½×Std column.
- If you usually eat slightly more than the Std portion, mark the 1½×Std column.
- If you usually eat much more than the Std portion, mark the 2×Std column.

STEP 3: Determine how often you eat each item in the list (column 3)

- If you eat/drink a specific item less than once a month, mark the Never/Seldom column.
- If you do eat/drink it more regularly, decide how often you eat it per month, OR per week, OR per day and write this number in the correct column.

Example: Mari eats carrots, pumpkin or butternut 3 times per week, she eats 2  per time. Look-up the correct way of recording it in the first row of the Table.

Abbreviations	
Std	Standard
tl	teaspoon
E	tablespoon
tl	Heaped teaspoon
E	Heaped tablespoon

Symbols	
	Dough model
●	Tennis ball
	Matchbox

COLUMN 1	COLUMN 2					COLUMN 3			
	Std Portion	1× Std	½ × Std	1½ × Std	2 × Std	Per day	Per week	Per month	Never/ seldom
Example: PUMPKIN, BUTTERNUT, CARROTS: cooked or salad					×		3		
GRAINS									
BREAD and/or ROLLS: white	1 slice/ roll								
BREAD and/or ROLLS: brown, whole wheat, health etc.	1 slice/ roll								
BREAKFAST CEREALS *(high fibre)*: All bran, high bulk bran, Muesli, Weet-bix, Pronutro etc.									
BREAKFAST CEREALS *(other)*: Rice crispies, Cornflakes, Coco pops, Fruit loops									
OATS: cooked porridge									
MAIZE PORRIDGE: stiff, crumbeld, soft									
RICE, MEALIE RICE, SAMP									
PASTA: macaroni, spaghetti, noodles									
POTATO: cooked, baked									

	Std Portion	1× Std	½ × Std	1½ × Std	2 × Std	Per day	Per week	Per month	Never/ seldom
POTATO: "mashed" or cooked/baked with fat added or potato salad									
POTATO: fried in any fat									
LEGUMES: baked beans, lentils, harricot beans, split peas, broad beans, kidney beans, sugar beans, dried bean salad/soup etc.									
VEGETABLES									
PUMPKIN, BUTTERNUT, CARROTS: cooked or salad									
SWEET POTATO, MEALIES, SWEETCORN									
BROCCOLI, BRUSSEL SPROUTS, BABY-MARROWS, SPINACH, PEAS, GREENBEANS									
MIXED VEGETABLES e.g. carrots, peas, mealies, green beans (in any combination)									
MIXED SALAD: lettuce, cucumber, tomato, peppers, onions, mushrooms in any combination or alone.									
CAULIFLOWER, BRINJAL, MUSHROOMS, CABBAGE (white or red), BEETROOT									
FRUIT									
ORANGE, GRAPEFRUIT, NARTJIES, GAUVAS	●								
STRAWBERRIES, LITCHIS, KIWI FRUIT, FIG: whole or finely cut (when in season).	● of 								
APPLES, PEARS, BANANA, GRAPES	●								
MANGO, PAWPAW, PINEAPPLE: whole or finely cut (when in season).	● of 								
PEACH, APRICOT, PRUNES (when in season)	●								
WATERMELON, SWEET MELON (when in season)	2 								
DRIED FRUIT: apricot, prunes, peaches	½ 								
FRUIT JUICE: gauva, orange, litchi etc.	1 glass								
FRUIT SALAD: fresh or tinned									
MILK AND CHEESE									
FULL CREAM: milk, yogurt, sour milk (maas), on porridge/to eat or drink.	½ cup or 								
SKIMMED/LOW FAT/2%: milk, yogurt, sour milk (maas) on porridge/cereal to eat or drink.	½ cup or 								
MILK: in coffee/tea	3 E								
MILK POWDER: in coffee/tea	2 tl								
COFFEE CREAMER: in tea/coffee e.g. cremora	1 tl								
MILK DRINKS: Milo, Nesquik, Horlicks	1 mug								
CHEESE: gouda, cheddar on bread									

	Std Portion	1× Std	½ × Std	1½ × Std	2 × Std	Per day	Per week	Per month	Never/ seldom
MEAT, FISH, CHICKEN									
RED MEAT: *Low fat cuts (no visible fat) vet)* e.g. steak, lean mince. Includes BEEF, MUTTON, PORK, VENISON, OSTRICH	3								
RED MEAT: *Med-high fat cuts* e.g. regular mince, chuck, neck, ribs, "boerewors". Includes BEEF, PORK, MUTTON	3								
SNITZELS, GORDEN BLUER	3								
CHICKEN/TURKEY: with skin	3								
CHICKEN/TURKEY: without skin	3								
FRIED CHICKEN: commercial e.g. Kentucky or homemade	3								
FRIED FISH in any fat or oil, with or without batter/crumbs.	3								
FISH: steamed, grilled, braaied (fire)	3								
FISH: tinned sardines, pilchards, salmon, tuna	¾								
SAUSAGES: viennas, russians, frankfurter	1 sausage								
COLD MEAT: polonie, salami, ham etc.	2 mm thick and surface area of								
BACON	2 mm thick and surface area of								
EGGS: cooked or poached	1 egg								
EGGS: scrambled, baked, omelet	1 egg								
FATS									
SOFT MARGARINE of SPREAD: *low/medium fat* on bread, vegetables, potatoes, porridge etc.	1 tl								
SOFT MARGARINE or SPREAD: *regular fat* on bread, vegetables, potatoes, porridge.	1 tl								
BUTTER/HARD MARGARINE: on bread, vegetables, potatoes, porridge etc.	1 tl								
SALAD DRESSING, MAYONNAISE	1 E								
PEANUTBUTTER	1 E								
CHOCLATE OR CHEESE SPREAD	1 E								
FAST FOODS AND TAKE AWAYS									
PIZZA	2								
PIE									
SAUSAGE ROLL	3								
TOASTED SANDWICH with cheese (2 bread slices)	1								
HAMBURGERS (= bun and meat or chicken patty)	1								
PANCAKE	1								
MEXICAN FOOD e.g. nancho,s, tortillas									
CHINESE FOOD	3 of								

	Std Portion	1× Std	½ × Std	1½ × Std	2 × Std	Per day	Per week	Per month	Never/ seldom
OTHER									
VETKOEK, SAMOOSAS, KOEKSISTER, DOUGHNUTS	1 or 3								
MUFFIN, SCONES, CAKE	½ or 2								
RUSKS: commercial or homemade e.g. bran, buttermilk, white, whole wheat etc.	2								
COOKIES commercial or homemade: e.g. oat, crunchies, shortbread	2 (2 cookies)								
PROVITA	2								
CHIPS: niknaks, simba	Small packet								
ENERGY BARS, HEALTH BARS,	1 bar								
CHOCLATE	2 blocks								
SUGAR	2 tl								
JELLY									
ICE CREAM									
CUSTARD									
TART e.g. milktart, lemon meringue etc.	2								
CHEESE SAUCE, WHITE SAUCE, MEATSAUCES: part of meal or extra	2 E								
TOMATO SAUCE, CHUTNEY, MOSTERD	1 E								
SWEETS	½								
NUTS	½								
RAISENS	½								
JAM, SYRUP, HONEY	1 tl								
DRINKS									
WINE: red or white	1 wine-glass								
PORT, SHERRY, LIQUEUR	1 sherry-glass								
BIER, CIDER e.g. castle, black label, hunters dry, savanna, smirnoff etc.	1 glass								
SPIRITS: e.g. brandy, whisky rim, vodka, gin	1 tot								
JUICE OR MIX WITH SPIRITS e.g. lemonade, orange juice	1 glass								
FIZZY SOFT DRINKS: e.g. coke, fanta	1 glass								
FIZZY DIET SOFT DRINKS: e.g. coke lite etc.	1 glass								
ENERGY DRINKS e.g. energade, powerade	1 glass								
MILKSHAKE	1 glass								

PHYSICAL ACTIVITY QUESTIONNAIRE

INSTRUCTIONS

- Make a cross (X) in the column which best applies to each question
- **Think of the past month when you complete this questionnaire.**
- Mark only one option per question
- **Please answer all the questions**

		Never	Seldom	Some-times	Often	Always
1.	During and between lectures I sit …					
2.	During and between lectures I stand …					
3.	During and between lectures I walk …					
4.	During and between lectures I lift heavy loads …					
5.	After lectures, I am physically tired …					
6.	During and between lectures I sweat …					

		Much heavier	Heavier	As heavy	Lighter	Much lighter
7.	In comparison with others my age, I think my daily physical activity during and between lectures is physically…					

		Yes	No
8.1	Do you exercise*?		

8.2	If **yes**, which exercise do you do most frequently?	

		<1 hour	1-2 h	2-3 h	3-4 h	>4 hours
8.3	How many hours per week do you do this exercise?					

		<1mth	1-3mths	4-6mths	7-9mths	>9mnths
8.4	How many months per year do you do this exercise?					

* Can be defined as any physical activity that is performed for the purpose of conditioning the body, improving or maintaining health and improving or maintaining physical fitness.

		Much less	Less	The same	More	Much more
9.	In comparison to others my own age, I think my physical activity during leisure time is…					

		Never	Seldom	Some-times	Often	Very often
10.	During leisure time I sweat (not due to heat)…					
11.	During leisure time I play sport…					
12.	During leisure time I watch television or play on a computer…					
13.	During leisure time I walk…					
14.	During leisure time I cycle…					

		<5 min	5-15 min	15-30 min	30-45 min	>45 min
15.	How many minutes per day, do you walk and/or cycle to and from class/town/friends?					

BODY SHAPE QUESTIONNAIRE

INSTRUCTIONS

- We would like to know how you have been feeling about your appearance over the **PAST FOUR WEEKS.**
- Place a cross (X) in the column, which applies best to each of the following questions.
- **Please answer all the questions.**

OVER THE PAST FOUR WEEKS:		**Never**	**Rarely**	**Some-times**	**Often**	**Very often**	**Always**
1.	Has feeling bored made you brood about your shape?						
2.	Have you been so worried about your shape that you have been feeling that you ought to diet?						
3.	Have you thought that your thighs, hips or bottom are too large for the rest of you?						
4.	Have you been afraid that you might become fat (or fatter)?						
5.	Have you worried about your flesh not being firm enough?						
6.	Has feeling full (e.g. after eating a large meal) made you feel fat?						
7.	Have you felt so bad about your shape that you have cried?						
8.	Have you avoided running because your flesh might wobble?						
9.	Has being with thin women made you feel self-conscious about your shape?						
10.	Have you worried about your thighs spreading out when sitting down?						
11.	Has eating even a small amount of food made you feel fat?						
12.	Have you noticed the shape of other women and felt that your own shape compared unfavourbly?						
13.	Has thinking about your shape interfered with your ability to concentrate (e.g. while watching television, reading, listening to conversations)?						
14.	Has being naked, such as when taking a bath, made you feel fat?						
15.	Have you avoided wearing clothes, which make you particularly aware of the shape of your body?						
16.	Have you imagined cutting off fleshy areas of your body?						

OVER THE PAST FOUR WEEKS:		Never	Rarely	Some-times	Often	Very often	Always
17.	Has eating sweets, cakes, or other high calorie food made you feel fat?						
18.	Have you not gone out to social occasions (e.g. parties) because you have felt bad about your shape?						
19.	Have you felt excessively large and rounded?						
20.	Have you felt ashamed of your body?						
21.	Has worry about your shape made you diet?						
22.	Have you felt happiest about your shape when your stomach has been empty (e.g. in the morning)?						
23.	Have you thought that you are the shape you are because you lack self-control?						
24.	Have you worried about other people seeing rolls of flesh around your waist or stomach?						
25.	Have you felt that it is not fair that other women are thinner than you?						
26.	Have you vomited in order to feel thinner?						
27.	When in company have you worried about taking up too much room (e.g. sitting on a sofa or a bus seat)?						
28.	Have you worried about your flesh being dimply?						
29.	Has seeing your reflection (e.g. in a mirror or shop window) made you feel bad about your shape?						
30.	Have you pinched areas of your body to see how much fat there is?						
31.	Have you avoided situations where people could see your body (e.g. communal changing rooms or swimming baths)?						
32.	Have you taken laxatives in order to feel thinner?						
33.	Have you been particularly self-conscious about your shape when in the company of other people?						
34.	Has worry about your shape made you feel you ought to exercise?						

ADOLESCENT SELF-CONCEPT SCALE

INSTRUCTIONS

- Each item in this questionnaire consists of contrasting descriptions of two people, A and B.
- Read both descriptions in each item and compare yourself with each one. Then decide which of the two resembles you the most.
- On the right hand side of each item are two letters, A and B. If you are more like A draw a cross over the letter A on the right hand side of the page. If you are more like B, draw a cross over the letter B on the right hand side of the page.
- **Perhaps you may not be exactly like either, but you must decide which of the two best describes you.**
- Make sure that you mark each item. Do not mark both, A and B in the same item.
- A and B do not represent the same persons in each item. Therefore, your answer to one item should not influence your answer to another.
- Follow the same procedure for each item. There is no time limit, but work quickly and answer every item.
- Please make sure that you answer all the questions.

1.	A is usually in perfect health B is seldom completely well	**A**	**B**
2.	A easily loses all self-control B usually remains very calm	**A**	**B**
3.	A is generally proud of her family B is often ashamed of her family	**A**	**B**
4.	A is usually unpopular; her company is seldom sought after B is usually popular; her company is generally sought after	**A**	**B**
5.	A rebukes (correct in a negative way) people who use coarse language B never has the courage to rebuke (correct in a negative way) people	**A**	**B**
6.	A would rather win than lose a competition B is indifferent to the results of a competition	**A**	**B**
7.	A considers herself attractive B considers herself unattractive	**A**	**B**
8.	A always feels inferior in company B never feels inferior in company	**A**	**B**
9.	A often feels guilty about the ease with which she tells a lie B is not aware that she ever tells a lie	**A**	**B**
10.	A is usually too self-conscious to offer help to other people B is always helpful and enjoys it	**A**	**B**
11.	A changes her behaviour if she becomes convinced that she is wrong B often continues with behaviour even though she knows it to be wrong	**A**	**B**
12.	A often postpones to the next day what should be done today B never postpones work to another day	**A**	**B**
13.	A likes to be well-dressed and neat in all circumstances B dislikes always being neat	**A**	**B**
14.	A is often peevish and moody for long periods B is seldom if ever in a bad mood	**A**	**B**
15.	A usually looks forward to family gatherings B does not like family gatherings	**A**	**B**

16.	A wishes that others would show interest in her more often B is satisfied with the attention she gets	A	B
17.	A usually takes the side of the majority B usually decides for herself what is right and stand by this decision even though she stands alone	A	B
18.	A sometimes drives through a stop street without stopping B never drives through a stop street without stopping	A	B
19.	A is usually aware of pain somewhere in her body B is seldom aware of any pain	A	B
20.	A is completely satisfied with herself B is not satisfied with herself	A	B
21.	A is usually suspicious of her family's conversations and conduct B is never suspicious of her relatives	A	B
22.	A is someone who makes friends very easily B does not usually make friends easily	A	B
23.	A often does things which cause her to feel ashamed afterwards B seldom does things which cause her to feel ashamed afterwards	A	B
24.	A sometimes feels like swearing when things go wrong B never becomes so upset when things go wrong	A	B
25.	A is usually untidy B is seldom really untidy	A	B
26.	A is as friendly to other people as she would like to be B is not as friendly to everyone as she would like to be	A	B
27.	A is very sensitive to what her family says about her B does not easily feel hurt by what her family says about her	A	B
28.	A usually gets on very well with other people B's relationships are easily disturbed by trivialities	A	B
29.	A sometimes uses questionable methods in order to be ahead B never considers using questionable methods	A	B
30.	A is inclined to gossip too much B never gossips	A	B
31.	A is usually aware of feeling unwell B seldom feels unwell	A	B
32.	A knows that she can usually solve her problems B is always afraid that she will not be able to solve her problems	A	B
33.	A often feels unhappy because she has so little love for her family B is satisfied that she loves her family	A	B
34.	A always sees other people's good points B seldom sees other people's good points	A	B
35.	A often feels unhappy because her life does not measure up to the high standards which others set for her B seldom cares what others expect of her	A	B
36.	A is someone who often enjoys a shady joke B never laughs at shady jokes	A	B
37.	A feels that her weight is correct B often feels worried about her weight	A	B
38.	A often experiences despair because she does not keeps to her principles B never experiences despair because she does not keeps to her principles	A	B

39.	A would never be unfair to her family B is not particularly scrupulous about being fair to her family	**A**	**B**
40.	A always finds it difficult to forgive someone who has accused her falsely B readily forgives others	**A**	**B**
41.	A does not like everyone that she knows B likes everyone she knows	**A**	**B**
42.	A is satisfied with her appearance B does not feel happy about her appearance	**A**	**B**
43.	A is always envious of traits of character which she perceives in others B is never envious of character traits which she perceives in others	**A**	**B**
44.	A is someone with little love for her fellowman B will often do herself down in order to favour others	**A**	**B**
45.	A always feels self-conscious in the company of strangers B seldom feels self-conscious in the company of strangers	**A**	**B**
46.	A's behaviours is always irreproachable and honorable in all circumstances B worries about her behaviour which often leaves much to be desired	**A**	**B**
47.	A takes little interest in the doings of other people B takes an intense interest in the actions and conversations of other people	**A**	**B**
48.	A feels perfectly happy about her height B is often self-conscious about her height	**A**	**B**
49.	A can never persevere with a task until it is finished B perseveres to the end with every task she undertakes	**A**	**B**
50.	A always treats her parents very well B often neglects her parents	**A**	**B**
51.	A finds it very difficult to enter into a conversation with strangers B talks to strangers with the greatest of ease	**A**	**B**
52.	A will always return change when she is given too much B does not trouble to return change when it is too much	**A**	**B**
53.	A often feels that she is angry with the whole world B rarely feels irritable or sulky	**A**	**B**
54.	A feels dissatisfied with certain aspects of her physical appearance and would change them if she could B is satisfied with her physical appearance just as it is	**A**	**B**
55.	A can usually hold her own in any situation B finds it difficult to hold her own in all situations	**A**	**B**
56.	A usually ignores the wishes of her parents B always considers the wishes of her parents	**A**	**B**
57.	A is very religious B is not very religious	**A**	**B**
58.	A feels that other find it difficult to make friends with her B is sure that others make friends easily with her	**A**	**B**
59.	A feels dissatisfied because she is often unwell B is satisfied with the state of her health	**A**	**B**
60.	A does not become annoyed when she is rebuked B cannot tolerate rebuke ("tereggewys", corrected in a negative way)	**A**	**B**
61.	A sometimes has serious quarrels with members of her family B never has serious quarrels with members of her family	**A**	**B**
62.	A is always friendly B is not always friendly	**A**	**B**

63.	A's family seldom ask her opinion B's family consults her about most of their affairs	**A**	**B**
64.	A longs for more attention from the opposite sex B is satisfied with the attention she gets from the opposite sex	**A**	**B**
65.	A usually performs well B often performs badly	**A**	**B**
66.	A's family criticize her often B seldom offends in the eyes of her family	**A**	**B**
67.	A is sometimes irritable when she is unwell B is never irritable when she is unwell	**A**	**B**
68.	A is particularly popular amongst friends of her own sex B is not very popular amongst friends of her own sex	**A**	**B**
69.	A thinks that her family does not love her B is completely sure of her family's love	**A**	**B**
70.	A likes to care for her body to the best of her ability B often feels guilty because she neglects her body	**A**	**B**
71.	A often acts without first considering the consequences of her deeds B carefully considers the consequences before she takes action	**A**	**B**
72.	A is particularly popular with the opposite sex B is not very popular with the opposite sex	**A**	**B**
73.	A feels that her family is suspicious of everything she does B is sure that she is trusted by her family in everything	**A**	**B**
74.	A occasionally thinks about improper things which cannot be discussed B never thinks about improper things	**A**	**B**
75.	A enjoys exacting (demanding) work B prefers routine (easier) work	**A**	**B**
76.	A easily changes her opinions; she never disagrees B firmly adheres to her convictions	**A**	**B**
77.	A has relatives who will support her in any situation B does not have relatives on whom she can rely in any situation	**A**	**B**
78.	A is calm and composed in almost any circumstances B can never defend her viewpoint in a calm and composed manner	**A**	**B**
79.	A often gets cross when she is thwarted (oppose, let down, "teengegaan") B seldom gets cross when she is thwarted	**A**	**B**
80.	A feels very energetic most of the time B feels tired and lethargic most of the time	**A**	**B**
81.	A is a member of a very happy family B's family is not very happy	**A**	**B**
82.	A does not feel inferior to her friends B feels inferior to her friends and acquaintances in many ways	**A**	**B**
83.	A usually finds it very difficult to reach a decision B considers the available information and usually decides quickly	**A**	**B**
84.	A is usually cheerful irrespective of circumstances B is only cheerful when things go well	**A**	**B**
85.	A feels that she is highly respected by her family B thinks that she is unimportant in the eyes of her family	**A**	**B**
86.	A often regards herself as a bad person B regards herself as a good person	**A**	**B**

87.	A is a good mixer and usually enlivens the company B often wishes that she could be more sociable	**A**	**B**
88.	A feels guilty because she seldom goes to church B finds her church attendance satisfactory	**A**	**B**
89.	A takes an interest in her family and visits them often B does not take much interest in her family	**A**	**B**
90.	A is always very polite to strangers B often finds herself lacking in courtesy	**A**	**B**
91.	A is very clumsy and awkward in certain situations B seldom suffers from clumsiness and awkwardness	**A**	**B**
92.	A is satisfied that she faithfully observes the virtues of honesty, integrity, loyalty, truthfulness, etc. B often feels guilty because she neglects these virtues	**A**	**B**
93.	A is almost never reserved or self-conscious B is usually reserved and self-conscious with strangers and particularly with people in authority	**A**	**B**
94.	A is very nervous when she has to appear before a group of people B almost never suffers from nervousness	**A**	**B**
95.	A is someone who does not feel particularly guilty if she is compelled to tell a small lie B is someone who never tells a lie	**A**	**B**
96.	A's religion offers her considerable inspiration, comfort and hope B constantly worries about her religion	**A**	**B**
97.	A is easily worried B seldom suffers anxiety	**A**	**B**
98.	A often feels guilty about her frequent irresponsible behaviour B is satisfied that she fulfils his responsibilities	**A**	**B**
99.	A usually understands the members of her family very well B frequently misunderstands her family	**A**	**B**
100.	A is someone who sacrifices much to help the underprivileged B is hardly aware of the poor, cripples, blind people etc. and ignores rather than helps them	**A**	**B**

EATING ATTITUDES TEST

INSTRUCTIONS

- Please place a cross (X) in the column, which applies best to each of the numbered statements.
- Most of the questions directly relate to food or eating, although other types of questions have been included.
- **Please answer each question carefully.**

		Always	Very often	Often	Some-times	Seldom	Never
1.	Am terrified about being overweight						
2.	Avoid eating when I am hungry						
3.	Find myself preoccupied with food						
4.	Have gone on eating binges where I feel that I may not be able to stop						
5.	Cut my food into small pieces						
6.	Aware of the calorie content of foods that I eat						
7.	Particularly avoid foods with a high carbohydrate content (e.g. bread, potatoes, rice, etc.)						
8.	Feel that others would prefer if I ate more						
9.	Vomit after I have eaten						
10.	Feel extremely guilty after eating						
11.	Am preoccupied with a desire to be thinner						
12.	Think about burning up calories when I exercise						
13.	Other people think I am too thin						
14.	Am preoccupied with the thought of having fat on my body						
15.	Take longer than others to eat my meals						
16.	Avoid foods with sugar in them						
17.	Eat diet foods						
18.	Feel that food controls my life						
19.	Display self control around food						
20.	Feel that others pressure me to eat						
21.	Give too much time and thought to food						
22.	Feel uncomfortable after eating sweets						
23.	Engage in dieting behaviour						
24.	Like my stomach to be empty						
25.	Enjoy trying new rich foods						
26.	Have the impulse to vomit after meals						

GENERAL HEALTH QUESTIONNAIRE

INSTRUCTIONS

- We would like to know how your general health has been over the **past few weeks**.
- Please answer **ALL** the questions by making a cross (X) in the column, which applies best to each question.
- Remember that we want to know about present and recent complaints, not those you had in the past.

HAVE YOU RECENTLY?		Not at all	No more than usual	Rather more than usual	Much more than usual
1.	- been able to concentrate on whatever you're doing?				
2.	- lost much sleep over worry?				
3.	- been having restless, disturbed nights				
4.	- been managing to keep yourself busy and occupied				
5.	- been getting out of the house as much as usual				
6.	- been managing as well as most people would in your shoes?				
7.	- felt on the whole you were doing things well?				
8.	- been satisfied with the way you've carried out your task?				
9.	- been able to feel warmth and affection for those near to you?				
10.	- been finding it easy to get on with other people?				
11.	- spent much time chatting with people?				
12.	- felt that you are playing a useful part in things?				
13.	- felt capable of making decisions about things?				
14.	- felt constantly under strain?				
15.	- felt you couldn't overcome your difficulties?				
16.	- been finding life a struggle all the time?				
17.	- been able to enjoy your normal day-to-day activities				

HAVE YOU RECENTLY?		Not at all	No more than usual	Rather more than usual	Much more than usual
18.	- been taking things hard?				
19.	- been getting scared or panicky for no good reason?				
20.	- been able to face up to your problems?				
21.	- found everything getting on top of you?				
22.	- been feeling unhappy and depressed?				
23.	- been losing confidence in yourself?				
24.	- been thinking of yourself as a worthless person?				
25.	- felt that life is entirely hopeless?				
26.	- been feeling hopeful about your own future?				
27.	- been feeling reasonable happy, all things considered?				
28.	- been feeling nervous and strung-up all the time?				
29.	- felt that life isn't worth living?				
30.	- found that time you couldn't do anything because your nerves were too bad?				

Naam: .....

SLEGS VIR KANTOOR GEBRUIK
MOET ASSEBLIEF NIE OP DIE RES VAN HIERDIE BLADSY SKRYF NIE

ANTROPOMETRIE

Bloeddruk			
Bo-arm omtrek (cm)			
Middel omtrek (cm)			
Heup omtrek (cm)			
Lengte (m)			
Triseps velvou (mm)			
Gewig (kg)			

ADDENDUM B:

Information sheet received by each student at Follow-up-1 and Follow-up-2

UNIVERSITY OF STELLENBOSCH
DEPARTMENT OF PHYSIOLOGICAL SCIENCES

Name Surname

Residence:

This is a report of your measurements, which were taken in Feb/March. Use the following tables to interpret your measurements. Compare these values with the next set of measurements, which will be taken during May and August.

Weight = 63.8 kg
Height = 1.700 m
BMI = 22.1

Interpret your BMI using the following table:

Interpretation of BMI values		
	BMI-value	**Interpretation**
Unacceptable	BMI = 15 - 17	You are seriously underweight; this is a great health risk.
	BMI < 18	You are seriously underweight; this is a health risk.
	BMI >= 18 but < 20	You are underweight; this might be a health risk
Acceptable	BMI >= 20 but < 25	Your weight is normal.
Should be avoided	BMI >= 25 but < 28	You are overweight; this might not yet be a health risk.
	BMI >= 28 but < 30	You are overweight; this might be a health risk.
	BMI >= 30	You are obese; this is definitely a health risk.

REMEMBER that a BMI>25 does not indicate in all cases that weight loss is essential e.g. if you have a family history of a higher BMI and/or a personal history of unsuccessful weight loss attempts.

Middle circumference = 70.8 cm
Hip circumference 105.9 cm
Middle-Hip ratio = 0.67

A Middle-hip ratio greater than 0.8 is an indication that you have a higher risk for the development of obesity, heart disease and diabetes.

Triceps skinfold = 17.2 mm

A triceps skinfold <9.5mm is an indication of low fat stores and undernutrition and a skinfold >24mm indicates high fat stores and overweight. The normal is 18mm.

Systolic blood pressure = 100 **Diastolic blood pressure** = 58

Interpret your blood pressure using the following table:

Classification	**Systolic Blood-pressure**	**Diastolic Blood-pressure**	**Do the following**
Hypotension	<105	<60	Check with your doctor
Normal	105 - 140	60 - 90	Self-check
Limit value hypertension	140 -160	90 - 95	Check with your doctor
Mild hypertension	>160	95 - 105	Consult your doctor
Moderately serious hypertension	>160	105 - 115	Consult your doctor
Serious hypertension	>160	>115	Consult your doctor urgently

Janetta Cilliers, RD(SA) Marjanne Senekal, Ph.D, RD(SA)