The efficacy of short-messaging service in a weight reduction programme amongst women in a general practice

by
Rosetta Guidozzi

Thesis presented in partial fulfilment of the requirements for the degree Master of Nutrition at the University of Stellenbosch

Supervisor: Dr. Debbie Marais
Co-supervisor: Mrs. Janicke Visser

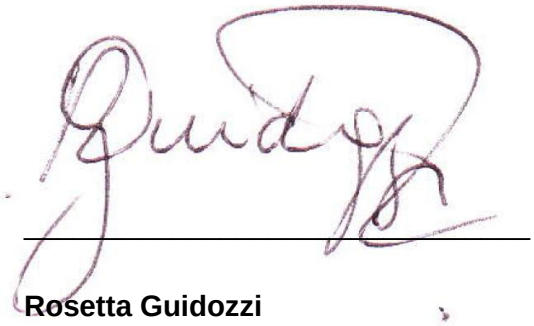
Faculty of Health Sciences
Department of Interdisciplinary Health Sciences
Division of Human Nutrition

March 2011

DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification

Signature: Date: March 2011



Rosetta Guidozzi

ABSTRACT

Obesity has become one of the major conditions contributing towards chronic lifestyle diseases. The management of obesity, in order to prevent chronic lifestyle disease, requires a combination of treatment modalities. There is therefore a constant need to search for innovative behavioural and awareness programmes regarding the treatment of obesity, and to develop innovative strategies to improve compliance and ultimately to change lifestyles.

The notion of utilizing short message services (SMS), during a weight reduction progamme to provide regular reminders and information to achieve the aforementioned goals, was therefore used as an intervention in the study. Furthermore a questionnaire validating the effectiveness of the short message service was devised and completed by the recipients of the intervention. The purpose of the questionnaire was to statistically quantify the effectiveness of the SMS as an intervention. Each question had four graded answers, with a score allocated to each - 1 being the least effective and 4 being the most. These values were converted to percentages and according to these percentages a rating of effectiveness was ascertained. Ultimately the study set out to determine whether the intervention had a statistically significant effect on weight reduction, compliance in attending appointments and on the attrition rate.

This was a double blinded randomized, controlled study in which 75 participants were recruited at a general medical practice in Gauteng. The sample comprised of three groups. Group 1 (N = 25) had no intervention; Group 2 (N = 25) received a SMS weekly and Group 3 (N = 25) received a SMS three times per week. The weight reduction programme, which included dietary modifications and lifestyle advice was standardized and remained the same for each group. The programme extended over a 12 week period and the questionnaire was completed at the end of the programme.

Upon analysis of the results there was a decrease in the mean BMI and waist circumference for all the three groups, with no statistically significant difference (p-value > 0.05) between them. The percentages of the participants completing the programme in each group were – Group 1: 44%, Group 2: 60% and Group 3: 68%. The effectiveness of the intervention was manifested by the compliance of attendance at each visit and the reduced attrition rate in the intervention groups, although this was not found to be statistically significant. The analysis of the scores allocated to the responses of the questionnaire, equated to an outcome of above 75% and was assessed as being very successful in both the intervention groups.

In conclusion the use of short message servicing in this weight reduction programme improved the compliance and reduced the attrition rate although not statistically and was perceived by the participants as a successful intervention.

OPSOMMING

Vetsug (obesiteit) het een van die primêre kondisies geword wat bydrae tot chroniese leefstyl siektes. Die hantering van obesiteit vereis ‘n kombinasie van behandelingsmodaliteite, ten einde hierdie siektes te voorkom, Daar is dus ‘n konstante soeke na innoverende gedrags- en bewustheidsprogramme rakende die behandeling van obesiteit, asook ‘n behoefte om innoverende strategieë te ontwikkel om inskiklikheid te verbeter en uiteindelik leefstyle te verander.

Die idee om kortboodskapdienste (SMS) gedurende ‘n gewigsverliesprogramme te gebruik om gereelde aanmanings en inligting te kommunikeer ten einde die genoemde doelwitte te bereik, is aangewend as intervensie in hierdie studie. “n Vraelys is ontwikkel wat die effektiwiteit van die kortboodskapdiens valideer, en is voltooi deur die ontvangers van die intervensie. Die doel van die vraelys was om die effektiwiteit van die SMS as ‘n intervensie te kwantifiseer. Elke vraag het vier gegradeerde antwoorde gehad, met ‘n telling wat aan elk toegeken is – 1 wat aandui minste effektief en 4 wat aandui die meeste. Hierdie waardes was omgeskakel tot persentasies en na aanleiding van die persentasies is ‘n waarde van effektiwiteit bepaal. Uiteindelik was die doel van die studie dus om vas te stel of die intervensie ’n statisties beduidende effek op gewigsverlies, die nakom van afsprake en uitvalskoerse het.

Hierdie was ‘n dubbelblind, ewekansige gekontroleerde studie waarin 75 deelnemers gewerf was by ‘n algemene mediese praktyk in Gauteng. Die steekproef het bestaan uit 3 groepe. Groep 1 (N = 25) het geen intervensie gehad nie; Groep 2 (N = 25) het ‘n weeklikse SMS ontvang en Groep 3 (N = 25) het ‘n SMS ontvang drie keer per week. Die gewigsverliesprogramme, wat dieetaanpassings en leefstyl advies ingesluit het, was gestandardiseer en het dieselfde gebly vir elke groep. Die programme het gestrek oor ‘n 12 weke periode en die vraelys was voltooi aan die einde van die programme.

Analise van die resultate het ‘n afname getoon in die gemiddelde LMI (Liggaamsmassa indeks) en middelomtrek vir al drie groepe, met geen statisties beduidende verskil (p-waarde > 0.05) tussen groepe nie. Die persentasies van die deelnemers wat die programme voltooi het in elke groep was Groep 1: 44%, Groep 2: 60% en Groep 3: 68%. Die effektiwiteit van die intervensie was gemanifesteer deur die inskiklikheid van bywoning tydens elke besoek en die verlaagde uitvalkoers in die intervensie groepe, alhoewel dit nie statisties beduidend was nie. ‘n Analise van die tellings geallokeer aan die response tot die vraeslys, dui ‘n uitkoms aan van bo 75% en was beskou as baie suksesvol in albei die intervensie groepe.

Die gebruik van kortboodskapdienste (SMS) in hierdie gewigsverliesprogramme het inskiklikheid verbeter en uitvalskoerse verlaag, alhoewel nie statisties beduidend nie, en was deur die deelnemers beskou as ‘n suksesvolle intervensie.

ACKNOWLEDGEMENTS

I would like to thank my supervisors Dr. Debbi Marais, Mrs. Janicke Visser and Prof. Daan Nel, for their valued input, understanding and patience.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ADA	American Dietetic Association
AHA	American Heart Association
ANOVA	Analysis of Variance
BMI	Body Mass Index
CATCH	Child and Adolescent Trial for Cardiovascular Health Study
CCK	Cholecystokinin
CDC	Centre for Disease Control
CVD	Cardiovascular Disease
CI	Confidence Index
IL-6	Interleukin-6
IOTF	International Obesity Task Force
Kg/KG	Kilogram
Kj	Kilojoule
M	Metre
MMS	Multi-Media Message Service
N	Number
NAFLD	Non-Alcoholic Fatty Liver Disease
NASH	Non-Alcoholic Steatohepatiitis
NCDs	Non-Communicable Disease
NFHCS	National Food and Health Consumption Survey
NHLBI	National Heart, Lung and Blood Institute
NHS	National Health System
NIH	National Institute of Health

OMA	Obesity Management Association
PPA	Peroxime Proliferator-activated Receptor
PPY	Peptide yy
RCT	Randomized Controlled Trial
RW	Relative Weight
SAHDS	South African Demographics and Health Survey
SASOM	South African Society of Obesity Management
SD	Standard Deviation
SIGN	Scottish Intercollegiate Guidelines Network
SMS	Short Messaging Service
TNF-ALPHA	Tumour Necrosis Factor Alpha
USA	United States of America
USDA	United States Department of Agriculture
WC	Waist Circumference
WHO	World Health Organization

LIST OF TABLES

Page Number

LIST OF FIGURES

Page Number

LIST OF ADDENDA

Page Number

CHAPTER 1: LITERATURE REVIEW

1.1 INTRODUCTION

1.1.1 Definition of Obesity

Obesity can be broadly defined as an excess of subcutaneous and visceral fat in proportion to lean body mass. The excess fat accumulation is associated with both an increase in the size (hypertrophy) as well as the number (hyperplasia) of adipose tissue cells. Obesity is further defined by various terms which include absolute weight, weight-height ratio and the distribution of subcutaneous fat versus visceral fat, according to societal and general aesthetic norms. Measures of weight in proportion to height include relative weight (RW, namely body weight divided by median desirable weight for a person of the same height and medium frame according to actuarial tables), body mass index (BMI, namely, body weight divided by height squared, kg/m^2) and ponderal index (namely body weight divided by body volume, kg/m^3). These do not however differentiate between excess adiposity and increased lean body mass. In contrast, subscapular and triceps skinfold measurements and determination of the waist-hip ratio, as well as the waist circumference (WC) measurements, help define the regional deposition of fat which then differentiates the more medically significant central obesity, in the adult population, from peripheral obesity.[1]

1.1.2 Classification of Obesity

The American National Heart, Lung and Blood Institute (NHLBI) and the World Health Organisation (WHO) classify obesity and overweight according to BMI values and they relate both the BMI classification and the WC measurements to disease risks. Essentially both the NHLBI and the WHO classifications for obesity according to the BMI tables are similar. The obesity-associated metabolic complications according to waist circumference specify that a WC greater than 88cm in the female and 102cm in the male are substantially increased.[2] The rationale for using the NHLBI classification (Table 1.1) is that it is endorsed by an institute concerning the medical disease states affecting people.[3] Furthermore, this purposefully

highlights the value for weight reduction, as a reason to reduce the cardio-vascular co-morbidities associated with obesity and overweight. These classifications include the measurements of BMI and WC in their tables. They both, in fact, link the measurements of BMI and WC to the relevant risks for development of cardio-vascular conditions. The reason for the inclusion of the WC measurement is that this measurement is an indication of the localisation of excess adipose tissue in the abdominal area and visceral organs and the relevance thereof is the association this measurement has with cardio-vascular co–morbidities.[4]

Table 1.1: NHBLI-Classification of Overweight and Obesity by BMI, WC and Associated Disease Risks

	BMI (kg/m^2)	Obesity Class	Men≤ 102 cm Women ≤88cm	Men > 102 cm Women >88cm
Underweight	< 18.5		-	-
Normal	18.5 - 24.9		-	-
Overweight	25.0 - 29.9		*Increased	*High
Obesity	30.0 – 34.9	I	*High	*Very high
	35.0 – 39.9	II	*Very high	*Very high
Extreme Obesity	40.0 +	III	*Extremely high	*Extremely high

*This is disease risk for type 2 diabetes mellitus, hypertension and cardio-vascular disease (CVD).
Increased WC can be a marker for increased risk in persons of normal weight.

For the purposes of this study, the following classification for obesity as defined by the BMI will be used. The BMI classification defines obesity into the following classification groups.[5]

a) Overweight is represented by a BMI of 25-29.9kg/m^2
b) Obese I is represented by a BMI of 30-34,9kg/m^2
c) Obese II is represented by a BMI of 35-39.9kg/m^2
d) Pre-morbid obesity is represented by a BMI of greater than 40kg/m^2

For the purpose of this study, the WC references used will be the same as those in the table for the NHBLI Classification: less than 88cm for adult females and less than 102 cm for males.

1.1.3 Obesity and Associated Disease States

The present epidemic of obesity appears to have commenced during the early 1980's and it has increased exponentially ever since. This has lead to an ever increasing number of obese and overweight individuals and a concomitant development of co-morbidities associated with obesity. These co-morbidities include the disease states that affect the cardio-vascular system such as coronary heart disease, the disease states that affect the endocrine system such as diabetes and poly-cystic ovarian syndrome and those disease states that encompass certain cancers such as breast cancer and colon cancer.[6] This increase in disease states has been paralleled by an equally explosive scientific research arena in trying to curb the development of obesity. In 1997 the WHO accepted obesity as a major public health problem.[7] In spite of the abundant research into the underlying causes of obesity and the knowledge at all levels i.e. cellular, physiological, behavioural and psychological, the management of obesity still remains complex and difficult.[8] These difficulties seem to arise from the paucity of effective short term and long term treatment options as well as due to the reality that obesity has a chronic and relapsing profile.[9] It therefore follows that over the last two decades there has been a constant search for novel and innovative behavioural and awareness progams in trying to curb the development of obesity.[10]

1.2 THE PREVALENCE OF OBESITY ON A GLOBAL SCALE

The International Obesity Task Force (IOTF) claims that 400 million people are obese while 2 billion people are overweight.[11] The global burden of obesity was estimated in 2005 and projected figures were calculated for 2030 by Kelly *et al*.[12] In this study representative population samples were drawn from 106 countries, representing 88% of the world population. In 2005, 23.2% of the world's adult population (24% male and 22.4% female), was considered to be overweight, whilst 9.8% (7.7% men and 11.9% women), was considered to be obese. This translated into approximately 937 million adults being overweight and 396 million being obese. If the present secular trends continue unabated, the projected figures for 2030 estimated that 2.16 billion adults will be overweight whilst 1.12 billion will be obese.[12] The WHO figures for obesity are consistent with these findings, but their figures for the number of people being overweight differ.[13] The WHO has estimated that 1.6 billion adults were overweight in 2005, while 400 million adults were obese. The projected figures estimated by the WHO for 2015 reveal that 2.3 billion adults will be overweight while 700 million adults will be obese.[13] The other global statistics shown by the WHO are those for children, where 20 million children under the age of 5 years were shown to be overweight or obese in 2005. The obvious concern amongst these children is not only the possible metabolic consequences of the obesity on the health of these children but that

the pattern will extend into adulthood, which was demonstrated in the Child and Adolescent Trial for Cardiovascular Health Study (CATCH).[14] It was shown that only 5% of children who were obese or overweight would attain a normal body weight. Also, it was demonstrated that cardio-vascular risk factors such as atherosclerosis commences during childhood, especially in those children with a high BMI or demonstrating an increase in BMI.[15]

1.2.1 The Prevalence of Obesity in South Africa

In South Africa there are different ethnic and racial population groups and there exists a difference in the weight and BMI amongst these groups. Table 1.2 represents the BMI for males and females, as occurs in the different racial groups. The table is adapted from 2 studies on obesity in South Africa-the South African Demographic and Health Survey (SADHS)[16] and a study from the school of Public Health at the University of the Western Cape.[17]

Table 1.2: BMI in kg/m^2 for Different Racial Groups of South African Males (M) and Females (F) (%)

Race	Black		Coloured		Indian		White		Total	
Gender	M	F	M	F	M	F	M	F	M	F
BMI<19.5	13.0	4.9	12.0	10.5	17.0	15.0	5.0	3.1	13.0	5.6
BMI=19.5-24.5	62.0	36.7	57.0	36.3	50.0	36.0	40.5	48.0	58.5	38.0
BMI=24.5-29.5	19.0	26.0	23.0	26.0	24.0	28.0	36.5	26.0	21.0	27.0
BMI>29.5	6.0	31.0	8.0	26.0	9.0	21.0	18.0	22.0	7.5	30.0

According to the South African Society of Obesity and Metabolism (SASOM), one in two women and one in three men in South Africa are overweight, about 25% of South Africans are overweight with a BMI between 25-30 kg/m^2, while another 20% are obese with a BMI > 30kg/m^2.[18] The National Food and Health Consumption Survey (NFHCS) has shown that 17% of South African children between the ages of 1-9 years are overweight or obese.[19] The Youth Risk Behaviour Survey which included a total of 9054 participants and was conducted in 2002, showed that 17% of adolescents were overweight while 4.2% were obese.[20] South African female children are more overweight than their male counter-parts across all races until the age of puberty or the age of 11 years. After that black female children show the highest frequency for obesity and overweight.[21] In fact this population group is considered a high risk category for obesity. The prevalence of obesity and being overweight in black females at age 18 years is estimated to be 37%.[22] The evidence to suggest that urbanisation is a causative factor for the development of obesity and overweight children and adolescents

is supported by the fact that obesity is found in 20.1% of urban children compared to 10.8%-15.8% of rural children.[21]

The prevalence and distribution of obesity which was once believed to be an occurrence particular to higher-income communities is now also on the rise in lower–income communities and with this comes the advent of the concept of the double-burden of disease in lower- income countries.[23]

1.3 THE UNDERLYING CAUSES AND DETERMINANTS OF OBESITY

The aetiology for the development of this global obesity and overweight problem is primarily brought about by the imbalance of kilojoule or kilojoule intake and energy expenditure.[24] This translates essentially into the greater intake of energy-rich foods coupled with a more sedentary lifestyle, which is being witnessed in most parts of the world. Research has shown that certain factors associated with overweight and obesity may be linked to early-life determinants.[25] These determinants have been implicated in enhancing the development of obesity and overweight individuals on a global scale. It has also been accepted that there are genetic determinants which predispose certain individuals to obesity. It can further be said that most of these associated factors have arisen and developed exponentially with urbanisation and globalisation of the world.

1.3.1 Dietary Changes

The introduction of high energy, high fat diets with less physical activity and consequently, less utilization of energys, as is typically displayed in the traditional Western lifestyle, has been strongly linked to the rise in the tide of obesity.[26] Portion size of foods have enlarged significantly over the past two decades and the global supply of fat has increased by 20g per capita in the United States of America (USA), East Asia and Western European countries since the 1960's.[27] It appears that humans have evolved in an environment prone to food scarcity and that the natural instinct or genetic programming is to respond to hunger. Early man expended most of his physical energy on the sourcing of food with the responsive instinct to eat. Restraint is difficult to implement as this is not part of the natural programming of man on an evolutionary level. Food was cyclical and in short supply.[28] Unfortunately with the development of excess food states and especially, the increasing availability of high energy foods, "the human natural check to restrain" is markedly less evident.[29] Fat renders food palatable and enhances taste. Fat that is ingested is preferentially stored. High fat diets may be linked to genetic predispositions for obesity, where the development of the obesity is promoted by the presence of a high fat diet.[30]

The consumption of sugar-sweetened foodstuffs, especially beverages is linked to an increase in total energy consumption as part of an ongoing diet.[31] There is some evidence to suggest that high-fructose corn may be implicated in the increase in global obesity, however it always remains to be seen in the context of total energy intake.[32]

1.3.2 Physical Inactivity

Less than 30 minutes of daily physical activity is directly linked to a decrease in energy consumption.[33] Furthermore, the physiological effect of the skeletal muscles is to maintain fat balance by the oxidation of fat. Regular and repeated physical activity therefore encourages the oxidation of fat in the muscle as well as promoting the consumption of post-exercise oxygen. In the presence of adiposity and during exercise, the adipose tissue is able to increase the presence of fat oxidation by elevating the available circulating free fatty acids. This leads to a substrate competition between the free fatty acids and glucose available to the skeletal muscles which culminates in the development of insulin resistance.[33] Therefore urbanisation and its associated decreased levels of physical activity increase the susceptibility of the individual towards obesity. Linked to a reduction in activity levels is the fact that almost 25% of children in the USA watch approximately four hours of TV per day and that these children have a higher BMI value than children who do not watch TV for the time periods.[34] Increased TV viewing is linked to adiposity in children as shown in many studies. This is obviously associated with decreased metabolic rates and decreased energy consumption. It may further be linked to the advertisements that children are exposed to while watching television, where they are encouraged to eat high fat and sweetened foods.[35]

1.3.3 Urbanisation

In South Africa, the 1999 National Food and Health Consumption Survey (NFHCS) confirmed a higher prevalence of overweight and obese children, especially those between the ages of 1 to 3 years, in urbanised areas.[36] With the advent of industrialization and globalisation, mothers are often expected to return to workplaces before full weaning of their children with a decrease in breast-feeding practices. Similarly, with the increase in urbanisation, there is an increased exposure to a greater variety of foods, which has been shown to be linked to an increased energy intake due to the stimulation of people's sensory-specific satiety.[37] Furthermore, with urbanisation, there is a decrease in activity levels following on the increase in transportation as well the increase in leisure time activities, such as television viewing.[38]

Consequences to the forces of urbanization as well as globalization, many of the population groups, as seen in South Africa, have now been subjected to and influenced by the changes

that have occurred elsewhere and globally.[39] These pressures and influences have subsequently shaped the population's eating and lifestyle patterns and also have contributed to the higher fat diets being available and desirable. With urbanization and the change in social lifestyles there has been an associated decrease in levels of physical activity.

1.3.4 Early Life Determinants

Recent research has shown that certain factors associated with overweight and obesity may be linked to early-life determinants.[40] Factors relating to maternal health and early childhood rearing practice may have an impact on the development of obesity.[40]

Maternal pre-pregnancy BMI is positively correlated with adult obesity in her child, according to a study by Stettler *et al*.[41] Furthermore, maternal diabetes with the concurrent hyperglycaemic state during gestation mediates the process for obesity. During pregnancy, the foetus has its first interaction with the maternal physiology and therefore the external environment, which may be conducive to inducing patterns for obesity. This has been confirmed by Maffeis, who showed that children born to diabetic mothers were more often obese.[42]

The concept of rapid infant growth is largely linked to the state of overfeeding. Gillman has revealed through observational studies and feeding trials that a rapid gain in weight in the first half of infancy will predict later overweight or obesity and a higher blood pressure.[43]

The Agency for Healthcare Research and Quality in the USA issued a report on breastfeeding. They concluded that breastfed children had a reduced risk for obesity when compared with non-breastfed infants.[44]

Later onset obesity is associated with children who sleep for less than 10 hours per night. A prospective cohort study by Touchette *et al*. looked at the longitudinal sleep patterns of 2223 children from birth to 6 years of age, while controlling for a variety of obesogenic environmental factors.[45]

The development of obesity in the nutritionally stunted infant, has been proposed to originate from an impairment of fat oxidation and a less efficient ability to regulate energy intake.[46] Meanwhile, the obese or overweight infant or young child may be locked into the longitudinal tracking of obesity into adulthood due to the development of a persistent obesity. This is linked to the stage of growth during young childhood when there is a period of adverse visceral fat accumulation with early adiposity rebound. This is initiated and triggered

by the state of hyperplastic obesity. The child is predisposed to obesity and the associated metabolic consequences.[47]

1.3.5 Genetic Determinants

It has been accepted that there are genetic determinants which predispose certain individuals to obesity and being overweight, and on exposure to a high energy, high fat and high sugar diet the onset of obesity is triggered, favouring the development of earlier and more severe forms of obesity.[48] Therefore it can be deduced that foodstuffs such as high fat intake or high sugar intake precipitate the genetic expression of obesity and that in environments where there are reduced intakes of these offending agents, the genetic expression of the obesity would not have been manifested.[49] However, even though it is known that there is a genetic predisposition to obesity, the promotion of this as a cause for obesity may in fact enhance the genetically deterministic beliefs and perceptions, which in turn decreases motivation for change towards healthier lifestyle patterns. In fact, it appears that individuals who perceive that their obesity is of genetic origin will demonstrate a resistance to modifying their eating patterns and will have a reduced intake of vegetables and fruit and participate in less physical activity.[49]

Recent research suggests that there may be an underlying genetic factor creating a predisposition to rapid weight gain in the presence of higher fat diets.[50] The gene that appears to be triggered by a high fat diet and has been implicated in leading to obesity, is referred to as the tumor necrosis factor (alpha) gene.[50] The presence of this gene has in fact been shown to be manifested in the black South African woman and not in any of the other ethnic groups of South African women.[50] This suggests that in the face of a sudden increase in the intake of a higher fat diet, the tendency to gain weight will be presented and manifest itself. In the presence of a normal fat intake however, the tendency to weight gain is similar to any other woman of a different racial group.

1.3.6 The Causes of Obesity in South Africa

Briefly the causes of obesity, in South Africa, are no different to other countries globally, and Mickey Chopra previously from the School for Public Health at the University of the Western Cape, and presently the Chief of Health at UNICEF, has stated that South Africa has one of the fastest growing markets of international fast food outlets.[51] This correlates with the increase in urbanization and modern living styles, which in turn have increased the susceptibility to unhealthy eating choices and lifestyle. The fundamental cause of the obesity epidemic in South Africa is a more sedentary lifestyle and the introduction of low nutrient and high fat density diets.[52] The behavioural patterns of communities have changed drastically

due to urbanization and industrialization.[52] There has been markedly reduced physical activity due to the introduction of mechanization and transportation. The WHO has reiterated that globally, as in the case of South Africa , the fundamental cause of the obesity epidemic has been sedentary lifestyles with high fat density diets, as well as the behavioural patterns of communities due to urbanization, industrialization and globalization.[52] Urbanisation which incorporates the concepts of decreased physical labour efforts; increased transportation opportunities with less ambulatory activities; more sedentary recreational activities in a background of increased availability of “on-the-go” high energy, sugar–rich and high fat foodstuffs, has induced behavioural patterns and modifications.[53] It can further be concluded therefore that old traditional patterns such as regular meal-time, and cooked meals at home have been replaced by take-aways, quick meals and fried foods.

Furthermore research in the South African context enforces and correlates the relationship between body weights and urbanization: percentage of body fat measured amongst young adolescents has been shown to be consistently less in rural children when compared to urban children.[54] A study of 1040 black females confirmed that rural women had a lower mean BMI than urban woman and that the diets of the rural females contained less fat.[55] In contradiction to the aforementioned, evidence appears to affirm the previously related concerns that black females appear to have a higher risk for obesity in the South African context.[55] On a closer inspection of the statistics they do reveal that women across all racial groups are at risk for obesity and for being overweight in comparison to the male.[55]

Simultaneously, South Africa has shown alarming rates of increased cardio-vascular disease and diabetes across all races which previously had shown a very low prevalence rate.[39] As South Africa has a heterogenous mixture of racial and ethnic population groups it is endowed with many of its own unique cultural factors, perceptions and belief systems. Interestingly, despite these obvious changes, studies from South Africa have shown that South African black females do not perceive themselves as being obese or overweight and that thinness could possibly be associated with the immune deficiency virus infection.[56]

On a global level as well as a local level, evidence that urbanisation and globalisation are triggers for the sudden increase in the prevalence of obesity is demonstrated by the figures of the percentage changes arising from most developing countries. Another example, although not relevant in the South African context but also highlighted this reality, is that of Brazil which, in its role as a third-world country, has demonstrated a three-fold increase in the percentage of their population who have become obese or overweight. The figures in Brazil increased from 4.1% in 1974 to 13.9% in 1997.[57]

1.4 THE PHYSIOLOGY OF ADIPOSITY IN THE HUMAN BODY

Body weight is regulated by food intake and energy expenditure. The mechanism has both central and peripheral triggers. The peripheral tissues which are involved in the regulation of weight are adipose tissue, the gastro-intestinal tract and the pancreas. Centrally, weight is regulated in the hypothalamus via the arcuate nucleus. The nucleus of the solitary tract in the brain then allows for the integration of both of these central and peripheral triggers.[58]

The adipose tissue is associated with leptin production. It is meant to be found in higher levels in subcutaneous fat than visceral fat. The blood level of leptin is proportional to the amount of fat in the body.[59]

There are multiple hormones involved in the regulation and pathophysiology of obesity, including the gut-related hormones. The gastro-intestinal tract is associated with the production of ghrelin, glucagon-like peptide (GLP-1), peptide yy (PYY), oxyntomodulin and cholecystokinin (CCK).[58]

Ghrelin is a circulating peptide hormone originating from the stomach. It is the only recognised and peripherally acting orexigenic hormone and is responsible for stimulating appetite.[58] All the other gut-derived hormones act as anorectic agents and are responsible for limiting food intake. They aid optimal digestion and absorption while avoiding the consequences of overfeeding, such as hyperinsulinemia and insulin resistance. Peptide YY (PYY) is found throughout the intestine but predominantly at higher levels distally, with the highest levels being found in the colon and rectum. It is secreted by the L cells of the distal small bowel and colon. PYY is released postprandially, and in turn will impact on the hypothalamus resulting in delayed gastric emptying, thereby reducing gastric secretion.[59] The administration of PYY before a meal will result in decreased food intake.CCK is produced in the gallbladder, pancreas and stomach, and is concentrated in the small intestine. The release of CCK is in response to the presence of dietary fat. CCK regulates the contraction of the gallbladder, pancreatic exocrine secretion, gastric emptying and gut motility. CCK acts centrally by increasing satiety and decreasing appetite. The control of appetite is mediated through the satiety signal via subtype CCK-A receptors on the afferent vagal fibres to the brain.[60] The termination of a meal is also regulated by the postprandial release of oxyntomodulin. This peptide is secreted by similar intestinal cells that secrete PYY. Oxyntomodulin is associated with a reduction in fasting ghrelin levels.[61] Leptin, a dominant long-term signal responsible for relaying information centrally to the brain, is transported across the blood-brain barrier, binds to specific receptors on appetite-modulating neurons and the arcuate nucleus in the hypothalamus and inhibits appetite.[62]

At a cellular level, adipose tissue exerts its effects through an increased release of free fatty acids.[63] Excess adipose tissue has been shown to produce adipose-derived factors called adipokines that exert their specific functional effects on the body.[64] These substances include the hormones, such as leptin and adiponectin; cytokines such as Interleukin-6 (IL-6) and Tumour necrosis factor-alpha (TNF-alpha): as well as transcription factors such as Peroxisome proliferator-activated receptor (PPA), as well as other products released from the adipose tissue such as angiotensinogen.[64]

The presence of these hormones and inflammatory promoting substances produced by the adipocytes are regarded as the underlying chemical agents that precipitate the mechanisms associated with the co-morbidities of the obese or overweight state in the human body, (both those of cardiovascular origin and cancer linked). The TNF-alpha has also been linked to insulin resistance.[65] Levels of TNF-alpha are higher in the more obese and overweight individual and this appears to be linked to the release of free fatty acids, which in turn is linked to a decreased adiponectin synthesis.[66] This all sums up to having a negative effect on the signalling of insulin.[67] TNF-alpha also activates nuclear factor-kappa B, which leads to inflammatory changes in the vascular tissues.

There is ample evidence in the scientific and medical literature to provide relevance to the role of insulin in many of the cardio-vascular disease states as well as in the metabolic syndrome and diabetes.[68] Meanwhile, adiponectin is defined as an adipokine which is derived from plasma protein. It acts as an insulin sensitizer, anti-inflammatory and anti-atherogenic agent.[69] Adiponectin serves many beneficial metabolic and vascular functions as it inhibits vascular smooth muscle proliferation, increases fatty acid oxidation in the peripheral tissues, prevents the endothelium from macrophage-induced injury and prevents the storage of ectopic adipose tissue. Adiponectin therefore has by implication a protective effect on the physiology of the body. Levels of adiponectin have been shown to be reduced in obese and overweight individuals.[70] Adiponectin may well be under feedback inhibition in obesity.

Evidence has established that adipose tissue localised within the abdominal cavity and deposited within the internal organs or ectopic adipose deposition, is the most metabolically significant.[71] This adipose tissue which is deposited in the abdominal cavity is referred to as visceral adipose tissue (VAT) in contrast to subcutaneous or peripheral adipose tissue (SCAT), which is considered less metabolically significant. VAT is deposited in the body cavity beneath the abdominal muscles which is composed of the lesser and greater omentum and the mesenteric fat.[71] Usually, VAT makes up 20 percent of total fat in men and

5-8 percent in women. Adipokines such as IL-6 and PAI-1 are produced in greater quantities by VAT than SCAT and they can be delivered via the portal system directly to the liver where they can result in hepatic and systemic inflammation.[72] In contrast, leptin is more highly secreted by SCAT. Adiponectin mRNA and protein levels are reduced in omental VAT compared with SCAT, and other adipokines produced in VAT destabilize adiponectin mRNA.[73] There is therefore a strong inverse correlation between serum adiponectin levels and VAT mass and this may in part explain the link between VAT and the metabolic syndrome, with its known co-morbidities.[73] Subsequent to weight reduction, the levels of many of these metabolic agents produced by the adipose tissue, are restored to normal.

A weight reduction of between 5% to 10% of the original weight is considered significant and clinically beneficial.[74] In fact during a weight reduction progam and after weight reduction, the initial weight reduction affected is that from the fat deposited in the visceral areas and this in turn benefits homeostasis significantly.

1.5 CONSEQUENCES OF THE OVERWEIGHT STATE AND OBESITY

The consequences of obesity and being overweight are two-fold. Firstly the physical presence of excess fat tissue in the body leads to metabolic events that are detrimental to people's health. It has been shown in the literature that excess adiposity and especially adipose tissue distributed in certain areas of the body, such as visceral fat and ectopic adipose tissue, becomes metabolically active and produces metabolic substances which are linked to illnesses seen in the obese and overweight individual. These are collectively referred to as the co-morbidities of the obese or overweight state.[6]

Secondly, the increased prevalence of these disease states in a community, impacts on the healthcare systems and personnel.[75] The most obvious direct effect on the healthcare systems of a country is that there are increased costs to the state and healthcare systems.[76]

Whereas previously, it was infectious diseases and conditions related to under-nutrition that impacted mostly on the health system, they have more recently been replaced globally to varying degrees by the disease entities brought about by obesity and lifestyle modifications. These conditions incorporate primarily the cardio-vascular disease states such as heart disease.[77] Other disease states linked to obesity include diabetes mellitus as well as certain cancers such as breast cancer, colon and prostate cancers.[78,79] There has furthermore been an increase in the prevalence of sleep apnoea over the past two decades and this is linked to the increase in obesity prevalence.[80,81] In England 67% of hospital consultant episodes for women, between 2002 and 2003, were related to obesity.[82] In 1998, the direct cost to the

National Health System in the United Kingdom imposed by people's state of obesity and overweight was estimated at 480 million pounds, while in 2004, this had increased to 1,1 billion pounds and in 2007 this expenditure had reached a figure of 3,2 billion pounds.[82] In Australia, the Baker IDI (International Diabetes Institute) Heart and Diabetes Institute, estimated that 9 million Australians were obese or overweight in 2008. They further showed that 700,000 cardio-vascular related illnesses over the next few years will amount to 3 billion dollars in hospital costs. Diabetes Australia, a representative organisation, has estimated that obesity will cost the Australian taxpayer 58 billion dollars per year as a consequence of the burden it will have on the health system combined with the loss in productivity induced by the disease states or co-morbidities linked to the obesity.[83] This figure also includes welfare payments that will have to be made to support affected individuals and their families. This figure has tripled since estimates had been permutated in 2005. In Scotland, the recently published Scottish Intercollegiate Guideline Network (SIGN) Guidelines reveal that 68.5% of Scottish men, 61.8% of Scottish women, 36.1% of Scottish boys and 26.9% of Scottish girls are obese or overweight.[84] Figures from 2001, showed that costs due to obesity and obesity-related disease amounted to 171 million pounds and that this figure could well double in the next decade.[85] Obesity accounts for between 0.7% to 2.8% of a country's healthcare costs. It has been shown that obese individuals have a 30% higher medical expenditure in comparison to their age – equivalent and normal weight peers.[76] The sudden increase in healthcare costs correlates with the increased incidence of obesity and its respective co-morbidities such as heart disease, diabetes and cancers. The WHO has shown that 17 million people die from heart disease and strokes yearly and that diabetes has become a global epidemic.[85] There will be an increase of more than 50% diabetic related deaths worldwide within the next 10 years. The SIGN Guidelines has further stated that obesity at the age of 40 years decreased life expectancy by 7.1 years in a Scottish female and 5.8 years in the Scottish male.[84] Therefore, obesity and being overweight represent a rapidly growing threat to both the economic soundness of the healthcare systems of countries as well as on the direct wellness and health of populations. Ultimately the deduction can be made that the obesity-related co-morbidities have become so common that these have now replaced the more traditional problems, such as under-nutrition and infectious disease which were historically the disease states for medical science and research and that these now dominate this arena.[86]

1.6 RATIONALE FOR WEIGHT REDUCTION TO IMPROVE HEALTH OUTCOMES

The impact of obesity is its link to the co-morbidities associated with multiple organ systems of the human body, of which the most significant encompasses the cardio-vascular system which is associated with an increase in global mortality as the degree of obesity increases.[87] The Framingham Heart Study showed that obesity is a cardiovascular system risk factor independent of other risks such as type 2 diabetes mellitus, smoking and dyslipidaemia.[88] In the USA, coronary heart disease is the single leading cause of death, with 1 in 2.9 deaths being attributed to coronary disease.[89] Obesity and being overweight also encompasses the endocrine system and here it includes type 2 diabetes mellitus and the Metabolic Syndrome.[90] The association of obesity with type 2 diabetes mellitus are significantly correlated – hence the term 'diabesity' has been formulated.[91] A direct link between obesity and the risk for diabetes mellitus exists to a point where obesity could be considered a causative factor of diabetes. Obesity is linked to certain cancers, of which robust studies have implicated breast, colon and prostate cancers.[92] Other disease states linked to being overweight and obese include the hyper- coagulable states which render the patients susceptible to emboli and strokes, gallbladder disease, dyslipidaemias, osteo-arthritis, gout and sleep apnoea as referred to before.[6]

Of more recent interest is the effect of obesity and overweight and the consumption of high kilojoule or kilojoule foods on the liver.[93] This condition could be broadly defined as one of the ectopic adipose tissue depositions. Of real concern is the entity of the hepatic manifestations of obesity such as non-alcoholic fatty liver disease (NAFLD) and nonalcoholic steatohepatitis (the NASH syndrome).[94] The liver can normally maintain a relatively constant fatty acid flux into triglyceride biosynthesis. During states of high lipogenic dietary intakes, the fatty acids are synthesized de novo in adipose tissue as well as in the liver. The hepatocytes are usually able to control the rate of very low density lipoproteins (VLDL) secretion so as to prevent the accumulation of excess triglyceride in the liver, referred to as hepatic steatosis. The heritability of hepatic steatosis and therefore the inability of the hepatocytes to maintain normal flux of fatty acids from the liver in the presence of high lipogenic diets, is quite high and linked to a gene, referred to as PNPLA3, which is expressed in adipose tissue and liver.[95] NAFLD is the most common cause of abnormal liver tests in North America, with a prevalence of 42% in obese women and 32% of obese men. Five percent of these individuals will progress to cirrhosis within 5 years.[96] Besides the abnormal blood tests found in the NASH syndrome, fatty infiltration of the liver is visualized on liver ultrasound. A weight reduction of between 5-10% of original body weight in the overweight and obese adults could

reduce the ectopic adipose tissue in the liver as well as many of the other co–morbidities associated with obesity or overweight.[97]

Many of the aforementioned disease states are often inter-linked and often occur concurrently.[98] The reality that obesity and overweight are precursors to most of the diseases presenting today, suggests that they should be managed both by implementing management and treatment strategies as well as formulating preventive strategies. The implementation of preventive strategies should provide for the needs of the adult population, however, they should be aimed primarily at children and adolescents.[99] There is evidence to suggest that adiposity in the mid-life of a female is related to a reduced probability of healthy survival to older age and that maintaining a normal weight during adulthood improves survival and healthier outcomes.[100] The assumption is therefore that the application of management strategies for weight reduction and lifestyle modification for adults should have a dual effect. Adults must be educated, who in turn are to then extend these strategies to their immediate family or individuals within their households.

1.7 MANAGEMENT OF OBESITY AND THE OVERWEIGHT STATE

The Obesity Management Association (OMA) represents an organisation that was established to regulate and monitor the weight reduction sectors of the industry. [102] Besides the fact that they monitor weight reduction strategies, they do however stress the benefits of weight reduction and emphasize the increased mortality and morbidity associated with obesity and the overweight state. In April 2009, the American Society for Nutrition hosted a symposium on the “Integrative View of Obesity” which concluded that there has been an enormous growth in the knowledge of the physiology and neuro- endocrine regulation of appetite and satiety, as well as the genetic determinants of obesity.[103] The obesogenic environment with its constant supply of toxic foods, referring to the high fat, high refined carbohydrate and low fibre content foods, as well as cultural and ethnic issues were recognised as important factors contributing to obesity and recommended management options, which included public health campaigns, corporate and industry co-operation in procuring changes in the food supply.[102] The notion of affecting changes within the industrial production of foods was alluded to and deemed as being important; thereby creating the awareness that the implementation for changes in food production is important and imperative. Other important strategies that emanated from the symposium included the concept of developing innovative medical, behavioural and social progammes to address people’s dietary patterns. Once the environmental components of obesity and overweight have been addressed there is a need to focus on improving the lifestyle of the individual.

This should in turn lead to an improvement in dietary patterns and activity levels. These changes should then equate with a decrease in the co–morbidities linked to the obese and overweight state.[8,103] The management of obesity encompasses a variety of treatment options that have arisen over the years. These treatment and management options have now penetrated into most societies.

1.7.1 Treatment and Management Options for Weight reduction

Various options for weight reduction are available both globally and in South Africa and these management strategies for weight reduction include the following:

1.7.1.1 Dietician and healthcare professional programmes

These interventions include cognitive-behavioural strategies which are directed toward modification of eating patterns. It encompasses the social-contextual approach which is directed toward the social and partnership relationship to intervention. Biophysical strategies that have demonstrated success in weight reduction include the effect of dietary restriction. Appropriate dietary information is provided to the patients.[104]

1.7.1.2 Exercise programmes with dietary intervention

Recent studies have shown the benefit of exercise in conjunction with energy restriction compared to kilojoule restriction alone. These studies included the study by Larson-Meyer, who looked at the fitness versus the fatness debate.[105,106] These studies demonstrated the value of exercise training when combined with weight reduction (energy restriction). The results showed that body weight decreased similarly in both the energy-restricted group and the exercise with energy restricted group. However, the reduction in visceral fat was significantly greater in the exercise with energy reduction group and manifested a significant improvement in insulin resistance.

1.7.1.3 Medical management with pharmacological agents

The pharmacological agents used for the treatment of obesity are either for short –term (< 4 months) use only, or those available for long-term use (> 4 months). Examples of the short –term medications include, phentermine, whilst those advocated for long-term use include orlistat.[107] Medication, which is classified as ‘novel therapy’ used in the treatment of obesity include Lorcaserin, Naltrexone-bupropion and topiramate.

1.7.1.4 Bariatric surgery

This refers to the surgical procedures that are performed for the single reason to lose weight.[108] Bariatric surgery is divided into two groups:

- malabsorptive procedures
- restrictive procedures

1.7.1.4.1 Malabsorptive procedures

These techniques decrease the absorption of nutrients by shortening the functional length of the small intestine creating a short-bowel syndrome, which leads to a negative energy balance and subsequent weight reduction.[108] The first bariatric operation was the jejunoileal bypass. It is, however, associated with long-term complications such as liver failure, malnutrition, electrolyte imbalances, vitamin deficiencies, renal (oxalate) stones, and death, therefore it is no longer performed. Currently performed operations are the biliopancreatic diversion and the biliopancreatic diversion with duodenal switch and in both, a partial gastrectomy is performed, leaving a 100–150 ml gastric pouch. The biliopancreatic diversion with duodenal switch usually results in less dumping and marginal ulcers than a classical biliopancreatic diversion. Both procedures are dependent on the length of the common limb i.e. the time during which digestion and nutrient absorption can occur which in turn determines the degree of malabsorption.

1.7.1.4.2 Restrictive procedures

These operations limit the storage capacity of the stomach and as a result early satiety arises, which leads to a decrease in caloric intake. Restrictive procedures are simpler to perform and are therefore accompanied by fewer complications than the malabsorptive procedures. The vertical banded gastroplasty and the laparoscopic adjustable gastric band are fairly popular operations done. In the vertical banded gastroplasty, the fundus of the stomach is stapled parallel to the lesser curve of the stomach, using a surgical stapling device.[108] The distal exit of the created pouch is narrowed with a band and a food-receiving reservoir of 50 ml will remain. The laparoscopic adjustable gastric band technique involves applying a silicon inflatable gastric band horizontally around the proximal part of the stomach. The gastric band is inflated via a subcutaneous port creating a pouch. The tension of the gastric band can be adjusted as required. Another technique includes the intragastric balloon. This is a smooth saline-filled balloon that is endoscopically placed into the stomach. It can be used as a temporary method to aid in weight reduction.

At present, in the United States of America, the Roux-en-Y gastric bypass is the most frequently performed bariatric procedure.[109] This has both restrictive and malabsorptive aspects. The restrictive component includes a gastric pouch which is created and then separated from the rest of the stomach. Continuity to the small intestine is restored by a Roux-Y-limb, which is connected to the jejunum. When eating, the gastric pouch is filled quickly and leads to a sensation of satiety. Food from the gastric pouch will enter the jejunum

via the Roux-Y-limb and the length of the common limb, which is inversely related to the length of the Roux-Y-limb, will determine the degree of malabsorption.

Bariatric surgery is restricted to individuals with a BMI greater than 40 kg/m^2 or a BMI greater than 35 kg/m^2 in an individual with significant obesity-related co-morbidities.

1.7.1.5 Commercial programmes on the internet

Due to the escalating obesity epidemic, healthcare professionals seek interventions that could reach large numbers of individuals in a timely and possible cost-effective manner of which the Internet is an obvious solution. There are many commercial weight reduction programmes available on the Internet.[110] A review by Weinstein, describing the efficacy of weight reduction programmes on the Internet in the USA, concluded that the Internet could be an alternative to face to face weight reduction programmes.[111] Eight published studies that met the inclusion criteria were reviewed. Of the 8 studies, five evaluated the internet as a means for weight reduction while three evaluated the Internet as a means to maintain long-term weight reduction. Those examining weight reduction via internet programmes reported positive results, except for one investigating a commercial programme. The results from the three weight reduction maintenance programmes conducted on the internet were equivocal. The participants of all these studies were predominately white and educated women, therefore generalizations of results may be limited. It still remains doubtful as to the efficacy of using the Internet for long-term weight reduction maintenance.[111] More research is needed to determine the applicability of Internet based programmes for different age, ethnic, and socioeconomic groups.

1.7.1.6 Commercial 'diet' centers

Examples of this are centres such as weigh-less or weight watchers. They usually include group sessions and group interventions.[112] A systematic review of an evaluation of commercial weight reduction programmes in the USA by Tsai, revealed that the evidence to support the use of the major commercial and self-help weight reduction programmes is suboptimal and that future controlled trials are necessary to assess the efficacy and cost-effectiveness of these interventions.[113] Essentially, according to the literature, the average weight reduction achieved by the average weight reduction programme is between 3-6kgs. during a 6 to 12 month period.

1.7.2 Management Options in the South African Context

South Africa has followed many of the global trends in the management of obesity and overweight individuals. Many of the technologically driven programmes (in reference to computers) are attainable, but are often not available to the poorer sectors of the population due to the 'digital divide' that exists in the South African society.[114] In South Africa, most pharmacological agents licensed for the treatment of obesity are available, but require prescription from a medical doctor and are not reimbursed by the medical aids. The commercially available diet centers are widespread and active in most cities. Bariatric surgery has become more widely accepted with the development of specialized Bariatric centers in certain major cities. The option of bariatric surgery remains expensive for many individuals and is not covered by the medical aid schemes or insurances. However, more recently, it appears that particular options of certain medical aids will effectively reimburse for Bariatric surgery in the pre-morbidly obese.[115] The vast majority of available dietary weight reduction options, besides bariatric surgery, however have significant drop-out rates and poor maintenance results.[116]

1.7.3 Components for weight reduction programmes

During weight reduction programmes, the evidence has shown that nutrition education and lifestyle advice was more effective if it included 3 important components and essentially, these factors increased the outcomes of the weight reduction programmes when compared to programmes that did not. These factors include the following;[116]

1.7.3.1 A motivational component

The effect of this was to increase awareness and enhance change by addressing people's beliefs, attitudes and behaviour patterns. This could be achieved through effective communication strategies.[117]

1.7.3.2 Action component

It was necessary to facilitate people to attain their goals by setting attainable goals and developing cognitive self – regulation skills.[118]

1.7.3.3 Environmental component

It was necessary to develop environmental supports.[119] This included the support of family, community organizations or support centres.

It could be deduced that the lack of motivational interventions is one of the main causative issues for the disappointing results of weight reduction programmes.[118] There is evidence to

show that the addition of motivational interventions to encourage behavioural modification and to provide dietary advice improves the results of both long term and short term outcomes with view to weight changes and anthropometric changes during a weight reduction programme.[119] Weight reduction programmes that include dietary advice, physical activity promotion and behavioural change, which all collectively require motivation and therefore, motivational interventions are more successful than those that do not contain them.[120]

SIGN has emphasized that healthcare providers should become proficient in the diagnosis and assessment of individuals who are obese or overweight.[121] SIGN has published evidence- based guidelines for the management of obesity as it has become evident that the costs of the consequences of not treating obesity far outweigh the costs of treating or preventing obesity. The directive applied in these guidelines, is that weight reduction programmes should be individualized and should incorporate dietary advice, physical activity and behavioural changes.[84] The weight reduction programme should be viewed as a long term solution and a lifestyle change. The notion of weight cycling, where a repetitive pattern of weight reduction is followed by a rebound gain in weight, should be prevented as this is often associated with a higher BMI with each cycle of subsequent weight gain.[122] Bariatric surgery should be reserved for the morbidly obese or if there is a resistance to weight reduction in the obese.[123]

1.7.4 Motivational Interviewing during a Weight reduction Programme

The literature has indicated that during weight reduction programmes, lifestyle patterns, which would promote healthier behavioural changes are necessary and that these changes are required to be motivated.[118] The added benefit of utilizing the modality of 'motivational interviewing' as a style of interaction with patients during a weight reduction programme has been shown to decrease resistance to behavioural change and to optimize the changes in lifestyle behaviour patterns.[119] The intention of using 'motivational interviewing', was to initiate a resolution of the patient's ambivalence towards a healthier lifestyle option. Motivational interviewing emerged from experience in the treatment of problem drinkers, and was first described by Miller in 1983 and published in Behavioural Psychotherapy. In 1991, the fundamental concepts were broadened by Miller and Rollnick.[124] The definition according the these authors, describe motivational interviewing as a directive, client-centred counselling style for eliciting behaviour change, by helping clients to explore and resolve ambivalence. When compared with nondirective counselling, motivational interviewing is more focused and goal-directed. The central purpose of motivational interviewing is the examination and resolution of ambivalence, and the healthcare practitioner should be

intentionally directive in aiding the pursuit of this goal. The focus of motivational interviewing is on the “spirit” which pertains to the style of consultation rather than on the technique. The “spirit” can be described by the inclusion of the following qualities namely, that the motivation to change is initiated from within the patient and not enforced from without and that motivational interviewing relies upon identifying and mobilizing the patient’s intrinsic values and goals to stimulate his or her own behaviour change.[125] It is further said that it remains the patient's responsibility to resolve their own ambivalence. Ambivalence takes the form of a conflict between two courses of action (e.g., indulgence versus restraint), each of which has perceived benefits and costs associated with it. The healthcare practitioner’s task is to facilitate articulation of both sides of the ambivalence impasse, and help guide the patient towards an acceptable resolution that will initiate change. The use of direct persuasion is not believed to be effective for resolving ambivalence (Miller, Benefield and Tonigan, 1993, Miller and Rollnick, 1991).[124] It is advised that the counselling style should be a quiet and eliciting one and that the healthcare practitioner is directive in helping the client to examine and resolve ambivalence. The operational assumption in motivational interviewing is that ambivalence or the lack of resolve is the main obstacle to overcome in triggering change. The specific strategies of motivational interviewing are designed to elicit, clarify, and resolve ambivalence in a patient-centred and respectful counselling atmosphere. Motivational interviewing also accepts that the readiness for change is not a patient trait, but rather a fluctuating product of interpersonal interaction between the patient and the healthcare practitioner and, therefore, the health practitioner should be highly attentive and responsive to the client's motivational signs. Finally, the therapeutic relationship is more like a partnership of trust rather than viewed as expert versus recipient roles. The healthcare practitioner must respect the patient's autonomy and freedom of choice regarding their own behaviour.[125]

1.7.4.1 Characteristics of healthcare practitioner for motivational interviewing

a) Seek and comprehend the patient’s frame of reference, especially via reflective listening
b) Express acceptance and affirmation
c) Selectively reinforce the patient's self motivational statements when they recognise their problems and show concern, desire and intention to change.
d) Affirm the patient's freedom of choice and self-direction

Ultimately the intention is to have engaged the patient's participation and trust to initiate change.[125] This affords the healthcare practitioner the opportunity to offer and empower the patient with the appropriate information, knowledge and skills.

Motivational interviewing includes the following four main criteria and also incorporates the following concepts.[126]

a) **Empathy**: The initial consultation should demonstrate an understanding of the patient's presenting condition.
b) The **motivational interviewing spirit** includes autonomy, evocation and collaboration and asking for permission
c) **Motivational interviewing includes asking for permission, affirmation**, emphasizing **the patient's own control** and **recruiting their support**.[127]
d) **Motivational interviewing** includes the concept of **being directive and not proscriptive.**

During a weight reduction programme, the directive should be towards a change in lifestyle and towards an improvement in food choices, eating patterns and activity levels. Individuals need to be encouraged to assume responsibility.[128] Special attention must be focused on evoking and strengthening the patient's own verbalized motivations for change. The change-promoting value of hearing oneself discuss change was linked to the formulation of cognitive dissonance, and with a reformulation as self-perception theory.[129] Also relevant is the theory of the Counter-change (Roger) arguments.[130] The notion of "sustain talk," was originally conceptualized within the framework of motivational interviewing and this appeared to deal with the concept of "resistance' which actually represented the other side of the patient's ambivalence. Argumentation or confrontation is counterproductive and heightens resistance and especially resistance to change.[130] Specific patterns of behaviour require to be addressed and individuals have to be directed to act within the constraints of an autonomous and responsible person.[131] Brief interventions have developed and are adapted to the style of motivational interviewing. These share some of the features of classical motivational interviewing and have given rise to the expression which is found in the acronym **FRAMES,** originally devised by Miller and Sanchez.[132]. The letters of **FRAMES** refer to the use of **F**eedback, **R**esponsibility for change being initiated by the individual, **A**dvice-giving, providing a **M**enu of change options, an **E**mpathic counselling style, and the enhancement of **S**elf-efficacy.[133] Although these ingredients are congruent with the concepts of the classically described motivational interviewing style, advice-giving is not (Rollnick, Kinnersley and Stott 1993).[133] The concept of providing advice in a weight reduction programme, with the

provision of dietary advice and energy- reduction is integral to the programme and may appear to conflict with the traditional classical theory of motivational interviewing. However this should be viewed in the context of collaboration and providing a directive.[134] The literature further also refers to commitment, whereby a commitment to lifestyle changes needs to be undertaken by the patient.[135] Accountability must be viewed as the responsibility of the individual and the necessary lifestyle changes should remain within the context of the individual. In fact, the literature reveals that improved outcomes for weight reduction are derived from a baseline of motivation-enhanced individuals when compared to individuals that are not.

As obesity has a multi-factorial origin, it has created a predetermined multiple responsibility in the prevention and management thereof. Obesity and the state of being overweight has been highlighted both as one of the greatest challenges for the healthcare profession and as a matter for social ethics.[136]

1.8 JUSTIFICATION

In view of the obesity problem, both globally and in South Africa, the need to explore new modalities in the management of this condition is imperative. Although this present study involved a population sample of adult females who were in possession of a cellular phone with the skills to use this form of technology, the aim was to provide a possible intervention that could be viewed as being successful in the female population, as the occurrence of obesity and overweight is high amongst this group.

In addition the use of cellular telephones was employed by the study because of the fact that it is accessible, inexpensive and has a high penetration rate. In fact, 10.2 million adults in South Africa own a cellular telephone, being roughly ¼ of the total population.[137] On consideration of households, 60% have access to a cellular telephone, 20% have access to a landline and 17% have access to both. Furthermore on comparison to email accessibility, only 4.6 million adults in South Africa have access to the internet, with only 2/3 of these adults having access to email communication media.[138]

1.8.1 Short Message Service (SMS)

SMS, sometimes referred to as text-messaging, is a reliable way for communication between people and their healthcare provider.[139] It is generally accepted that regular care and informational support are beneficial in improving health outcomes. A systematic review of healthcare via cell phones by Krishna S *et al*. was done to evaluate the empirical evidence related to the use of cell phones and text messaging interventions.[140] Significant benefits

were demonstrated in compliance with medicine taking, HbA1C levels in diabetics, symptoms of asthma, ability to stop smoking, stress management and self-efficacy, fewer failed appointments, diagnoses that were made faster and an improvement in teaching and training. These findings suggest that standard care with reminders, the monitoring of disease and management with education through short message servicing can help to improve health outcomes and care processes.[141] The premise of utilizing SMS to provide both nutritional information and reinforcing positive encouragement was deemed to enhance and motivate the participant to improve their relationship with food while losing weight during a programme.

The consideration of utilizing SMS in a weight-reduction programme was viewed as a possibility, after having seen the intervention programmes which were used in diabetics, smoking cessation and out-patient attendance studies.[142] The studies in diabetics used the SMS to remind patients to monitor their blood sugar levels. This translated into improved HbA1C levels. For smoking cessation, patients were provided with advice, support and distraction, such as music, and these resulted in improved outcomes for smoking cessation. The studies in which patients were reminded to attend their follow-ups, demonstrated an improvement in the attendance rates for follow-ups.[141] A recent study has shown that SMS reminders were effective in promoting physical activity levels amongst adolescents.[143]. The SMS used in this study manipulated either affective beliefs eg. enjoyable / unenjoyable, or instrumental beliefs eg. beneficial / harmful.

So far there has been a study in Korea and a more recent study done in the USA, where SMS was used during a weight reduction programme.[144, 145] The study by Joo and Kim, which took place in Korea included 927 male and female participants. An initial assessment of the participants took place when their anthropometric measurements, including weight, waist circumference and BMI were assessed. An SMS was delivered weekly and these included messages pertaining to diet, exercise and behaviour modifications. After a 12- week period the participants were assessed again to evaluate their anthropometric measurements. At the end of the study, it was found that 47% of the original group completed the programme and the mean reduction of original weight was 1, 6 kg ($p<0,001$), waist circumference was 4.3 cm ($p<0,001$) and BMI was 0.6kg/m^2 ($p<0,001$).[144] A similar study was undertaken in the USA by Patrick, Roab *et al*. In this particular study they utilized SMS modality together with a multi-media message service (MMS). The MMS uses the concept of the cellphone but this includes small pictures which delivers messages during the weight reduction programme. The SMS was viewed as an intervention tool to both improve the dietary behaviour and reduce weight. Initial formative research with overweight and obese men and women was

done. The intention was to gather information which related to dietary behaviour, cell phone texting and picture message habits. The type and frequency of text and picture messages that could be beneficial for weight reduction was analysed together with nutrition-related concepts that needed to be included in a weight reduction programme. The system used in this USA study was personally tailored and interactive. Personal tailoring was accomplished by providing flexibility in the number and timing of the SMS each day. About a half of the messages delivered requested a reply while the rest provided tips, suggestions and positive reinforcement or encouragement to improve lifestyle behaviour.

The study was a randomized controlled trial. It consisted of 75 male and female participants, of which 33 comprised the intervention group, and this study took place over a period of 4 months. At the outset the study noted participants' BMI's to be between 25-39.5 kg/m$^{2.}$ The intervention group received the SMS and MMS, 2-5 times daily as well as monthly printed materials about weight control and furthermore they received concise monthly calls from a health counsellor. The purpose of the SMS and the MMS messages was to serve as prompts for behavioural improvements and food selection. At the initial assessment the participants were given a bound file with nutrition modifications as well as advice on behavioural strategies to supplement the messaging. Furthermore a food and exercise handbook to support self-monitoring was issued. The comparison group received the same baseline dietary assessment and were mailed a few printed booklets once a month. They did not receive the SMS or MMS. At the end of the study, the intervention group had a 1.97 kg, more weight reduction with a 95% confidence interval = -0.34kg – 3.60kg and a p-value=0.02.[145]

As no study with a similar intervention of utilizing SMS for weight reduction has taken place in South Africa, the notion of SMS as an intervention during a weight reduction programme in a South African setting developed. As the majority of the patients attending the practice are females and in possession of a cellular phone and speak English, the investigation was deemed a possibility.

1.8.2 The SMS in the Context of Weight Reduction

It is described in the literature that a lack of motivation and support structures in the context of social or psychological systems could lead to poor outcomes during weight reduction programmes. Hence prompt and regular reminders might be important in both the short term and the long-term management of the obese and overweight individual[146]. One of the important distinguishing factors would be to determine the necessary frequency of the SMS that would have a beneficial effect on weight reduction changes during a weight reduction

programme. Furthermore previous studies performed to evaluate the effectiveness of SMS on weight reduction have utilized the SMS as the vehicle for delivery of information, reminders and prompts alone.

Compliance with follow-up visits is an important aspect of a weight reduction programme. The management of the obese and overweight individual, as for most chronic lifestyle diseases, will be most effective in the context of ongoing participation and collaboration between patient and healthcare provider.[147] The management and assessments should therefore not be episodic and there should exist an understanding that the condition of obesity or being overweight requires a continuity of care. This should be emphasized from the onset of a weight reduction programme and the attendance at each subsequent visit would be reflective of such a commitment. The effectiveness of the SMS is viewed as whether it is able to improve the compliance at each visit and increase the total number of participants that would complete the programme as well as the anthropometric outcomes. Thereby, the assumption would be that the ongoing use of the SMS could be utilized for further follow-ups and improve the long-term commitment to the management of obesity and overweight.

The SMS offers the healthcare practitioner an additional modality to maintain continuity with their patients and a medium for additional communication.

CHAPTER 2: METHODOLOGY OF STUDY

2.1 AIM AND OBJECTIVES

To determine the efficacy of SMS on weight reduction and compliance, during a weight reduction programme involving an adult female population from a medical practice in Gauteng, South Africa.

The following objectives were identified for investigation during the weight reduction programme amongst the female participants of this study:

a) To determine the efficacy of the SMS during the programme on weight reduction as measure by change in, body weight, BMI and WC.
b) To determine the efficacy of the SMS on the compliance and attrition rate of follow up visits during the 3 month weight reduction programme.
c) To determine the efficacy of the SMS on the attitudes of the participants and the beneficial motivations experienced by the intervention groups.

2.2 HYPOTHESIS

The dispatching of SMS to adult, female participants during a weight reduction programme will result in the greatest changes of anthropometric measurements, i.e. decreases, in body weight, BMI classification and W.C as well as an improved compliance, translating into a decreased attrition rate seen amongst those receiving the SMS.

2.3 STUDY DESIGN

The study was a blinded randomized controlled trial (RCT), where the researcher remained blinded, and included a control group (no SMS), weekly SMS group and regular SMS group (in three separate cohorts). The study domain was in the quantitative domain.

2.4 STUDY SITE

The study was conducted in a medical practice situated in Gauteng, South Africa. The practice has a focus on Chronic Lifestyle Disease and the management of obesity. Particular emphases of this practice include the assessment of patients for the co-morbidities of obesity and a full assessment of anthropometric statuses. Dual treatment plans for managing these disease states, as well as the obesity or overweight with an emphasis on weight reduction, has been prioritized and implemented in the management of these patients.

Many of the patients attending this practice seek weight-reduction management and view it as a priority. The practice consists of a medical practitioner, nurse, receptionist and an office assistant. The practice is equipped and functions as an established medical practice.

2.5 STUDY POPULATION

2.5.1 Target Population

The population targeted consisted of cross-cultural English speaking females that were recruited only from the medical practice based in Gauteng.

2.5.2 Inclusion and Exclusion Criteria

The participants were included in the sample if they were English speaking females aged between 18-65 years, overweight or obese, not taking medications known to cause weight gain, were not currently being treated at the practice for weight reduction and had the use of a mobile cellphone for sending and receiving SMS messages. Participants were informed about the study and had to consent to participate in the study. Exclusion criteria were pregnancy, confirmed diabetes, psychiatric diseases and epilepsy. The decision to use females for the study was brought about by the fact that obesity is more prevalent amongst the female population and because they formed the overwhelming majority of patients seen in the practice.

2.5.3 Sampling Procedure

2.5.3.1 Recruitment

Advertisements and SMS messages were sent to the present existing database of the practice, informing the patients about the proposed study. The patients were told that the study required new participants (first time patients), and that they could possibly inform their family and friends as to whether they might be interested in participating in the study. A time period of one month was allocated to recruit the stipulated number of participants. Interested

individuals were requested to contact the practice. The assistant answered the telephone and screened potential participants for an appointment provided they met the inclusion criteria. Individuals eligible and interested in the study scheduled an appointment with the researcher for a baseline visit. The participants were not randomized during the scheduling process but were randomized at their first visit and were not informed of their group allocation.

2.5.3.2 Sample size

As no study using SMS messages for weight control had been previously done in South Africa, the sample size for powering the study was based on estimate of likely effect. The sample size of 75 participants determined according to practicality and was deemed a feasible number of patients to have been assimilated from this practice.

2.5.3.3 Randomization

Participants were briefed about the procedure of the study and requested to sign the informed consent form (ADDENDUM 1).From the sample group, 25 participants were randomly selected for each cohort. Participants were randomized according to an unmarked white envelope randomly chosen by the participants from a collection of white envelopes. The envelope was then given to the assistant, who was responsible for allocating each participant to a particular group designated within the envelope. Each envelope was allocated randomly to one of the 3 study cohorts and the determination thereof remained the knowledge of the assistant alone and the researcher remained blinded to the allocation. Once each envelope had been allocated to a participant, the assistant recorded the group to which the participant was allocated and this was kept locked for the attention of the assistant alone. The assistant was responsible for forwarding the SMS to the participants in group 2 and group 3, at the pre-defined times. The assistant informed the participants that they were not to disclose whether they received an SMS or not.

With reference to the cohorts, 25 formed the control group (group 1), which did not receive the SMS intervention, while the remaining fifty were divided equally into two groups which constituted the weekly SMS group (group 2) [who received the SMS once-a-week on a predetermined day and time] and the frequent SMS group (group 3) [who received the SMS three-times a week on predetermined days and times]. The latter two groups formed the intervention groups (Figure 2.1).

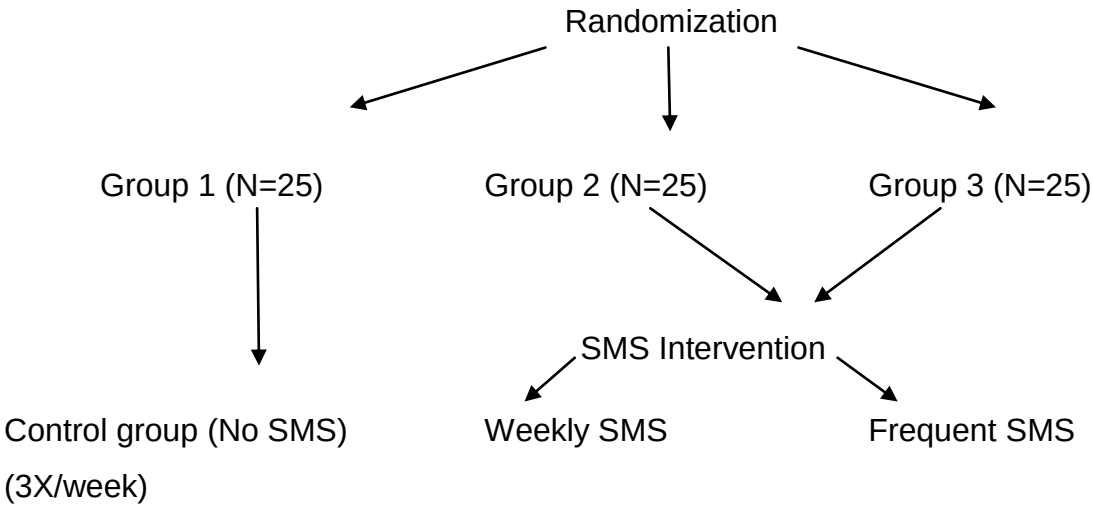


Figure 2.1: Randomized Controlled Trial Design and Sampling Procedure

2.6 METHOD OF DATA COLLECTION

The study included the first consultation which established a baseline motivational platform and included motivational interviewing with the provision of dietary information with the initial assessment and two consecutive follow-up visits. These follow-up visits included a second visit after six-weeks - which was a follow-up assessment, and then a third visit six-weeks later, which was the final visit.

The initial assessment, follow-up visit and final visit remained the same for all three cohorts. Each participant was attended to individually at each consultation and a time limit of 45 minutes was allocated for each visit. Allowance was made at the first consultation for an extension of time to a maximum of 60 minutes to allow for further discussion. All participants received the same medical attention and advice. No pharmaceutical agents were prescribed.

Weight, height and WC were measured by the researcher and the data was recorded in each participant's personal file.

The technique of motivational interviewing was utilized at each visit: this included the motivational interviewing 'spirit' coupled with the researcher providing the participant with an opportunity and directive towards a healthier lifestyle. Dietary intake was discussed during all the consultations between researcher and participant.

The USDA Dietary plan and food guide (ADDENDUM 2) was selected because it provides a vast source of accessible information and is essentially available without having to purchase the information.[32]

The time period between follow-up consultations was at six-weekly intervals. The follow-up appointments were arranged between the assistant and the participant and this remained the responsibility of the participant. The researcher kept all the data in each participant's file.

2.6.1 First Consultation

At the first consultation the researcher's assistant ensured that all the relevant socio-demographic information and cell phone number were recorded.

The initial assessment of the participants took place in the consulting rooms.

The consulting room was equipped with a scale for measuring weight; a soft tape measure to measure WC, a stadiometer for measuring height and a BMI calculator for calculating BMI.[148]

2.6.1.1 Weight

a) Measuring Instrument

The weight was measured using a calibrated and standardized balance scale. (American Detecto Balance-Beam Scale).

b) Measuring procedure

The participants wore only their underwear and a light gown. They were measured in the earlier part of the morning. The participant was asked to stand still in the middle of the scale's platform, placing their feet evenly to distribute their weight equally. The participant's weight was measured in kg to the nearest 0.1kg.

c) Precautions to ensure validity and reliability of measurements

Validity: The researcher calibrated the scale daily by using a standard measure of 10kg (a 10kg dumbbell).

Reliability: Each participant's weight was taken three times and the average of the three measurements was used. The scale was placed on a tiled, flat surface and was not subjected to any displacements

2.6.1.2 Height

a) Measuring Instrument

The height was measured using a standardized stadiometer (American Detecto Stadiometer)

b) Measuring Procedure

The participant was requested to stand with their heels together, both arms to each side, legs straight, shoulders in a relaxed position and the head in the Frankfort horizontal plane. The

heels, buttocks, scapulae and the back of their heads were aligned against the vertical aspect of the measuring stadiometer. Just before the measurements were done, the participant was asked to inhale deeply and to hold their breath, while maintaining the erectness of their body. The headboard of the stadiometer was lowered onto the highest point of the skull and their hair was compressed. The measurements were taken to the nearest 0.1cm.

c) Precautions to ensure validity and reliability of measurement

Validity: The researcher had the stadiometer calibrated before the study and thereafter on a weekly basis.

Reliability: To ensure test-retest reliability, the same height meter was used to measure the height of the participants at the first consultation. Furthermore the measurement was read with the eye level to the headboard. All hair apparel was removed. Two readings were taken and the average was used.

2.6.1.3 Waist circumference (WC)

a) Measuring Instrument

A soft tape measure that was calibrated in cm was used.

b) Measuring Procedure

The participant stood upright, facing the researcher with both arms at her side. The shoulders were held erect and during normal respiration, the measurements were taken at the smallest area below the rib cage and above the umbilicus. The measurements were taken on the naked body, whilst participant wore underclothing.

c) Precautions to ensure validity and reliability of measurement

Validity: The tape measure was used solely for the purpose of this study and was kept in a container so as to prevent any damage to the markings.

Reliability: To ensure test-retest reliability, the same soft tape measure was used at each consultation and the same position was used for each measurement. Two measurements were taken and the average was used. The measurement was read to the nearest 0.1cm.

2.6.1.4 Body mass index (BMI) calculation

The BMI was calculated by using the following formula.[146]

$$\frac{weight \sim in \sim kg}{(height \sim in \sim m)^2}$$

The following classification was considered: [146]

(i) BMI = 19.5 – 24.5 (normal)
(ii) BMI = 24.5 – 29.5 (overweight)
(iii) BMI = 29.5 – 34.5 (obese class I)
(iv) BMI = 34.5 – 39.5 (obese class II)
(v) BMI > 39.5 (pre – morbid obese)

The BMI measurement was recorded in the participant's file.

2.6.1.5 Dietary guidelines

A copy of the United States Department of Agriculture (USDA) dietary guidelines together with a USDA food guide and a USDA energy guideline were issued to each patient (ADDENDUM 2). The researcher made changes to the diet for each participant as was requested, but the principles of the USDA guidelines were adhered to. Options as regards variety, alternative forms of preparation and combinations of foods, using different methods of cooking were provided so as to prevent boredom.

At the initial assessment, the plan for the weight reduction programme was provided individually to each participant in the medical consulting rooms and a suitable dietary plan was negotiated between the researcher and the participant. They were advised about the energy calculator and were issued with their personal copies of the guidelines. They were advised to use the USDA internet site for any other nutritional information.

The guidelines were discussed with each patient individually. Each participant was advised to follow the recommendations for their relevant energy intake according to their calculated requirements. The required energy intake for each participant was calculated using an USDA ENERGY CALCULATOR.[147] Once the energy intake of each participant's present weight was calculated using the USDA–BMI calculator, a reduction of 2100 kilojoules was advised, and each participant was guided as to their own relevant energy intake as shown by the USDA food guidelines.

It was ensured that each patient fully understood the directions, information and procedures required during the weight reduction programme. Any necessary changes or requirements

needed by the individual patient were implemented. The USDA Dietary Guidelines were chosen to provide the nutritional directive and dietary recommendations. The decision was taken to use these guidelines as the information is evidence-based and is reviewed every 5 years. The USDA is a well established source of information and offers directions for weight reduction. It includes the energy counter as well as a list of energy values for most available foods. The USDA uses information and resources from the CDC. The USDA guideline is user-friendly and reference to the internet is fairly easy and available. If difficulties emerged, it remained possible to download information from the internet and fax it to a participant, if it was deemed necessary. The information provided by these guidelines is informative, and choices are varied. Furthermore there exists the added benefit that these guidelines can be adapted to the South African environment thereby offering a practical tool that could be utilized for the purpose of this study.

2.6.1.6 Behaviour modifying techniques

The intention was to develop a positive and healthy contribution by the participant themselves in order to develop a sense of self-efficacy.

The behaviour modifying techniques were discussed with the patient and included the following guidelines.

a) Maintaining regular meals.
b) Avoiding high fat foods and foods high in sugar content as well as learning to read energy labels of foods.
c) Differentiating between hunger and inappropriate eating patterns and learning appropriate response to these.
d) Taking responsibility for choices and selection of foods.
e) Recognising and developing an internal locus of control to the recognition of eating responses.

2.6.1.7 General discussions

Difficulties experienced by the participants were discussed empathically. The opportunity was used to implement the motivational interviewing technique and the four criteria for motivational interviewing were employed. The opportunity was taken to provide a directive and it was elaborated that the programme was non-confrontational and non prescriptive. The provision of information was offered by the researcher but the choice to implement the strategies was voluntary, with the responsibility remaining in the realm of the participant with the emphasis on their self-directed participation and negotiation.

2.6.2 Second Consultation

The second consultation took place six weeks later. The same consulting rooms and the same calibrated equipment were used. The anthropometric measurements were taken. A consultation of 45 minutes was allocated which included a discussion pertaining to the dietary regime allowing for any adjustments to be made and moreover the technique of motivational interviewing was applied. A follow-up appointment was made for six weeks later by the assistant.

2.6.3 Third Consultation

The third and final consultation took place twelve weeks after the first consultation and followed the same procedure of the previous consultation. After the consultation, the participants from group 2 and group 3 were requested by the assistant to complete the questionnaire (ADDENDUM 3). Once the questionnaire was answered, they were inserted into the participant's file.

The participants who did not return for the second or third scheduled appointments were not included into any further evaluations or assessments in the study and were lost to follow-up. There were no participants who failed to attend the second consultation, who then attended the third consultation.

2.6.4 Application of the SMS intervention

The SMS messages were the interventions used in the study. The difference between the intervention groups was the frequency of SMS messages that each of the two groups received.

The frequency of the SMS indicated the number of SMS a participant from group 2(weekly SMS) and group 3(frequent SMS) received within the time period of one week.

- **Group 2** (Weekly SMS) - received one SMS per week which was on a Monday morning.
- **Group 3** (Frequent SMS) - received the same SMS as that forwarded to Group 2, but on three days of the week i.e. on a Monday morning, Wednesday morning and Friday morning. The participants from group 3 received the same message for that particular week on each issue of the SMS.
- **Group 1** (Control)- did not receive SMS.

The SMS messages were issued as per their formulation in the addendum (ADDENDUM 4) and broadly included reminders for the patients to attend their appointments, to monitor their

food portion, and other positive motivational messages. The intention was to provide a brief intervention with motivational support which included the provision of nutritional or dietary information.

2.6.4.1 Questionnaire

A questionnaire relating to the effects of the SMS (ADDENDUM 4) was handed out by the assistant to those participants who had completed the study, which included participants from both the intervention groups. The questionnaires were issued once the programme had been completed and after the final follow-up visit had taken place. The participants were requested to complete the questionnaires in the consulting rooms. The questionnaires were then collected by the assistant for collation.

The questionnaire utilized in this study was an original document devised intently for the purpose of this study, and included twelve categorical and closed questions. The first six questions aimed to determine the effect that the SMS had on the participant's attitudes and motivation to change their present lifestyle behaviour patterns. These questions related to those aspects of the SMS as an intervention which could possibly facilitate behavioural changes during a weight reduction programme. This could imply that the SMS is a vehicle that could possibly induce motivation, encouragement and improved decision making. The next six questions evaluated the practical validity and feasibility of the reception of the SMS. The intention was to evaluate the readiness to read the messages, the impact that the SMS messages had on the participants and the subjective responses ascertained by the reception of the SMS.

Each question in the questionnaire aimed to evaluate the following particular responses:

Question 1 queried whether the SMS had a positive effect on changing their eating patterns and reducing the temptations to stop the programme. This was to give an indication that the reception of SMS is in fact beneficial.

Question 2 asked whether the SMS had a motivational effect. This alluded to the motivation to remain committed to the programme.

Question 3 asked if the SMS had an effect on reinforcing the commitment to change in a lifestyle pattern. Here, the effect that the SMS actually reminded the participant to remain on the programme.

Question 4 alluded to the changes in attitude to food and changes in responses to possible environmental triggers. The idea was to elicit whether the SMS could have a beneficial effect on these behavioural patterns.

Question 5 asked whether the SMS helped the participant to feel more in control of their decisions as regards choices of foods. The idea was to encourage the participant to prevent bingeing and to make healthier choices at meal times.

Question 6 enquired if the SMS were actually perceived as being beneficial and helped the participant during the weight reduction programme**.**

Question 7 queried the practical application of the SMS and if the participants checked their SMS promptly**.**

Question 8 asked if the SMS helped the participant to stop bingeing. The notion of having a beneficial effect in deterring binge eating was being ascertained.

Question 9 attempted to allude to the notion of portion control and whether the SMS did in fact help to improve portion size.

Question 10 alluded to the concept of snacking, but this referred to the excessive snacking of high energy foodstuffs, with high fat and sugar content.

Question 11 asked if the SMS advice received, helped the participant to make better and healthier food choices during meal times and at snack times.

Question 12 queried as to whether the participant believed that the SMS did allow them to feel positive during the programme and in doing so, they benefitted by remaining committed and thereby did in fact help them to lose weight.

2.7 DATA ANALYSIS

2.7.1 Analysis of Outcomes

The Faculty of Health Science at the University of Stellenbosch appointed a statistician for consultation regarding the analysis of the data. Data was edited, coded, classified, tabulated and explored to allow for any corrections during collection of the data. After the three month study, the data was collated into one large table on *Windows Microsoft Excel* and was statistically evaluated. Data was statistically interpreted using the Statistica statistical computer software.[149] The initial descriptive analyses examined the sample characteristics, the randomization of participants, and the distribution of variables. A mixed-model repeated-

measures analysis compared the effect of the intervention groups to the control group on weight status over the 3-month study period. The continuous and cardinal variables were presented as means, standard deviations (SD) and confidence intervals (CI). This allowed for interpretation of the mean BMI and waist circumference measurements. The nominal data was presented as frequency tables.

An appropriate Analysis of Variance (ANOVA) was done where continuous response variables were compared with nominal input variables. Analysis of variance models examined weight change between baseline and 3 months once adjustments were made for baseline weight and age. Appropriate regression or multiple regression methods were applied when continuous response variables were compared with other continuous input variables. Contingency tables were used for chi-square statistics or Pearson chi-square statistics. To check for significance of findings, for cross tabulations, Chi square, P-value at 95% level of confidence were used with a P value> 0,05 indicating no statistical difference and P value<0,05 indicating a significant difference. Correlation coefficients were also determined at 95% and means of analysis were determined using standard deviation and averages. A significant level of p< 0, 05 was applied for a Type 1 error rate.

The attrition rate was calculated as a percentage of participant's attendance at each visit. An analysis and interpretation of the percentages at each visit was performed. Furthermore, the percentage of the participants who completed the study was calculated. The comparison of percentages of participants from each group that attended each visit as well as the percentages of those in each group that completed the study was done.

2.7.2 Analysis of the Questionnaire

A scoring system was utilized to analyse the questionnaire. The scoring system and value of the score remained undisclosed to the participants. Applying a score to a response provided the researcher and statistician with an ordinal scale, which then allowed for the calculation of a mean and standard deviation. The total tally of the score was then converted into a percentage with an outcome description.

The procedure for the scoring system was as follows:

All the time- received a score of 4
Sometimes- received a score of 3
Seldom- received a score of 2
Never- received a score of 1

There were 12 questions in the questionnaire. The response to each question was allocated a score and depending on the response given for each question, a maximum of 48 points could be achieved while the minimum points achievable were 12. The procedure followed for the analysis of the responses to the questions included the following:

- The score or ordinal value allocated to each question was tallied to yield the total value of all the respondent's scores for each question and these were analysed separately for each group.
- The mean score and the standard deviation for the total responses for each question from each group were determined and were presented as an ordinal value.
- This allowed for an analysis of the results for each question and a comparison could be made between the two groups i.e. group 2 and group 3.

The score which was allocated to each response as demonstrated in the scoring system, was given an appropriate percentage value. This percentage outcome was then in turn appropriated with an outcome description (Table 2.1).

Table 2.1:Scores and Outcome Descriptions of the SMS Questionnaire

Score range (out of a possible 48 points)	Percentage (%)	Outcome description
36 – 48	75 – 100	Very effective/successful
28 – 35	58 – 74	Moderately effective/successful
20 – 27	40 – 57	Mildly effective/successful
12 – 19	25 – 39	Not at all effective/successful

2.8 ETHICS AND LEGAL ASPECTS

2.8.1 Ethics Review Committee

The final protocol was reviewed by the Human Research Committee, at the Faculty of Health Sciences at the University of Stellenbosch for ethics approval, which was granted and the relevant ethics approval number ref No 09/05.153 was allocated.

2.8.2 Informed Consent

Each participant was provided with an informed consent form by the researcher at the initial visit. The standard informed consent form provided by the Faculty of Health Sciences of Stellenbosch University was used for the study (ADDENDUM 1).

2.8.3 Participant Confidentiality

All information relating to the participant's identification was omitted from the study to ensure participant confidentiality. The participants were ensured that all the information regarding their assessments would be kept confidential. All the data collected by the researcher was used solely for the purpose of the present study and not shared for any other purpose.

CHAPTER 3: RESULTS

3.1 SAMPLE DEMOGRAPHICS

A total of 75 females between the ages of 18-65 years were recruited for the study. All of the 75 participants expressed dissatisfaction with their weight and requested to lose weight. The mean age of the total study population was 44.82 years (SD = 5.51). Group 1 (control group) had the highest mean age of 47.08 (SD = 5.82) years, in contrast to group 2 (weekly SMS) whose mean age was 42.84 (SD = 5.30) years and group 3 (frequent SMS) whose mean age was 44.6 (SD = 5.34) years. Univariate tests of significance for age showed no significant difference in the mean age between the three groups (p-value=0.41).

3.2 CHANGES IN WEIGHT REDUCTION, BMI AND WC

3.2.1 Weight reduction

At the first visit, the mean weight for the population sample was 92.6kg (SD = 6.2) with the majority of the weights skewed to the left of the distribution (i.e. most participants had weights in the range of 70-100kg and fewer had heavier weights in the range 110+kg) (Figure 3.1)

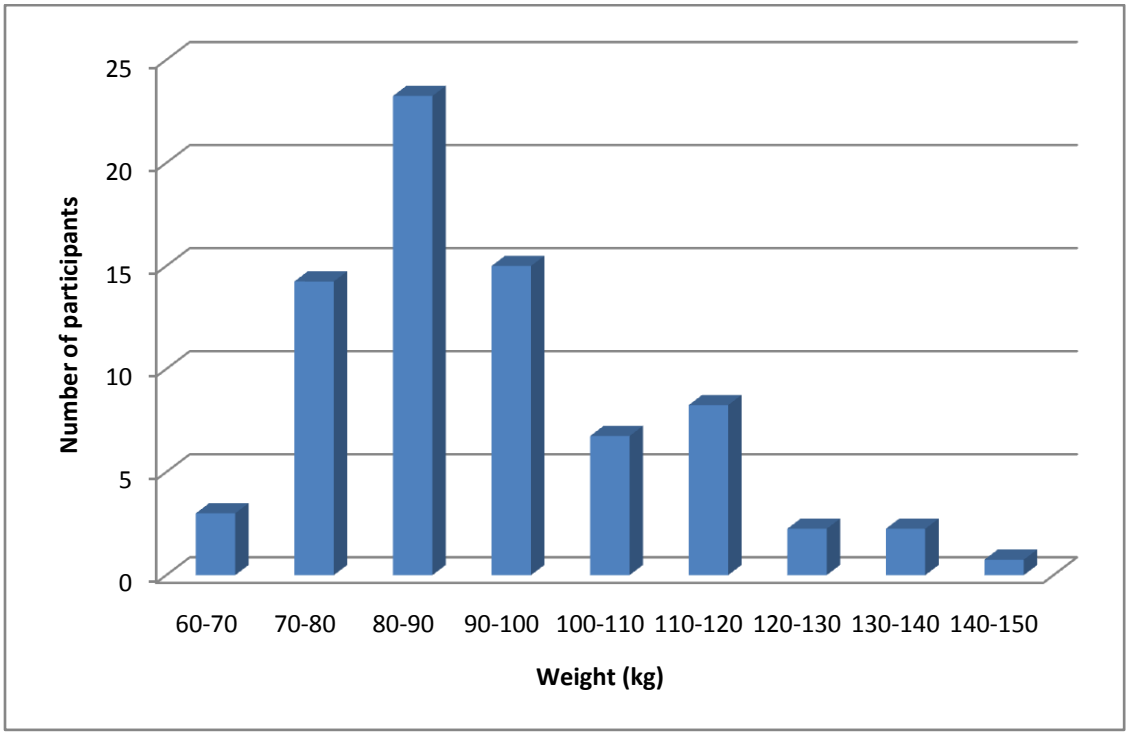


Figure 3.1: Histogram of Weights of Total Sample Population (1st Visit)

The mean weight decrease in group 1 was 8.99kg, 8.27kg in group 2 and 9.75kg in group 3(Table 3.1). These changes translated into a 9.5% loss in mean weight for group 1; 8.7%for group 2 and 10.55% for group 3. The total population sample showed a 9.58% loss in mean weight

Table 3.1: Mean Weight Changes in kg (SD) for Each Group

Study Group	First consultation (SD)	Second consultation (SD)	Third consultation (SD)	Total loss =% decrease
Control Group 1	93.96 (6.12)	86.82 (8.00)	84.97 (5.78)	-8.99 = 9.5% decrease
Weekly SMS Group 2	94.75 (6.46)	93.27 (7.39)	86.48 (5.89)	-8.27 = 8.7% decrease
Frequent SMS Group 3	92.40 (8.7)	86.39 (7.5)	82.6 (9.65)	-9.7 = 10.55% decrease

The mean weight for each group was not significantly different at each visit ($p>0.05$).There was no significant interaction as the group mean weights behaved consistently over time (ANOVA $p=0.083$). However over the course of the three month period and on reflection of

the mean weight changes that were seen in each of the three groups, the changes noted did show significant results (Bonferroni multiple comparison test F(2.80)=170;p=0.001), statistically. Therefore all of the three groups showed significant weight reduction over the course of the three month period, reflecting a significant weight reduction for the total population sample.

3.2.2 BMI

The BMI for each participant in each cohort was calculated at the initial visit and frequencies for each BMI classification were determined.

At the first visit the BMI classifications for the total population sample revealed that 20% (N=15) met the criteria for the classification of overweight,40% (N=31)for the classification of obese I,19% (N=140 for the classification of obese II and 21% (N=15) for the classification of pre-morbidly obese. There were no significant differences between the three cohorts (Figure3.2).

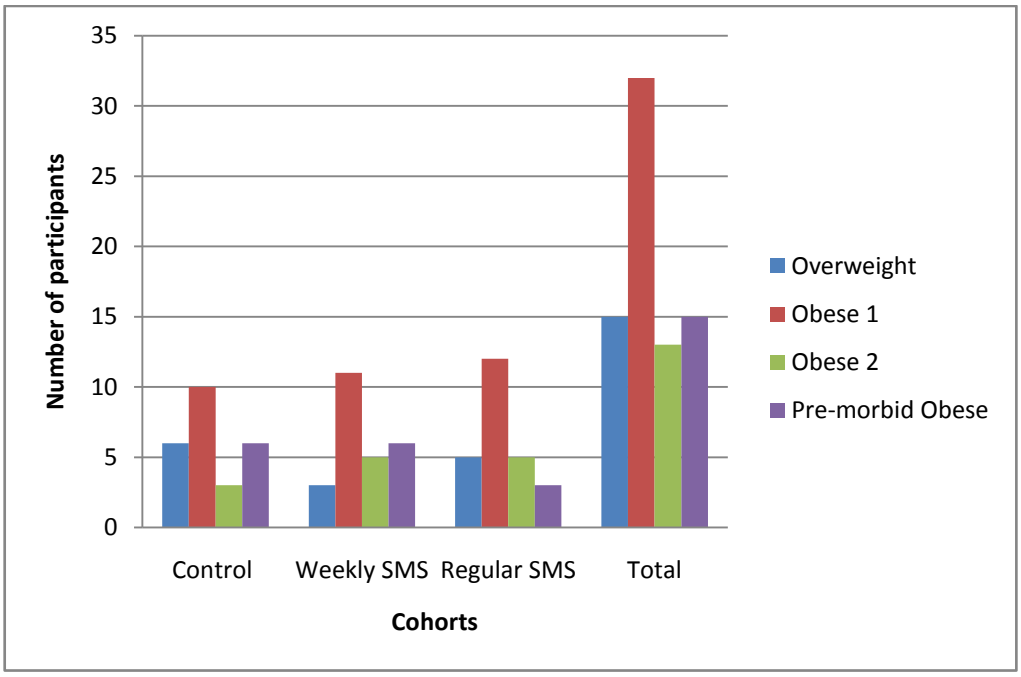


Figure 3.2: Obesity Classification Groups at Visit 1, defined by BMI

At the second visit, 42% of the participants had a BMI of 30-35, classified as Obese I, the same as that found at the first visit. The numbers comprising the Overweight category amounted to 27% which had increased by 3% from the first visit. The Obese II and Pre-morbid Obese had 15% of patients in each classification which reflected a decrease of 3 and 5% respectively (Figure3.3).

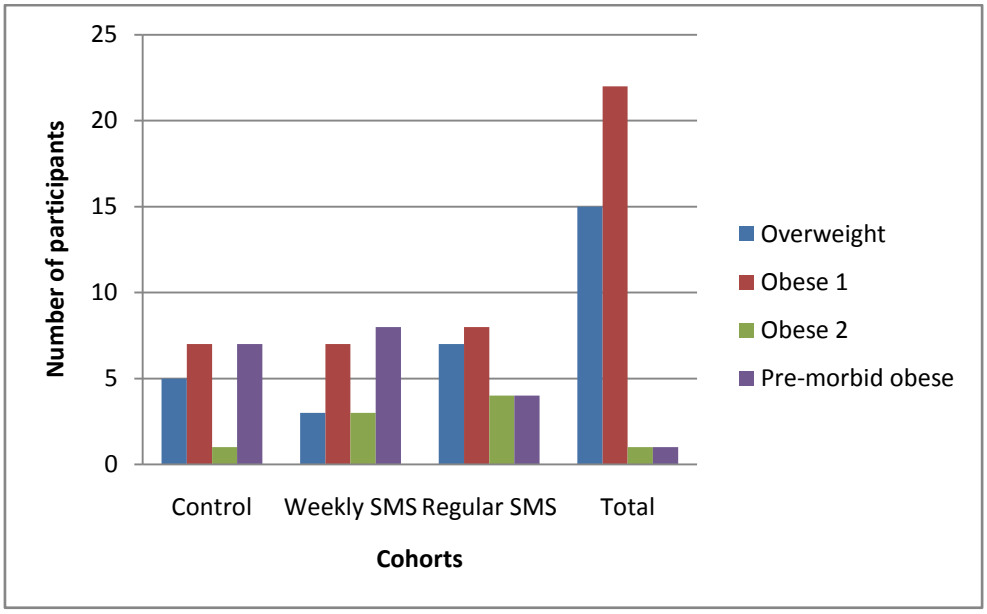


Figure 3.3: Obesity Classification Groups at Visit 2, defined by BMI

At the final visit, 44% of the participants had a BMI of 25-30 and were classified as overweight, which showed a marked improvement from the previous two visits. The figures from the obese I category comprised 23%, almost halved from those of the previous visits. Seven percent comprised a normal weight category, 16% the obese II and 10% the pre-morbid obese category, of which the latter had decreased by 5% from the second visit (Figure 3.4).

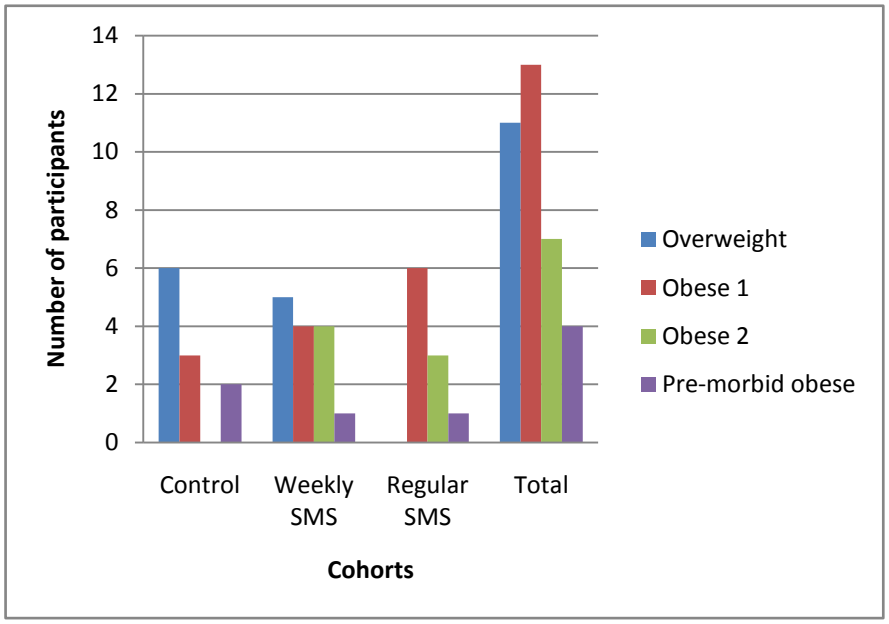


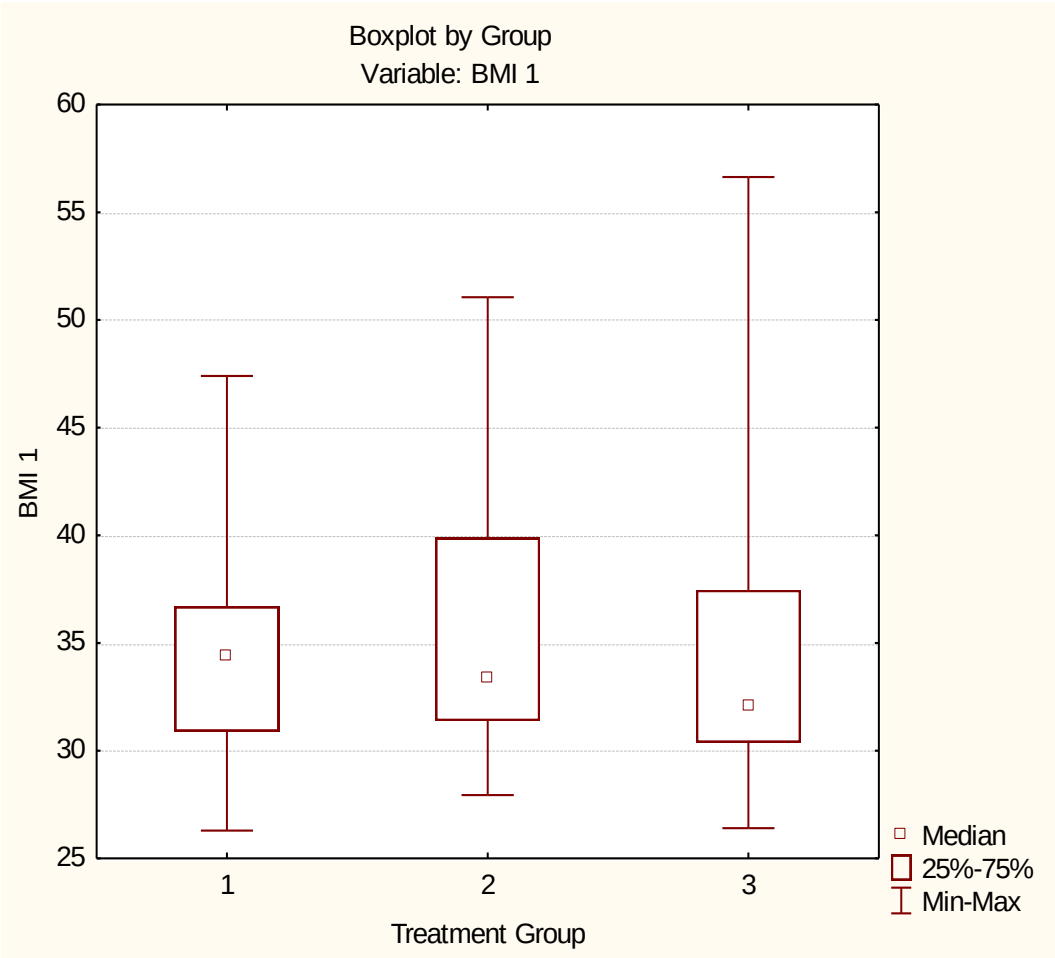
Figure 3.4: Obesity Classification Groups at Final Visit, defined by BMI

The three cohorts comprising the total population sample demonstrated collectively a reduction in their respective BMI classifications at each visit. The total population sample manifested a clinically significant change in their BMI classifications (Table 3.2).

Table 3.2: Total Population Sample BMI Classification at each Visit (N)

BMI Classification	First Visit	Second Visit	Third Visit
Normal			7
Overweight	20	27	44
Obese I	40	42	23
Obese II	19	15	16
Pre-morbid Obese	21	15	10

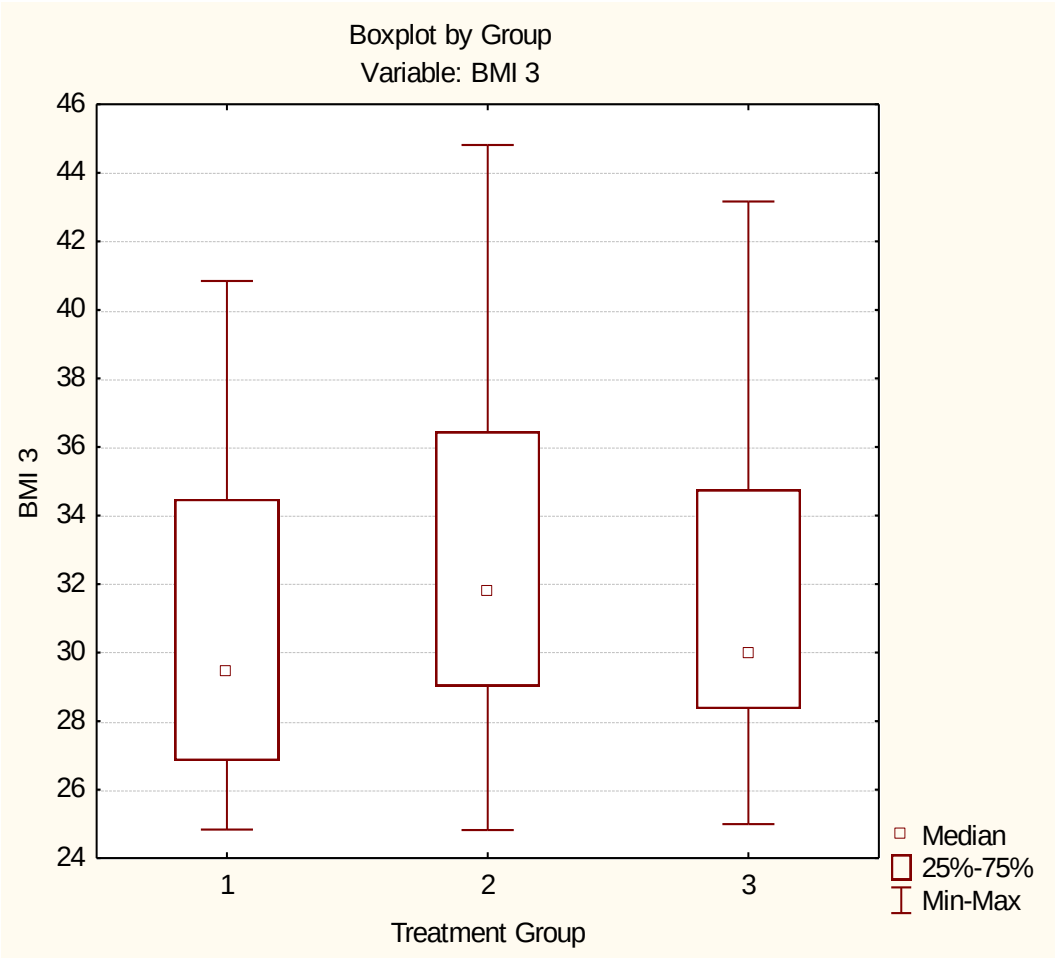
The mean BMI values for the participants in each group were not significantly different ($p>0.05$). This was demonstrated consistently at each visit. At the first visit (Figure 3.5) the mean value of the BMI for the control cohort (group 1) was 34.6(SD5.8); the weekly SMS cohort (group 2) had a mean BMI of 35.56(SD 5.79); while the frequent SMS (group 3) had a mean BMI of 34.31(SD 6.56). There was no statistically significant difference amongst the BMI of the groups at visit 1(Test of homogeneity of variances $p=0.75$; Hartley F–max of 1.26).



1. Control
2. Weekly SMS
3. Frequent SMS

Figure 3.5: Boxplot of BMI Values for Each Group (1ST Visit)

At the third visit (Figure 3.6), the mean value of the BMI for control (group 1) was 31.00 (SD = 5.42); the weekly SMS (group 2) had a mean BMI of 32.94 (SD =5.17), while the frequent SMS (group 3) had a mean BMI of 31.32 (SD = 4.52). There was no statistically significant difference amongst the BMI of the 3 groups at visit 3 (i.e. the final visit). (Test of homogeneity of variances p= 0.75; Hartley F-max =1.26).



1. Control
2. Weekly SMS
3. Frequent SMS

Figure 3.6: Boxplot of BMI Values for Each Group (3RD Visit)

Each cohort followed a similar pattern of weight reduction with no statistically significant difference between them. The control (group 1) and the frequent SMS (group 3) revealed a slightly greater loss in comparison to the weekly SMS (group 2).

The change in the mean BMI (kg/m^2) achieved by Group 1 was a 2.9 decrease, in Group 2 was a 2.6 decrease and in Group 3 was a 3.1decrease. There was no significant difference in the changes of the means between the three cohorts over the course of the study. (Table 3.3)

Table 3.3: Mean BMI (SD) in kg/m2 Changes for Each Group in Study

Study Group	First consultation (SD)	Second consultation (SD)	Third consultation (SD)	Total loss = % decrease
Control Group	34,6 (5,81)	32,4 (5,29)	31,7 (5,41)	- 0,9 =8,38%decrease
Weekly SMS Group 2	35,5 (5,79)	35,2 (5,81)	32,9 (5,17)	-2,6 =7,32% decrease
FrequentSMS Group 3	34,31 (6,56)	32,44 (4,66)	31,21 (4,52)	-3,1 =9,03% decrease

3.2.3 Waist Circumference

At the initial assessment, the mean WC in the control (group 1) was 109.96cm (SD = 8.12cm); the weekly SMS (group 2) had a mean WC of 109.23cm (SD= 8.46cm); the frequent SMS (group 3) had a mean WC of 108.06cm (SD = 12.70cm). There was no significant difference in the mean of the WC at the first visit between the three groups (p=0.79).

The mean WC values at the final and third visit did not reveal a significant difference between the groups (p>0.05).The control (group 1) had a 6.5% decrease (from the first visit) and mean WC of 102.81cm (SD = 7.78 cm) at the final visit; the weekly SMS (group 2) had a 5.8% decrease and mean WC of 103.53cm (SD = 7.89 cm**);** the frequent SMS (group 3) had a 6.1% decrease and mean WC of 101.45cm (SD = 10.77 cm).

The change in the mean WC at the third visit, compared to the first visit, achieved by the control (group 1) was a 6.15cm decrease, in the weekly SMS (group 2) a 5.7cm decrease and in the frequent SMS (group 3) was 6.61cm decrease. There was no significant difference between the changes in the means of the WC between the three cohorts (Table 3.4).

Table 3.4: Mean WC (SD) in cm Changes for Each Group in Study

Study Group	First consultation	Second consultation	Third consultation	Total loss=% decrease
Control Group 1	109.16 (8.12)	104.15 (12.0)	102.81 (7.78)	- 6.15 = 5.6% decrease
WeeklySMS Group 2	109.23 (8.46)	107.8 (9.39)	103.53 (7.89)	- 5.70 = 5.2% decrease
FrequentSMS Group 3	108.06 (12.70)	104.14 (11.0)	101.45 (10.77)	-6.61 = 6.1% decrease

3.2.4 Summary of Anthropometric Measurements over the 3 month period

Even though there was a reduction in both BMI and WC in all cohorts, there were no significant differences in the changes of the mean values for the weights, BMI and WC measurements between the three cohorts (Table 3.5).

Table 3.5: Total Change in Mean Weights, BMI and W.C. in Each Group

	Mean weight change (kg)	Mean BMI change (kg/m^2)	Mean W.C change (cm)
Control group Group1	-8.9	-2.9	-6.15
Weekly SMS Group 2	-8.27	-2.6	-5.7
Frequent SMS Group 3	-9.75	-3.1	-6.61

3.3 COMPLIANCE AND ATTRITION RATES

At the start of the study there were 75 participants. The second visit demonstrated a 72% attendance of the original population sample (N = 54), of which the control (group 1) contributed 30%, the weekly SMS (group 2) 33% and the frequent SMS (group 3) 37% (Table 3.6). There was no significant difference between the attrition rates of the three cohorts at the second visit.

In total, 57% of the original population sample completed the study and attended the third and final visit. Although the frequent SMS (group 3) appears to have a lesser attrition rate and better compliance figures, statistically there is no significant difference in the attrition rates between the three cohorts.

Table 3.6: Compliance Rates of Groups in Study

Group	Number attending Consultations			% Completed Study
	1st	2nd	3rd	
Control	25	16	11	44%
SMS weekly	25	18	15	60%
SMS frequent	25	20	17	68%
Total	75	54	43	57.3%

3.4 EXPERIENCE OF THE SMS INTERVENTION

Table 3.7: Results of Mean Score Values for Responses to Questions in Questionnaire

Question	Weekly SMS (Group 2) Mean response score (SD)	Frequent SMS (Group 3) Mean response score (SD)
1.Positive effect	3.86 (0.35)	3.6 (0.61)
2.Motivate	3.8 (0.41)	3.7 (0.47)
3.Reinforce	3.6 (0.48)	3.6 (0.5)
4.Attitude change	3.4 (0.51)	3.6 (0.49)
5.Control decisions	3.5 (0.51)	3.5 (0.51)
6.Beneficial	3.8 (0.35)	3.5 (0.5)
7.Read promptly	4.0 (0.0)	3.8 (0.33)
8.Stop bingeing	3.06 (0.25)	3.1 (0.48)
9.Reduce portions	3.4 (0.6)	3.4 (0.6)
10.Stop snacking	3.1 (0.35)	3.0 (0.5)
11.Healthier choice	3.6 (0.4)	3.3 (0.6)
12.Feel positive	3.9 (0.25)	3.3 (0.6)
Total Score	43.03	41.48

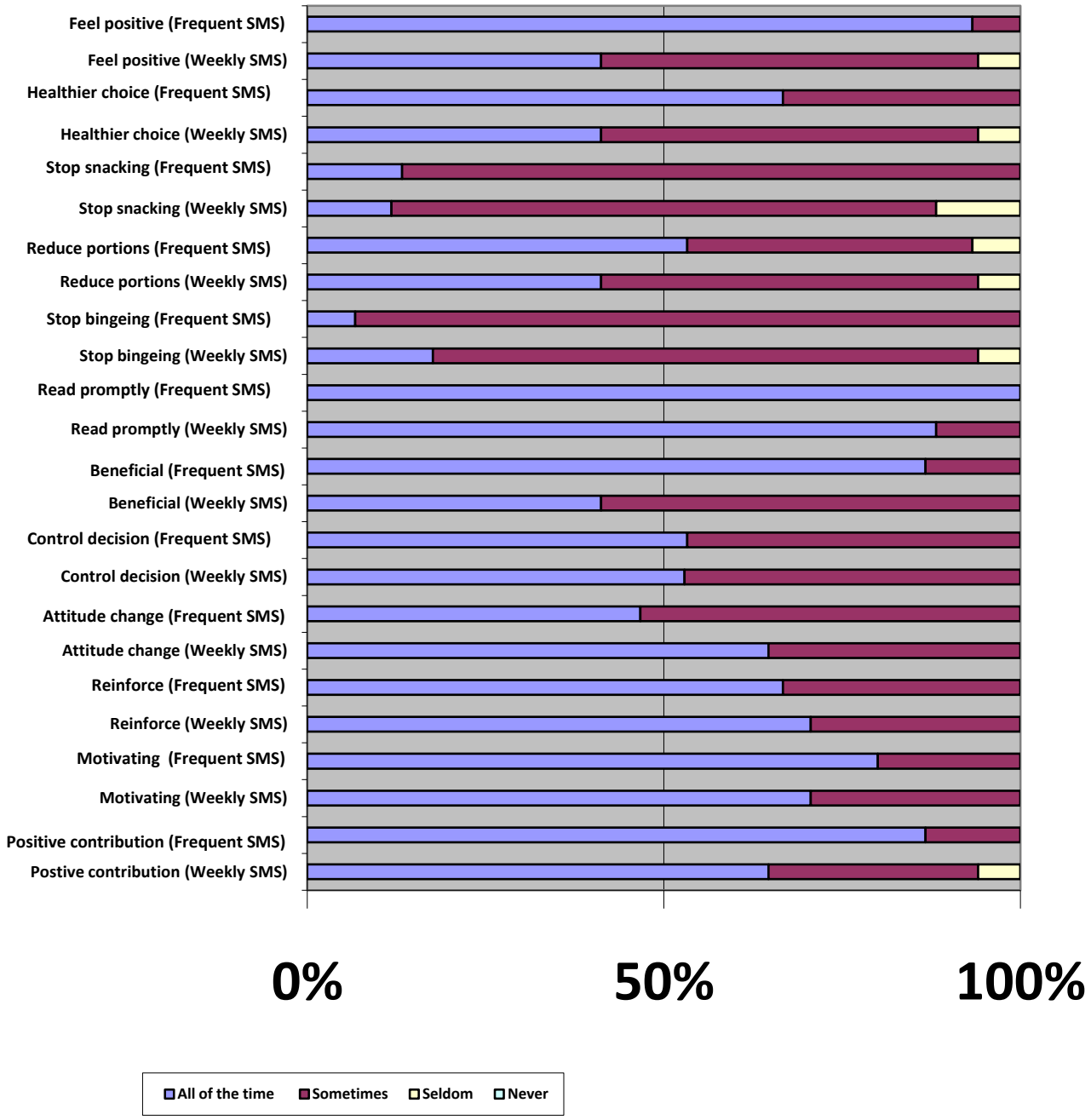


Figure 3.7: Percentage Response to Each Question in Questionnaire

There was no statistically significant variation in responses between the two groups other than for question 12 (Table 3.7). The weekly SMS (group 2) found the SMS as having a significantly more positive effect than the frequent SMS (group 3), (Mann-Whitney p=0.0024) demonstrated by the greater selection of the 'all the time' response in the questionnaire.

It is evident that the questions 1-11 did not reveal a statistically significant difference in their mean score values between the two cohorts, as they both scored between a 3 and a 4 to most of the questions. Question 12 was the only exception which revealed a significant difference in the responses between the two cohorts. (Mann-Whitney Test Z adjusted value =-3.0286; p-value = 0.0025) and is statistically significant. The question 12 related to whether the SMS did have a positive contribution during a weight reduction programme. The weekly SMS (group 2) perceived this intervention as being statistically more significant than the frequent SMS (group 3).

In both cohorts, the highest percentage scores of a 4 were demonstrated for the responses to reading the SMS promptly. Both cohorts had a higher percentage score of 3 rather than 4, for the response to the SMS which intended to help them stop bingeing or snacking. The Weekly SMS (group 2) demonstrated a consistently higher percentage (greater than 80%) of scores with a 4 in comparison to the frequent SMS (group 3).

The mean score of the responses to each question in the questionnaire was remained consistently between a 3 and 4 for both the intervention cohorts. This translated into a total score of 43.03 for the weekly SMS (group 2) and 41.48 for the frequent SMS (group 3). This effectively indicates a percentage of over 75% for both groups. The results can be rated as being very successful according to the scoring system applied to the evaluation of the questionnaire. Both the cohorts demonstrated that the SMS was a successful and effective intervention according to the results ascertained from the questionnaire.

There is no statistically significant difference in the mean between the two groups as the p-value varied between 0.1-1.0 for all questions and for the total score. The analysis of the nominal assessment of the questions revealed that the weekly SMS (group 2) persistently had a higher percentage value for the score of 4 than was seen in the frequent SMS (group 3). The perceived benefit of the SMS results was more favorable in the weekly SMS (group 2) which received the SMS once a week.

CHAPTER 4: DISCUSSION

The present study had the limitations of being represented by a relatively small population group of adult females. The weight reduction achieved in all three cohorts was significant, but the two intervention groups did not reveal any significant difference in their outcomes, in spite of the difference in frequency of the received SMS. The latter may have been influenced by the reality that group 3 which received the frequent SMS, in fact received the same motivational SMS three times per week, while group 2 received that same SMS once a week.

The objectives measured in the study are discussed according to the following:

- Weight reduction
- Compliance and attrition rate
- Efficacy of SMS

4.1 WEIGHT REDUCTION

The three cohorts collectively displayed significant weight reduction. This study demonstrated a mean weight reduction of 8.99kg for the population sample at the final visit. There was a favorable shift from the higher categories of obesity classification towards the lower categories in all three cohorts over the total duration of the study. All three cohorts achieved a small percentage of participants who had reached a normal weight and there was an increase in the overweight category due to a decrease in the percentages of the obese I, obese II and pre-morbid obese. This indicated a shift from the higher to the lower obesity classifications. No significant difference in the changes of the mean BMI between the three cohorts was shown and all three cohorts demonstrated similar changes and losses in their mean WC. The weekly SMS (group 2) and the frequent SMS (group 3) did not demonstrate a greater decrease in their weight reduction, BMI nor in their WC, and this suggests that the intervention of the SMS was not beneficial in promoting changes in the outcomes. In fact, the weekly SMS (group 2) showed the smallest decrease in mean weight reduction, BMI and WC, albeit statistically insignificant.

On consideration of the weight reduction shown by all of the three cohorts, the results demonstrated a clinically important threshold of weight reduction, with the clinically significant weight reduction of 5-10% of the original weight, being achieved. The results show that the total population sample had a 9.58% loss in their original mean weight. A weight reduction of 5-10% of weight is associated with a reduction in fatty infiltration of the liver and the Diabetes Prevention Programme has shown that there is a 13% reduction in the risk of developing diabetes linked to every 1kg of weight reduction in an obese or overweight individual.[146]

In comparison to the two previously published weight reduction studies utilizing SMS, the weight reduction in the present study is substantially greater. The study from the USA demonstrated a mean weight reduction of 1.97kg for the population sample, while the study in Korea showed a mean loss of 1.6 kg for the total population sample, at the end of their respective study periods.[145,144] The present study demonstrated a mean weight reduction of 8.99kg for the total sample group. The difference between these two studies and the present study is that in the present study the participants were attended to by the researcher at each of the three visits where the modality of motivational interviewing was applied. Each participant was assessed individually where a platform of motivational interviewing was implemented. In both the overseas studies, the technique of motivational interviewing was not practiced. Both these studies focused on the modality of the SMS to provide both dietary and behavioural information. The USA study did have a health counselor who provided a monthly, brief telephone call to encourage the participants to continue with the programme and to help the participant's with any social, dietary or environmental issues that may have arisen. The participants were provided with nutritional information in the form of binders at the initial assessment .The participants in both of the overseas studies were followed up for assessment of their weights alone. The Korean study had an initial assessment at a public health centre and a final assessment at the end of the 12 week period. They further offered all dietary and behavioural advice once a week via text-messaging or SMS. The present study offered an initial assessment with a consultation which had an average duration of 60 minutes followed by each subsequent visit with a duration of 45 minutes. The length of contact between the researcher and the implementation of the motivational interviewing at each consult and for each participant, suggests that this may have played a significant role in the favorable outcomes measured in each cohort.

The mean weights showed no significant difference at the initial assessment and these figures had not changed significantly at the final follow up visit.

Frequency of the SMS did not appear to significantly influence outcome although the frequency of the dispatching of the SMS may not have reached a threshold to be effective. In comparison to the study done in the USA, the participants in this study, received a SMS between 3-5 times per day and the same message was not repeated.

All the participants from the three cohorts received the same initial assessments and motivational interviewing. These same assessments with the motivational interviewing were repeated at each visit. The reinforcements due to the follow-up consultations must have had a positive impact on the three cohorts as they had all equally benefitted from this.

The three cohorts collectively demonstrated similar decreases in their mean weight, BMI and WC measurements. The two overseas studies which utilized the SMS as a modality for delivering information during a weight reduction programme both demonstrated a positive efficacy from utilizing the SMS. The Korean study demonstrated a mean reduction of 4.3 cm in WC and a mean decrease in BMI of 0,6kg/m^2. The study from the USA showed a greater reduction in weight reduction in the intervention group than in the control group; 1.97 kg more in intervention group was seen (p-value=0.02). However, the patients involved in the present study had 8.99kg. mean weight reduction, mean BMI decrease of 2.86kg/m^2 and a decrease of 6.15cm in mean WC. The results seen in the present study may have resulted from the intervention of motivational interviewing that was offered to the participants. An additional reason may have been that from the outset a greater restriction in energy consumption was implemented during the study. All participants, including the control group also had two, 6-weekly follow-up consultations, each lasting 45 minutes, during which time the opportunity was again used to employ the technique of motivational interviewing. As there was no difference in the mean changes of the anthropometric measurements in the intervention cohorts, as well as no difference in any of the mean changes between the two intervention groups themselves, the assumption is that the relative frequency of reception of SMS did not display any favorable effect. This possibly implies that this particular cohort found that a SMS did add value to their programme and the fact that the frequent SMS (group 3) did not reveal any higher results to the reception of the SMS suggests that the frequency itself did not add any further value. A conclusion as to whether an increased frequency of the reception of SMS perceived by the participants cannot be made as both the weekly SMS (group 2) and the frequent SMS (group 3), found them as successful.

Although the Korean study dispatched the SMS messages on a weekly basis as well and included the provision of dietary, exercise and behaviour information, the loss in mean weight

was 1.6kg, the decrease in WC was 4.3cm and the decrease in BMI was 0.6kg/m^2. This Korean study had a population sample of 927 male and female adults and the study further did not have a comparative arm in its trial. Their outcome was to evaluate the efficacy of SMS in a population sample on a weight reduction programme.[144]

4.2 COMPLIANCE AND ATTRITION RATE

A larger number of participants from the weekly SMS (group 2) and the frequent SMS (group 3) completed the programme and on comparison to the control group (group 1) this was not statistically significant, ($p>0.05$). The lower attrition rate, however does give support to the fact that the SMS may have had a positive effect, albeit, minimal. Compliance appears to be positively influenced by the reception of an SMS intervention. A randomized controlled trial by Leong KC et al, revealed that the participants receiving text messages or mobile phone reminders (no statistically significant difference between these groups), had a significantly higher attendance rate than the control group which did not receive a SMS or mobile phone call ($p=0.005$).[150] The attendance rate for the cohort which had received the text message or SMS was 59%, which compares favorably with the results seen in the present study.

It would appear that the higher the frequency of reception of the SMS the more favorable the compliance figures. In comparison to the Korean study, the present study had a compliance rate of 60% (in the weekly SMS [group 2]) while it only had a compliance rate of 47%, in the weekly SMS category.[140] The compliance percentage of 68% in the frequent SMS (group 3) patients compares favorably with the USA study which showed a compliance of 72.7% of the intervention group completing their study.[141]

Initially the mean value changes of all the anthropometric outcomes measured are not statistically different between the three cohorts, with the SMS not ensuring greater weight reductions in the intervention groups compared to those of the control group. However, once the results of the compliance figures and the attrition rate were modeled into the results achieved in mean weight reduction and the loss in the mean BMI and mean WC, they suggested that the SMS did have a minimal positive effect. In the control (group 1), which did not receive the SMS, 44% completed the study. In the weekly SMS (group 2), 60% completed the study while in the frequent SMS (group 3), 68% completed the study. Therefore 24% more participants completed the study in the frequent SMS group, which received the SMS three times per week, and 16% more participants within the weekly SMS which received the SMS weekly, in comparison to the control group which did not receive the SMS. The attrition rate was the highest in the control group, which suggests that participants with the least amount of motivation do require a stimulus or reminder to comply or they are

likely to fail completion of a progamme. The results from the attrition rate in the weekly SMS (group 2) and the frequent SMS (group 3) demonstrate a trend of improved compliance in the weight-reduction programme and suggest that the SMS had a beneficial effect on the attrition rate. Therefore, even though the losses in the mean weights, mean BMI and mean waist circumference showed no statistically significant difference, the fact that 60% in the weekly SMS (group 2) and 68% in the frequent SMS (group 3), completed the study and achieved mean value changes of their anthropometric measurements comparable to the control (group 1) suggests that the SMS may have an important effect during a weight reduction programme from the point of view of attrition rates. It appears that the value of SMS may be in that of encouragement and motivation and may increase continued participation.

4.3 EFFICACY OF SMS

The participants from the weekly SMS (group 2) and the frequent SMS (group 3) who completed the study were requested to complete the questionnaire. The response to over 85% of the questions was either a 3 or a 4, which indicated that the SMS was viewed as being very successful and therefore perceived to be effective. It is apparent that the participants felt that the messages received, fulfilled the expectations of the researcher. In trying to evaluate the internalization of the messages, the questions were drafted in a format such as to enable the researcher to evaluate the participant's interpretation of the SMS. Retrospectively it would have been very interesting to interview those participants that did not complete the progam and establish what they thought of the SMS and why it did not have an impact on their compliance. Unfortunately this was not undertaken. The participants that did not comply with the programme were lost to all follow-up.

Analysis of the responses to the questionnaire relating to the SMS revealed that the SMS intervention was very successful. Although the mean value between the weekly SMS (group 2) and the frequent SMS (group 3) was not statistically significant, the weekly SMS (group2) had a higher mean value of 75% for the responses, however the results of the mean value for impact on BMI and waist circumference were the worst in the weekly SMS (group 2). The implication that the weekly SMS (group 2) perceived the SMS to be beneficial suggests that this particular cohort found that the SMS did add value to their programme. The fact that the frequent SMS (group 3) did not reveal any higher results to the reception of the SMS suggests that the frequency itself did not add any further value or that the fact that the same message was received each time, did not have a positive impact. A conclusion as to whether an increased frequency of the reception of SMS perceived by the participants cannot be made as both the weekly SMS (group 2) and the frequent SMS (group 3), found them equivalently successful. It is however difficult to explain why in a group of women who took it upon themselves to voluntarily enter a weight reduction progam, and in whom the majority of

those who completed the progam felt that the SMS was effective, did not reduce their weight by the largest amount. In fact they had the least reduction of parameters measured. A possible explanation is that women within a weight reduction progam are grateful to receive reminders in the form of an SMS and that the SMS improves their compliance but did not effectively impact positively on their weight reduction. The SMS would possibly need to be a much more frequent intervention, with the possibility of different messages each time. The assumption would be that these participants, i.e. those from the weekly SMS (group 2), derived the most benefit from the SMS, as it was an intervention that provided motivation, encouragement and information which they appreciated but was not sufficiently frequent or varied to translate into a practical result. They may have possibly become a group of participants who would have otherwise failed to complete their programme. In conclusion, although the SMS did not provide statistically significant results on the outcomes that were being evaluated during the weight reduction study, especially in the weekly SMS (group 2), the participants evaluation of the SMS messages proved itself to be positive and successful in the opinion of the receptive participants of the SMS during the weight reduction programme. The perceived benefit of the reception of the SMS results were more favorable in the weekly SMS (group 2), which received the SMS once a week. This possibly implies that this particular cohort found that a SMS did add value to their programme and the fact that the frequent SMS (group 3) did not reveal any higher results to the reception of the SMS suggests that the frequency did not add value but the actual reception of a SMS did. A conclusion as to whether an increased frequency of the reception of SMS perceived by the participants cannot be made as both the weekly SMS and the frequent SMS groups found them as successful and the weekly group found them to be more significantly positive. The increased frequency of SMS did show a slightly improved result in the anthropometric measurements in the frequent SMS (group 3) versus the results seen in the weekly SMS (group 2), however they were not statistically significant. More participants did complete the study in the frequent SMS (group 3), although not statistically of value, but if the figures are compared, there is a substantial difference and shows that the SMS did improve compliance. This highlights the importance of support and motivational systems during a weight reduction programme.

CHAPTER 5: CONCLUSION

The results of the study suggest that the implementation of SMS during a weight reduction programme may be utilized on a larger scale in the population, as it was experienced as a successful and effective intervention by the participants. The use of SMS may be especially significant in the management of obesity and overweight in children, with the consent use from parents (as well as with the supervision from parents), where the reinforcement of favorable lifestyle patterns could be implemented. The use of SMS messaging offers a valuable tool for the maintenance and management of weight and may be valuable for the prevention of rebound weight gain after a weight reduction programme, as well as to maintain the lifestyle changes developed during a programme. The real value of SMS appears to be in the improvement of compliance in attendance of consultations and follow-up visits. It also offers opportunities to maintain communication channels between the healthcare provider and his/her patients. It could afford the development of social support groups via SMS messaging. The overweight and obese patient requires constant reinforcements and support because weight reduction requires changes in lifestyle. It is also well described that overweight and obesity is associated with depression and mood disorders, therefore the creation of a support network could become a powerful social system to enable patients to maintain their weight (i.e. SMS LIFESTYLE CLUB). As it appears, our present environment is rather obesogenic due to the quality of foods available, the constant exposure to energy dense and relatively cheap foods, as well as due to the marketing of these products rendering our environment a conflicting and difficult one for the overweight and obese. The management of this difficult environment can be subliminally counter-acted upon by the use of SMS messaging. These messages are viewed personally by the recipient and are received spontaneously therefore they may reinforce and strengthen reserve against the conflicting environment. The difference between SMS messaging and other forms of electronic systems is that recipients will receive the messages involuntarily and unexpectedly whereas with other forms, for example internet or e-mail, they must actively log in and find the information. Furthermore, the thrust of the value of SMS messaging is in the perception of personal and private contact. From this study in a South African context, the use of SMS

has been shown to be useful in the sense that it improves compliance and decreases the attrition rate, suggesting that people can then improve on their attendance rates and follow-up visits could be used to encourage further management. However it is apparent from the results that the SMS must be received on a regular basis and ideally, not less than three times per week for it to have a beneficial improvement in compliance. In this study, the intervention based on the use of specific SMS messages was not statistically significant in promoting a greater weight reduction over a 3 month period among a group of overweight and obese adult females versus the control group which did not receive the SMS. To current knowledge, this is the first randomized controlled study to examine the use of weekly or regular SMS messages for this purpose to take place in South Africa. The weight reduction for the intervention group, regular SMS i.e. three times a week, showed the greatest weight reduction, however not statistically significant per se. Once the results are coupled to the statistically significant lower attrition rate, the benefits of the SMS could be viewed as being effective. The loss became robust when examined by different analyses and methods to handle the combined data, and the results may therefore become more meaningful if handled on a larger scale at a population level. The results compare favourably to most clinical weight reduction programmes and could be considered clinically significant because the total population sample showed a significant weight reduction. In comparison to most technologically driven programmes, this study proved favourable results. The advantage of using SMS is that it is a system that can be deployed at a relatively low cost per user. Although the study used a small population sample and included females only, the threshold weight reduction achieved did show clinical benefits and this can be attributed to the motivational interviewing process at the consultations as well as the benefits received by the messages in the SMS. In the South African context, even though many cell-phone users are familiar with the use of text messaging, it may be that the participants from this study were of a higher socio-economic status as well as fluent in the English language and from a higher literacy background. Therefore if the use of SMS were to be considered on a larger population level, consideration should be given to language and literacy. The reception of SMS appeared to be most favourable and successful and this offers the opportunity for further studies and investigations in the use of SMS for weight reduction as well as for lifestyle change. There is therefore promise for the use of mobile phones and text messaging since it is one of the only forms of communication that is usable on most types of cell-phones and is offered by all commercial phone companies. In addition, the popularity of SMS is growing among mobile users.

In conclusion, there are few obstacles to the utilization of this interventions- the SMS, which is essentially a relatively simple mode of communication that can reach individuals and offer them health behaviour prompts and coaching.

REFERENCES

1. Gidding SS, Leibel RL, Daniels S, Rosenbaum M, Van Horn L. Understanding Obesity in Youth, Circulation (Internet) 1996(cited 29 April 2010); 94:3383-3387. Available from http://circ.ahajournals.org/cgi/content/full/94/12/3383 .
2. Classification of Overweight and Obesity by BMI, NHBLI, June 1997 [Cited 2009 April 24]. Available from: http://www.nhlbi.nih.gov/guidelines/obesity/e_txtbk/txgd/414.htm.
3. Obesity Education Initiative, NHBLI, June 1997 [Cited 2009 April 24]. Available from: http://www.nhlbi.nih.gov/guidelines/obesity/e_txtbk/txgd/414.htm.
4. Jensen MK, Chiuve SE, Rimm EB,Dethlefsen C,Tjonneland A, Joense AN, Obesity, behavioral lifestyle factors and risk of acute coronary events, Circulation 2008 Jun 17(24) 3062-9.
5. James WP, The epidemiology of obesity: the size of the problem. J Internal Med. 2008 Apr; 263(4): 336-52.
6. Key TJ, Spencer EA, Reeves GK, Symposium 1 Overnutrition: consequences and solutions. Obesity and cancer risk, Proc Nutr Soc 2010 Feb:69(1):86-90.
7. Obesity: preventing and managing the global epidemic: Report of a WHO consultation, World Health Organ Tech Rep Ser.2000; 894: i-xii,1-253.
8. It’s not a diet it’s a lifestyle, 2008 July 15 [Updated 2008 July 15; cited 2009 April 23]. Available from: http://www.cdc.gov/search.do?queryText=it%27s+not+a+diet+it%27s+a+lifestyle&action=search
9. Werijj MQ, Jansen A, Mulkens S, Elgersma HJ, Ament A J, Hospers HJ, Adding cognitive therapy to dietetic treatment is associated with less relapse in obesity, J Psychosom Res 2009 Oct;67(4):315-24.
10. Ogden CL, Yanovski S Z, Carroll M D,Flegal KM, The Epidemiology of obesity, Gastroenterology, 2007 May; 132(6): 2087-102

11. International Association for the study of obesity, 2009 August [Cited 2009 April 25]. Available from:http://www.iotf.org/media.asp.

12. Kelly T, Yang W, Chen CS,Reynolds K,He J, Global burden of obesity in 2005 and projections to 2030,Int J Obes (Lond).2008 Sep;32(9):1431-7

13. WHO Global Infobase: Statistics for Saving Lives; [Updated 2008 August 24; cited 2009 April 25]. Available from: https://apps.who.int/infobase/?id=1

14. Gidding SS, Dennison BA, Birch LL, Daniels SR, Gilman MW, Lichtenstein AH. Dietary recommendations for children and adolescents: A guide for practitioners. Pediatrics. 2006; 117(2): 544-59.

15. Allcock DM, Gardner MJ, Sowers JR, Relation between childhood overweight and adult cardio-vascular risk, Int J Pediatr. Endocrinol. 2009:108-187. Oct19

16. South African Medical Research Council. South African Demographic and Health Survey 2003 [Cited April 24 2009]. Available at: www.mrc.ac.za/mrcnews/dec 2008/sa demographics.

17. van der Merwe, T. SA Obesity Statistics: SASOM 2006. [Cited April 24 2009] Available from: www.sasom.co.za/index.php?p=sa obesity stats.htm.

18. Trasande L,Chatterjee S,The impact of obesity on health service utilization and costs in childhood,Obesity (Silver Spring) 2009, sep:17(9),1749-54

19. National Food Consumption Survey. 2006 November 1 [Cited April 25 2009]. Available from: http://www.mrc.ac.za/chronic/foodstudies.htm

20. First South African Youth Risk Behavior Survey. 2003 [Cited 18 May 2009]. Available from: www.info.gov.za/otherdocs/2003/youth.

21. Kruger HS, Venter CS, Vorster HH, Obesity in African women in the North West Province, South Africa is associated with an increased risk of non-communicable diseases: the THUSA study. Transition and Health during Urbanisation of South Africans. Br J Nutr. 2001 Dec;86(6):733-40.

22. Kruger R, Kruger HS, Macintyre UE, The determinants of overweight and obesity among 10- to 15-year-old schoolchildren in the North West Province, South Africa - the THUSA BANA (Transition and Health during Urbanisation of

South Africans; BANA, children) study. Public Health Nutr. 2006 May; 9(3):351-8.

23. Amuna P, Zotor FB, Epidemiological and nutrition transition in developing countries: impact on human health and development, Proc Nutr Soc. 2008 Feb;67(1):82-90

24. Prentice AM, The emerging epidemic of obesity in developing countries, Int. J Epidemiol. 2006 Feb;35(1):93-9.

25. Apovian CM, The causes, prevalence and treatment of obesity revisited in 2009; what have we learnt so far? Am J Clin Nutr.2010 Jan;91(1) 277S-279S.

26. Melnik BC, Permanent impairment of insulin resistance from pregnancy to adulthood. The primary basic risk factor of chronic Western diseases, Med Hypotheses 2009 Nov;73(5):670-81.

27. Varela-Moreiras G, Controlling Obesity: What should be changed? Int J Vitam Nutr Res 2006, Jul; 76(4);262-8.

28. Hetherington MM, Cecil JE, Gene- environment interactions in obesity, Forum Nutr.2010 Nov. 27;63,195-203

29. O' Rahilly S, Farooqi IS, Genetics of obesity, Phlos Trans Soc Lond B Biol Sci,2006 Jul 29;361(1471): 1095-105.

30. Kewalramani G, Bilan PJ, Klip A,Muscle insulin resistance: assault by lipids, cytokines and local macrophages, Curr Opin Clin Nutr Metab Care. 2010 Jul;13(4):382-90.

31. Bremer AA, Auinger P, Byrd RS,Sugar-sweetened Beverage Intake Trends in US Adolescents and Their Association with Insulin Resistance, J Nutr Metab 2010;Epub 2009 Sep 6.

32. Jansen I, Leblanc AG, Systematic review of the health benefits of physical activity and fitness in school-aged children and youth, Int J Behav Nutr Phys Act 2010 May 11;7;40.

33. Slentz CA, Honmard JA, Kraus WE, Exercise, adominal obesity,skeletal muscle and metabolic risk; evidence for a dose response,Obesity(Silver Springs)2009 Dec;17 Suppl 3: 527-33

34. Hoffman DJ,Sawaya AL,Verreschi I.Why are nutritionally stunted children at increased isk of obesity?Studies of metabolic rate and fat oxidation in Shantytown children from Sao Paolo, Brazil, Am J Clin Nutr.2000 Sep;72(3);702-735.

35. Swinburn B, Shelly A. Effects of TV time and other sedentary pursuits Int J Obes (Lond). 2008 Dec;32 Suppl 7:S132-6.

36. Labadarios D, National Food Consumption Survey. 2006 [Cited January 28 2010]. Available from: http://www.sahealthinfo.org/nutrition/foodtitle.pdf.

37. Rolls BJ, McDermott TM, Effects of age on sensory-specific satiety. Am J Clin Nutr, 1991; 54:988-96.

38. Swinburn B, Shelly A, Effects of TV time and other sedentary pursuits Int J Obes (Lond). 2008 Dec;32 Suppl 7:S132-6.

39. Tibarzarwa K, Ntyintyane L.Sliwa K, Gurnholtz T, Carrington M, Wilkinson D, Stewart S, A time bomb of CVS risk factors in South Africa (Results from the Heart of Soweto study), Int. J Cardiol 2009 Feb 20, 132(2) 233-9.

40. Monasta L, Batty GD, Cattaneo A,Lutje V,Ronfani L, Van Lenthe FJ, Brug J, Early-life determinants of overweight and obesity-a review of systematic reviews, Obes Rev. 2010 Mar 16.

41. Stettler N, Tershakovec AM, Zemel BS,Leonard MB, Boston RC, Katz SH, Stallings VA, Early risk factors for increased adiposity: A cohort study of African American subjects followed from birth to young adulthood. Am J Clin Nutr. 2000; 72: 378-83.

42. Maffeis C. Aetiology of overweight and obesity in children and adolescents. Eur J Pediatr. 2000; 159 Suppl: S35-44.

43. Gillman MW, Early infancy as a critical period for development of obesity and related conditions, Nestle Nut. Workshop Pediatr Pogram, Feb,2010;65;13-24

44. US Dept. Of Health & Human Services: Agency for Healthcare Research and Quality. Effectiveness of Breastfeeding. [Cited on May 18 2009] from www.ahrq.goc/clinic/tp/brfouttp.htm. Site updated 06/08/2008.

45. Touchette E, Petit D, Tremblay RE, Boivin M,Falissard B, Genolini C, Montplasir JY, Associations between sleep duration patterns and overweight/obesity at age 6,Sleep. 2008 Nov 1;31(11):1507-14.

46. O'Connor TM,YangSJ,NicklasTA,Beverage intake among preschool children and it's effect on weight status,Paediatrics.2006 Oct;118(4);e1010-8

47. Dubois L, Girard M. Early determinants of overweight at 4.5 years in a population-based longitudinal study. Int J Obes (Lond). 2006 Apr;30(4):610-7

48. Rahilly S, Farooqi IS, Genetics of obesity, Phlos Trans Soc Lond B Biol Sci,2006 Jul 29;361(1471): 1095-105.

49. Obesity as a clinical and public health problem:Is there a need for a new definition based on lipotoxicity effects?, Biochim Biophys Acta. 2010 Mar;180(3):400-404.

50. Joffe YT, van der Merwe L, Carstens M ,Tumor Necrosis Factor-{alpha} Gene -308 G/A Polymorphism Modulates the Relationship between Dietary Fat Intake, Serum Lipids, and Obesity Risk in Black South African Women.J Nutr. 2010 Mar 24.

51. Mickey Chopra and Ian Darnton-Hill, Tobacco and obesity epidemics: not so different all? BMJ. 2004 June 26; 328(7455): 1558–1560. doi: 10.1136/bmj.328.7455.1558.

52. Chopra M, Galbraith S, Darnton-Hill, A global response to a global problem: the epidemic of overnutrition, Bull World Health Organ. 2002;80(12):952-8.

53. Jarosz M, Rychlik E, Counteraction against obesity ? WHO European region/European charter on counteracting obesity 2007, 52, 232-9

54. van der Merwe, Obesity in South Africa, Obesity Reviews Vol 7 Issue 4,Pg.315-322,2006.

55. Kruger HS, Puoane J,Senekal M , van de Merwe MT, Obesity in South Africa:challenges for government and health professionals,Public Health Nutr.2005. Aug 8 (5):491-500.

56. Caradas AA, Lambert EV, Charlton KE, An African ethnic comparison of eating attitudes and associated body image concerns in adolescent South schoolgirls. J Hum Nutr Diet. 2001 Apr;14(2):111-20.

57. Matijasevich A, Victora CG, Golding J,Barros FC,Menezes AM,Araujo CL,Smith GD,. Socioeconomic position and overweight among adolescents: data from birth cohort studies in Brazil and the UK, BMC Public Health. 2009 Apr 15;9:105.

58. Konturek PC, Konturek JW, Cześnikiewicz-Guzik M, Neuro-hormonal control of food intake: basic mechanisms and clinical implications.J Physiol Pharmacol. 2005 Dec;56 Suppl 6:5-25.

59. Valassi E,Scacchi M,Cavagrin F,Neuro-endocrine control of food intake,Nutr Metab Cardiovasc Dis.2008Feb;18920158-68

60. Diez JJ, Iglesias P, The role of the novel adipocyte-derived hormone adiponectin in human disease, Eur J Endocrinol. 2003 Mar;148(3):293-300.

61. Wang L, Barachina MD, Martinez V, Synergistic interaction between CCK and leptin to regulate food intake. Regul Pept. 2000 Aug 25;92(1-3):79-85.

62. Suzuki K,Simpson KA,Minnion JS, The role of gut hormones and the hypothalamic appetite regulation,Endoc J Vol.57(2010),No 5,359-372

63. Boden G, Obesity and free fatty acids, Endocrinol Metab Clin North Am. 2008 Sep;37(3):635-46, viii-ix.

64. Athyros VG, Tziomalos K, Karagiannis A. Should adipokines be considered in the choice of the treatment of obesity-related health problems?, Curr Drug Targets. 2010 Jan; 11(1):122-35.

65. Cook JR, Semple RK, Hypoadinponectinaemia-Cause or consequence of human “insulin resistance”, J Clin Endocrinol Metab.2010 Feb 17.

66. Tzanavari T, Giannogonas P, Karalis KP, TNF-alpha and Obesity, Curr Dir Autoimmun. 2010 Feb 18.(11):145-156.

67. Luo N, Liu J, Chung BH, Yang Q. Macrophage adiponectin expression improves insulin sensitivity and protects against inflammation and atherosclerosis, Diabetes 2010 Apr;59(4):791-9

68. Reaven GM, Insulin resistance: the link between obesity and cardiovascular disease; Endocrinol Metab Clin North Am. 2008 Sep;37(3):581-601, vii-viii.

69. Simpson F, Whitehead JP , Adinopectin-It's all about the modifications, Int J Biochem Cell Biol. 2010 Jan 4.

70. Gnacinska M, Malgorzewicz S, Stojek M. Role of adipokines in complications related to obesity: a review, Adv Med Sci.2009; 54(2); 150-7.

71. Hamdy O, Porramatikul S, Al-Ozairi E, Metabolic obesity: the paradox between visceral and subcutaneous fat. Curr Diabetes Rev. 2006 Nov;2(4):367-73.

72. Lafontan M, Girard J, Impact of visceral adipose tissue on liver metabolism. Part I: heterogeneity of adipose tissue and functional properties of visceral adipose tissue Diabetes Metab. 2008 Sep;34(4 Pt 1):317-27.

73. Holewijn S, den Heijer M, van Tits LJ. Impact of waist circumference versus adiponectin level on subclinical atherosclerosis, J Intern Med. 2009 Nov

74. Varady KA, Tussing L, Bhutani S, Braunschweig CL, Degree of weight reduction required .at:www.nhlbi.nih/gov/ealthy/public/heart/obesity

75. Trasande L,Chatterjee S, the impact of obesity on health service utilization and costs in childhood,Obesity(Silver Spring)2009, sep:17(9),1749-54

76. Withrow D, Alter DA,Economic burden of obesity worldwide: a systematic review of the direct costs of obesity, Obes Rev.2010 Jan 27.

77. Marinou K, Tousoulis D, Antonopoulos AS, Stefanadi E, Stefanadis C, Obesity and cardiovascular disease: from pathophysiology to risk stratification. Int J Cardiol. 2010 Jan 7;138(1):3-8.

78. Ceschi M, Gutzwiller F, Moch H, Eichholzer M, Probst-Hensch NM, Epidemiology and pathophysiology of obesity as cause of cancer, Swiss Med Wkly. 2007 Jan 27;137(3-4):50-6.

79. Calle EE, Thun MJ, Obesity and Cancer, Oncogene,2004 Aug 23;23(38):6385-7.

80. Vgontzas AN, Does obesity play a major role in the pathogenesis of sleep apnoea and its associated manifestations via inflammation, visceral adiposity, and insulin resistance? Arch Physiol Biochem. 2008 Oct;114(4):211-23.

81. Romero-Coral A, Caples SM, Lopez-Jimenez, Somers VK, Interactions between obesity and obstructive sleep apnoea: implications for treatment, Chest 2010 Mar;137(3):711-9.

82. Allender S, Rayner M, The burden of overweight and obesity related ill health on health system in the U.K. Obes Rev 2007, Sep8(5) 467-73.

83. Baker Heart and Diabetes Institute. 2006 [Cited April 25 2010] Available from: www.bakeridi.edu.au/heart and diabetes institute.

84. Scottish Intercollegiate Guidelines Network (SIGN). 2006 [Cited April 25 2010]. Available from: www.sign.ac.uk/pdf/sign115.pdf.

85. World Health Organisation. 2008 [Cited April 25 2009]. Available from: www.win.niddk.nih.gov/statisics/index.htm.

86. Mascie-Taylor CG, Karim E. The burden of chronic disease. Science. 2003 Dec 12;302(5652):1921-2.

87. Jensen MK, Chiuve SE, Rimm EB, Dethlefsen C,Tjonneland A, Joensen AN, Obesity, behavioral lifestyle factors and risk of acute coronary events, Circulation 2008 Jun 17(24) 3062-9.

88. Mendis S, The contribution of the Framingham Heart Study to the prevention of cardiovascular disease: a global perspective, Prog Cardiovasc Dis. 2010 Jul-Aug;53(1):10-4.

89. Zhang Y. Cardiovascular diseases in American women,Nutr Metab Cardiovasc Dis. 2010 Jul;20(6):386-393.

90. Bodier L, Cremades S, Dupuy O, Obesity and the metabolic syndrome: a new epidemic:Bull Acad Natl Med.2009 Jun;193(6):1289-300:discussion 1301.

91. Asrup A, Finer N,”Diabesity” term, Obes Rev 2000 Oct; 1(2):57-9

92. Fair AM, Montgomery K,Energy balance, physical activity, and cancer risk, Methods Mol Biol.2009;472:57-88.

93. Brunt EM, Pathology of non-alcoholic fatty liver disease, Nat Rev Gasterol Hepatol. 2010 Mar 2.

94. Moore JB, Symposium 1. Overnutrition: consequences and solutions. Non-alcoholic fatty liver disease- the hepatic consequences of obesity and the metabolic syndrome, Proc Nutr Soc.2010 Feb 17;1-10.

95. Fabbini E, Sullivan S, Klein S, Obesity and non-alcoholic fatty liver disease: biochemical, metabolic,and clinical implications,Hepatology.2010 Feb;51(2);679-89.

96. Petta S, Muratore C, Craxì A, Non-alcoholic fatty liver disease pathogenesis: the present and the future,Dig Liver Dis. 2009 Sep;41(9):615-25.

97. Bigornia SJ, Mott MM, Hess DT, Apovian CM. Long-term successful weight reduction improves vascular endothelial function in severely obese individuals. Obesity (Silver Spring). 2010 Apr;18(4):754-9.

98. Mishra NK, Cummo DM, Arnzen JJ, Bonander J ,A rule-based approach for identifying obesity and its comorbidities in medical discharge summaries, J Am Med Inform Assoc. 2009 Jul-Aug;16(4):576-9.

99. Cali AM, Caprio S,Obesity in children and adolescents,J Clin Endocrinol Metab.2008 Nov;93(11Suppl1);531-6

100. Sun Q, Townsend MK, Okereke OL, Adiposity and weight change in mid-life in relation to healthy survival after age 70 in women: prospective cohort study, BMJ.2009 Sep; 339:B3796.

101. Obesity Management Association, available at:http://www.omaorg.com/

102. Apovian CM, The causes, prevalence,and treatment of obesity revisited in 2009:what have we learned so far? Am J Clin Nutr 2010Jan;91(1):277S-279S

103. Forsythe LK, Wallace JM, Livingstone MB, Obesity and inflammation: the effects of weight reduction, Nutr Res Rev. 2008 Dec;21(2):117-33.

104. Caterson ID, Medical management of obesity and complications Ann Acad Med Singapore 2009 Jan;38(1):22-7.

105. Christianson T,Palse S, Bruun J, Overgaard K, Ringaard S,Pedese S, Comparable reduction of visceral adipose tissue depot after a diet induced

weiloss with or without aerobic exercise in obese subjects, Eur J Endocrinol 2009 Feb 11.

106. Bray GA, Lifestyle and pharmacological approaches to weight reduction: efficacy and safety, J Clin Endocrinol metab 2008 Nov 95 (11 Supp 17); 581-8.

107. Bult NJ, van Dalen T, Muller AF, Review: Surgical treatment of obesity, Eur J Endocrinol 2008 Feb; 158(2):135-45.

108. Belle SH, Berk PD, Courcoulas AP, Longitudinal Assessment of Bariatric Surgery Consortium Writing Group, Safety and efficacy of bariatric surgery: Longitudinal Assessment of Bariatric Surgery,Surg Obes Relat Dis. 2007 Mar-Apr;3(2):116-26.

109. McTigue KM, Conroy MB, Hess R. Using the internet to translate an evidence-based lifestyle intervention into practice. Telemed J E Health. 2009 Nov;15(9):851-8

110. Weinstein PK, A review of weight reduction programmes delivered via the internet, J Cardiovasc Nurs.2006 Jul-Aug;21(4) 251-8

111. Binks M,van Mierlo T, Utilization patterns and user characteristics of an ad libitum Internet weight reduction programme, JMed Internet Res.2010 Mar 29;12(1):e9.

112.. Herriott AM, Thomas DE, Hart KH,Warren J,Truby H, A qualitative investigation of individuals experience and expectations before and after completing a trial of commercial weight reduction progams, J Hum Nutr Diet 2008 Feb; 21 (1): 72-80.

113. Tsai AD, Wadden TA, Commerical Weight-Loss Programmes, Ann Intern Med 2005 June 21; 142(12):1024-25.

114. Guðmundsdóttir GB ,Approaching the digital divide in South Africa,NETREED Conference, 5-7 December 2005 at Beitostølen, Norway

115. Discovery Health. 2010 [cited January 11 2010]. Available from: discoveryhealthcme.discovey.com/bariatric surgery/bariatricsurgery html.

116. De Panfilio C, Torre M, Cero S, Salvatore P, Dall'Aglio E, Marchesi C, Personality and attrition from behavioral weight reduction treatment for obesity, Gen Hosp Psychiatry 2008,Nov-Dec:30(6):515-20.

117. Silva MN, Markland D, Minderico AS., A randomized controlled trial to evaluate self-determination theory for exercise adherence and weight control: rationale and intervention description, BMC Public Health. 2008, Jul 9;8;234.

118. Magill M, Apodaca TR, Barnett NP. The route to change; within session predictors of change plan completion in a Motivational Interview, J Subst Abuse Treat 2010 Apr,38(3):229-305.

119. Miller NH, Motivational interviewing as a prelude to coaching in healthcare settings, J Cardiovasc Nurs.2010 May-Jun.

120. Avenell A, Brown TJ, McGee M. What interventions should we add to weight reducing diets with obesity? A systematic review of randomized controlled trials of adding pharmacotherapy , exercise, behavior therapy or combinations, J Hum Nutr Diet 2004 Aug:17(4):293-316.

121. Logue J, Thompson L, Romanes F. Management of obesity:summary of SIGN guideline BMJ 2010 Feb 24:340:c154.

122. Field AE, Malspeis S, Willett WC. Weight cycling and mortality among middle-aged or older women. Arch Intern Med. 2009 May 11;169(9)881-6.

123. Dixon JB, Referral for a bariatric surgical consultation: it is time to set a standard of care, Obes Surg. 2009 May;19(5):641-4.

124. Miller WR, Rollnick S,'Motivational Interviewing,Preparing people to change addictive behavior', The Guilford Press, New York, London,1991.

125. Cochrane G, Role for a sense of self-worth in weight-loss treatments: helping patients develop self-efficacy, Can Fam Physician ,2008 Apr; 54(4):543-7.

126. Levensky ER, Motivational interviewing – an evidence-based approach. Am. J. 47.

127. Nestle J Dietary and weight control: Therapeutic education: motivational interviewing and CBT approaches for long-term weight-loss maintenance. Nestle Nutr. Workshop Ser. Clin. Performance Progam 2006, 11, 127-34.

128. Phelan S, Liu T, Gorin A. What distinguishes weight-loss maintainers from the treatment-seeking obese? Analysis of environmental, behavioral, and psychosocial variables in diverse populations. Ann Behav Med. 2009 Oct;38(2):94-104.

129. Buyx AM, Personal responsibility for health as a rationing criterion: Why we don't like it and why maybe we should. J Med Ehics.2008 Dec;34(12)871-4.

130. Emmons KM, Rollnick S, Motivational Interviewing in health care settings:opportunities and limitations,American Journal of Preventive Medicine Vol.20, Issue 1,Jan 2001,68-74.

131. Roche B and Barnes-Holmes, D; Behavior analysis and social constructionism: Some points of contact and departure,Behav Anal. 2003 Fall; 26(2): 215–231.

132. Rollnick S, Miller WR,What is motivational interviewing? (1995), Behavioral and Cognitive Psychotherapy, 23, 325-334.

133. Butler C, Rollnick S, Stott N,The practitioner, the patient and resistance to change:recent ideas on compliance,CMAJ 1996 May1;154(9):1357-1362

134. Searight R, Realistic approaches to counselling in the office setting, Am Fam Physician,2009 Feb15;79(4):277-84.

135. Jallinoja P, Pajari P, Absetz P, Negotiated pleasures in health- seeking lifestyles of participants of a health promoting intervention, Health (London);2010 Ma:14(2); 115-30.

136. Reid J, Obesity prevention between predisposition and personal responsibility. A social ethics approach, Dtsch Med Wchensch. 2008 Jan;133(3) 92-5.

137. Internet access to double by 2014 – South Africa. 2008 [Cited April 14 2008]. Available from http://www.southafrica.info/business/trends/newbusiness/internet-260309.htm.

138. Anthropometry.In:Lee RD, Nieman DC, editors. Nutritional Assessment. 3rd edition. London:Mc Graw Hill; 2003.Chapter 6.p.163-215.

139. Neville RG, Reed C, Boswell B. Early experience of the use of SMS technology in routine clinical care, Inform. Prim Care,2008:16(3):203-11.

140. Krishna S, Boren SA, Balas EA, Healthcare via cellphones: a systematic review, Telemed JE Health,2009 Apr; 15(3); 231-40.

141. Foley J, O'Neill M, Use of mobile telephone SMS as a reminder: the effect on patient attendance,Eur Arch Paediatr Dent,2009 Jan;10(1) 15-8.

142. Bramley, D, Riddell T, Whittaker R, Corbett T, Lin RB, Wills M. Smoking cessation using mo bile phone text messaging is as effective in Maori as non-Maori. NZ Med J 2005 Jun 3;118(1216).

143. Sirriyeh R, Lawton R, Ward J,Physical activity and adolescents: An exploratory randomized controlled trial investigating the influence of affective and instrumental text messages. Br J Health Psychol. 2010 Feb 12.

144. Joo, N and Kim, B.T. . Mobile phone short message service messaging for behavior modification in a community-based weight control progam in Korea. Journal of Telemed Telecare, 2007 13(8), 416-20.

145. Patrick K, Raab F,Adams MA. A text message-based intervention for weight reduction: randomized controlled trial, J Med Internet Res. 2009 Jan 13;11(1).

146. Anthropometry.In:Lee RD, Nieman DC, editors. Nutritional Assessment. 3rd edition. London:Mc Graw Hill; 2003.Chapter 6.p.163-215.

147. Burke LE, Swigart V, Warziski T M, Experiences of self-monitoring: successes and struggles during treatment for weight reduction, Qual Health Res. 2009 Jun;19(6):815-28.

148. U.S. Department of Health and Human Services. Dietery Guidelines for Americans,2005.(Updated January 2005) available at:http;//health.gov/dietaryguidelines/dga2005/document/default htm.accessed on 2 March 2008.

149. STATISTICA Software, Statsoft, Inc (2010).

150. Leong KC, Chen WS, Leong KW, The use of text messaging to improve attendance in primary care: a randomized controlled trial, Fam Pract.2006 Dec 23(6);699-705.

ADDENDA

Addendum 1: Patient informed consent form

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM

ASSESSMENT OF BEHAVIOUR PATTERNS IN WEIGHT REDUCTION

REFERENCE NUMBER:

PRINCIPAL INVESTIGATOR: *R. Guidozzi*

ADDRESS: *20 Cheetham Road*

St. Andrews

Bedfordview

2007

CONTACT NUMBER: *(011) 454 3626*

You are being invited to take part in a research project. Please take some time to read the information and please ask any questions that you do not understand. It is important that you clearly understand what this research entails and how you are involved. Your participation is entirely voluntary and you are free to decline. If you say "no", this will not affect you negatively. You are free to withdraw from the study at any point.

This study has been approved by the committee for human research at Stellenbosch University and will be conducted according to the ethical guidelines and principles of the International Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the MRC Ethical Guidelines for Research.

What is this research study all about?
The study will be conducted at the medical rooms of the address above and will include a total 45 patients. The study is to look at motivation and behaviour patterns during a weight reduction progam. Some patients will receive the normal dietary guidelines and medical care whilst others will be receiving an additional input to the dietary guidelines. No medication will be utilized.

Why have you been invited to participate?
You are seeking weight reduction and therefore you are a suitable candidate for the study.

What will your responsibilities be?

Clearly, you are asked to continue with the progam to the best of your ability.

What will your benefits be?
There are clearly no monetary or obvious benefits besides having participated in a study which might then add value to the future.

Are there any risks involved?
There are absolutely no risks involved.

If you do not agree to take part, what alternatives do you have?
The doctor will offer you an alternative weight reduction plan.

Who will have access to your medical records?
Nobody will have access to your personal medical records besides the anonymous results of the study being forwarded to the University of Stellenbosch.

What will happen in the unlikely event of some form of injury occurring?
There should be no injury occurring as a result of participating in this study.

What will you be paid to take part in this study and are there any costs involved?
No, you shall not be paid to take part in the study and there are no costs involved.

- ***You can contact doctor Guidozzi on the contact number above if you have any further queries.***
- ***You will receive a copy of this information and consent form for your own records.***

Declaration by participant

By signing below, I …….. agree to take part in a research study on THE ASSESSMENT OF BEHAVIOUR PATTERNS IN WEIGHT REDUCTION.

I declare that:

- *I have read or had read to me this information and consent form and it is written in a language which I am fluent in and comfortable*
- *I have had a chance to ask questions and all my questions have been adequately answered*
- *I understand that taking part in this study is **voluntary** and I have not been pressurised to take part*
- *I may choose to leave the study at any time and will not be penalised or prejudiced in any way*
- *I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to*

Signed (at place) ……..…….. on (date)
…….. 2008

…… ……..

Signature of participant *Signature of witness*

Declaration by investigator
I (name) …….. declare that:

- *I explained the information in this document to ……*
- *I encouraged him/her to ask questions and took adequate time to answer them*
- *I am satisfied that he/she adequately understands all aspects of the research, as discussed above.*
- *I did not use an interpreter.*

Signed (at place) ……..…….. on (date)
…….. 2008

……..
……..

Signature of investigator *Signature of witness*

Addendum 2: Standardised USDA (United States Department of Agriculture) dietary plan (according to energy requirements):

USDA Food Guide

The suggested amounts of food to consume from the basic food groups, subgroups, and oils to meet recommended nutrient intakes. Nutrient and energy contributions from each group are calculated according to the nutrient-dense forms of foods in each group (e.g., lean meats and fat-free milk).

Daily Amount of Food From Each Group (vegetable subgroup amounts are per week)						
Energy Level	**1,000**	**1,200**	**1,400**	**1,600**	**1,800**	**2,000**
Food Group[1]	Food group amounts shown in cup (c) or ounce-equivalents (oz-eq), with number of servings (srv) in parentheses when it differs from the other units. See note for quantity equivalents for foods in each group.[2] Oils are shown in grams (g).					
Fruits	1 c (2 srv)	1 c (2 srv)	1.5 c (3 srv)	1.5 c (3 srv)	1.5 c (3 srv)	2 c (4 srv)

Vegetables[3] Dark green veg. Orange veg. Legumes Starchy veg. Other veg.	1 c (2 srv) 1 c/wk .5 c/wk .5 c/wk 1.5 c/wk 4 c/wk	1.5 c (3 srv) 1.5 c/wk 1 c/wk 1 c/wk 2.5 c/wk 4.5 c/wk	1.5 c (3 srv) 1.5 c/wk 1 c/wk 1 c/wk 2.5 c/wk 4.5 c/wk	2 c (4 srv) 2 c/wk 1.5 c/wk 2.5 c/wk 2.5 c/wk 5.5 c/wk	2.5 c (5 srv) 3 c/wk 2 c/wk 3 c/wk 3 c/wk 6.5 c/wk	2.5 c (5 srv) 3 c/wk 2 c/wk 3 c/wk 3 c/wk 6.5 c/wk
Grains[4] Whole grains Other grains	3 oz-eq 1.5 1.5	4 oz-eq 2 2	5 oz-eq 2.5 2.5	5 oz-eq 3 2	6 oz-eq 3 3	6 oz-eq 3 3
Lean meat and beans	2 oz-eq	3 oz-eq	4 oz-eq	5 oz-eq	5 oz-eq	5.5 oz-eq
Milk	2 c	2 c	2 c	3 c	3 c	3 c
Oils[5]	15 g	17 g	17 g	22 g	24 g	27 g

Discretionary energy allowance[6]		165		171		171	132	195	267
Energy Level	**2,200**	**2,400**	**2,600**	**2,800**	**3,000**	**3,200**			
Fruits	2 c (4 srv)	2 c (4 srv)	2 c (4 srv)	2.5 c (5 srv)	2.5 c (5 srv)	2.5 c (5 srv)			
Vegetables[3] Dark green veg. Orange veg. Legumes Starchy veg. Other veg.	3 c (6 srv) 3 c/wk 2 c/wk 3 c/wk 6 c/wk 7	3 c (6 srv) 3 c/wk 2 c/wk 3 c/wk 6 c/wk 7	3.5 c (7 srv) 3 c/wk 2.5 c/wk 3.5 c/wk 7 c/wk 8.5	3.5 c (7 srv) 3 c/wk 2.5 c/wk 3.5 c/wk 7 c/wk 8.5	4 c (8 srv) 3 c/wk 2.5 c/wk 3.5 c/wk 9 c/wk 10	4 c (8 srv) 3 c/wk 2.5 c/wk 3.5 c/wk 9 c/wk 10			

	c/wk	c/wk	c/wk	c/wk	c/wk	c/wk			
Grains[4] Whole grains Other grains	7 oz-eq 3.5 3.5	8 oz-eq 4 4	9 oz-eq 4.5 4.5	10 oz-eq 5 5	10 oz-eq 5 5	10 oz-eq 5 5			
Lean meat and beans	6 oz-eq	6.5 oz-eq	6.5 oz-eq	7 oz-eq	7 oz-eq	7 oz-eq			
Milk	3 c	3 c	3 c	3 c	3 c	3 c			
Oils[5]	29 g	31 g	34 g	36 g	44 g	51g			
Discretionary energy allowance[6]		290		362		410	426	512	648

Notes for Appendix A-2:

[1] Food items included in each group and subgroup:

- Fruits – Only fresh fruit
  - Vegetables - In developing the food patterns, only vegetables with no added fats or sugars were used. And *see note 6*
  - Dark green vegetables - All fresh, frozen, and canned dark green vegetables, cooked or raw: for example, broccoli; spinach; romaine; collard, turnip,and mustard greens.
  - Orange vegetables - All fresh, frozen, and canned orange and deep yellow vegetables, cooked or raw: for example, carrots, sweetpotatoes, squash, and pumpkin.
  - Legumes - All cooked dry beans and peas and soybean products: for example, pinto beans, kidney beans, lentils, chickpeas, tofu. (dry beans

and peas) (See comment under meat and beans group about counting legumes in the vegetable or the meat and beans group.)
    - Starchy vegetables - All fresh, frozen, and canned starchy vegetables: for example, white potatoes, corn, green peas and beans,
- Grains - only grains in low-fat and low-sugar forms to be used..
    - Whole grains - All whole-grain products and whole grains used as ingredients: for example, whole-wheat and rye breads, whole-grain cereals and crackers, oatmeal, and brown rice..

Dry beans and peas and soybean products are considered part of this group as well as the vegetable group, but should be counted in one group only.

- Milk, yogurt, and cheese (milk) - All milks, yogurts, frozen yogurts, dairy desserts, cheeses (except cream cheese), including lactose-free and lactose-reduced products. Most choices should be fat-free or low-fat. In developing the food patterns, only fat-free milk was used. Calcium-fortified soy beverages are an option for those who want a non-dairy calcium source.

[2] Quantity equivalents for each food group:

- Grains - The following each count as 1 ounce-equivalent (1 serving) of grains: ½ cup cooked rice, pasta, or cooked cereal; 1 ounce dry pasta or rice; 1 slice bread; 1 small muffin (1 oz); 1 cup ready-to-eat cereal flakes.
- Fruits and vegetables - The following each count as 1 cup (2 servings) of fruits or vegetables: 1 cup cut-up raw or cooked fruit or vegetable, 1 cup fruit or vegetable juice, 2 cups leafy salad greens.
- Meat and beans - The following each count as 1 ounce-equivalent: 1 ounce lean meat, poultry, or fish; 1 egg; ¼ cup cooked dry beans or tofu; 1 Tbsp peanut butter; ½ ounce nuts or seeds.
- Milk - The following each count as 1 cup (1 serving) of milk: 1 cup milk or yogurt, 1½ ounces natural cheese such as Cheddar cheese or 2 ounces processed cheese. Discretionary energys must be counted for all choices, except fat-free milk.

[3] Explanation of vegetable subgroup amounts: Vegetable subgroup amounts are shown in this table as weekly amounts, because it would be difficult for consumers to select foods from each subgroup daily. A daily amount that is one-seventh of the weekly amount listed is used in calculations of nutrient and energy levels in each pattern.

[4] Explanation of grain subgroup amounts: The whole grain subgroup amounts shown in this table represent at least three 1-ounce servings and one-half of the total amount as whole grains for all energy levels of 1,600 and above. This is the minimum suggested amount of whole grains to consume as part of the food patterns. More whole grains up to all of the grains recommended may be selected, with offsetting decreases in the amounts of other (enriched) grains. In patterns designed for younger children (1,000, 1,200, and 1,400 energys), one-half of the total amount of grains is shown as whole grains.

[5] Explanation of oils: this table represent the amounts that are added to foods during processing, cooking, or at the table. Oils that have no *trans* fats. The amounts of oils listed in this table are not considered to be part of discretionary energys because they are a major source of the vitamin E and polyunsaturated fatty acids, including the essential fatty acids, in the food pattern. Solid fats must be avoided. compared with oils, they are higher in saturated fatty acids and lower in vitamin E and polyunsaturated and monounsaturated fatty acids, including essential fatty acids..Explanation of discretionary energy allowance: The discretionary energy allowance is the remaining amount of energys in each food pattern after selecting the specified number of nutrient-dense forms of foods in each food group. Examples such as the fat in low-fat, reduced fat, or whole milk or milk products or cheese and the sugar and fat in chocolate milk, ice cream, pudding, etc.

- The fat in higher fat meats (e.g., ground beef with more than 5% fat by weight, poultry with skin, higher fat luncheon meats, sausages)
- Avoid -The sugars added to fruits and fruit juices with added sugars or fruits canned in syrup
- Avoid -The added fat and/or sugars in vegetables prepared with added fat or sugars

- Avoid -The added fats and/or sugars in grain products containing higher levels of fats and/or sugars (e.g., sweetened cereals, higher fat crackers, pies and other pastries, cakes, cookies)
- Oils to be used include olive oil,canola oil. Sunflower oil,avocado oil ,grape seed oil and sesame seed oil as well as flax seed oil.Avoid fat from animal products. As an alternative to sugar please use sucrolose or xylitol.

Addendum 3: SMS messages forwarded to the intervention groups:

The weekly SMS (group 2) and the regular SMS (group3), received the same message, but the regular SMS(group 3) received the same message three times a week while the weekly SMS(group 2)l received the SMS once a week.

The messages were distributed as bulk SMS and all participants received the identical message at the same time in the same format.

Week 1

Control your portions of food

- Please measure your food intake

Week 2

This is a lifestyle change

- Try & make long lasting changes

Week 3

Eat at mealtimes only

- Avoid eating for emotional reasons only

Week 4

Remember to attend your follow-up visit

Exercise moderately

- Include activity on a regular basis

Week 5

Read your menu plan daily

- Remain aware of the healthier food options

Week 6

Stay focused and motivated

- A positive attitude to a healthy lifestyle is important

Week 7

Please remember to attend your follow-up visits

- Remain committed to your progam

Week 8

Remember to attend your follow-up visit

Avoid deep fried foods

- Prepare food in a healthy & attractive way

Week 9

Avoid bingeing

- Avoid food or situations that act as triggers for overeating

Week 10

Try to avoid alcohol

- Drink only low or energy free fluids

Week 11

Keep animal fat intake to a minimum

- Eat more fish, poultry & legumes

Week 12

Remember to attend your final visit

Keep salt intake to a minimum.

Addendum 4: Questionnaire for short messaging services

Please circle your appropriate answer

---

1) The SMS messages made a positive contribution to my lifestyle changes .

- All the time
- Sometimes
- Seldom
- Never

2) The SMS messages helped me to encourage and motivate myself.

- All the time
- Sometimes
- Seldom
- Never

3) The SMS messages reinforced my changes towards eating.

- All the time
- Sometimes
- Seldom
- Never

4) The SMS messages helped me feel more in control of my attitudes towards eating.

- All the time
- Sometimes
- Seldom
- Never

5) The SMS messages helped to give me more control over my own decisions on food choices.

- All the time
- Sometimes
- Seldom
- Never

6) Overall, the SMS has been beneficial in helping me change my lifestyle.

- All the time
- Sometimes
- Seldom
- Never

7) The SMS messages were read promptly.

- All the time
- Sometimes
- Seldom
- Never

8) The SMS messages stopped me from bingeing.

- All the time
- Sometimes
- Seldom
- Never

9) The SMS messages helped me to reduce my portion sizes.

- All the time
- Sometimes
- Seldom
- Never

10) The SMS messages helped me to stop the ‘snacking’.

- All the time
- Sometimes
- Seldom
- Never

11) The SMS messages helped me to make healthier food choices.

- All the time
- Sometimes
- Seldom
- Never

12) The SMS messages made me feel positive about my lifestyle changes.

- All the time
- Sometimes
- Seldom
- Never

Addendum 5: Ethics approval letter:

28 May 2009 **MAILED**

Dr R Guidozzi
Dep of Human Nutrition
3rd flr,clinical bld
Stellenbosch University
Tygerberg campus
7505

Dear Dr Guidozzi

"The evaluation of the efficacy of short messaging service (SMS) in a weight reduction practice."

ETHICS REFERENCE NO: N09/05/153

RE : APPROVAL

A review panel considered the application for approval and registration of the abovementioned project on behalf of the Health Research Ethics Committee.

In principle the panel is in agreement with the project, but requested that you should attend to the following matter(s)
before the project could be approved:

1. There is no indication whether participants are required to pay for their consultations; please clarify.
2. The full approved study name and number should be given in the patient information consent form.
3. Why is the nature of the intervention not described in the information consent form? The participants would be consulting to something while not knowing what it entails.
Mass in kg
4. BMI = (Height) ^{2}, not weight.
5. Should the word kilojoule or kilojoule not be replaced with kilojoule where appropriate, and conversions be done in a scientific dissertation?
6. This is not a true randomization though it might be acceptable for this study.
7. The cell number of the investigator and contact details of the committee must appear on the informed consent form.
8. Limitation of the study population as described may limit the value of the study.
9. The study is described as double blind but will it not be clear to the participant that she is part of an intervention leg if she receives sms's, or is told that she is going to receive them? Please also see the note on the informed consent form - that the nature of the intervention should ideally be explained to the participants in full since they would need to know what it is that they consent to. How does the researcher intend keeping herself blinded since participants will talk to her about the study, or would tend to, unless it is particularly explained to them that they should not and why not.

On receipt of the additional information/corrected document(s) the application will be reconsidered. Please HIGHLIGHT
or use the TRACK CHANGES function to indicate ALL the corrections/amendments clearly in order to allow rapid scrutiny and appraisal.

Please quote the abovementioned project number in ALL correspondence henceforth.

Verbind tot Optimale Gesondheid · Committed to Optimal Health
Afdeling Navorsingsontwikkeling en -steun · Division of Research Development and Support
Posbus/PO Box 19063 · Tygerberg 7505 · Suid-Afrika/South Africa
Tel.: +27 21 938 9075 · Faks/Fax: +27 21 931 3352

For standard CHR forms and documents please visit: www.sun.ac.za/rds

Yours faithfully

MRS MERTRUDE DAVIDS
RESEARCH DEVELOPMENT AND SUPPORT
Tel: 021 938 9207 / E-mail: mertrude@sun.ac.za
Fax: 021 931 3352

29 May 2009 10:40