The use of a musical play in the transfer of knowledge on nutrition, a healthy lifestyle and the prevention of obesity

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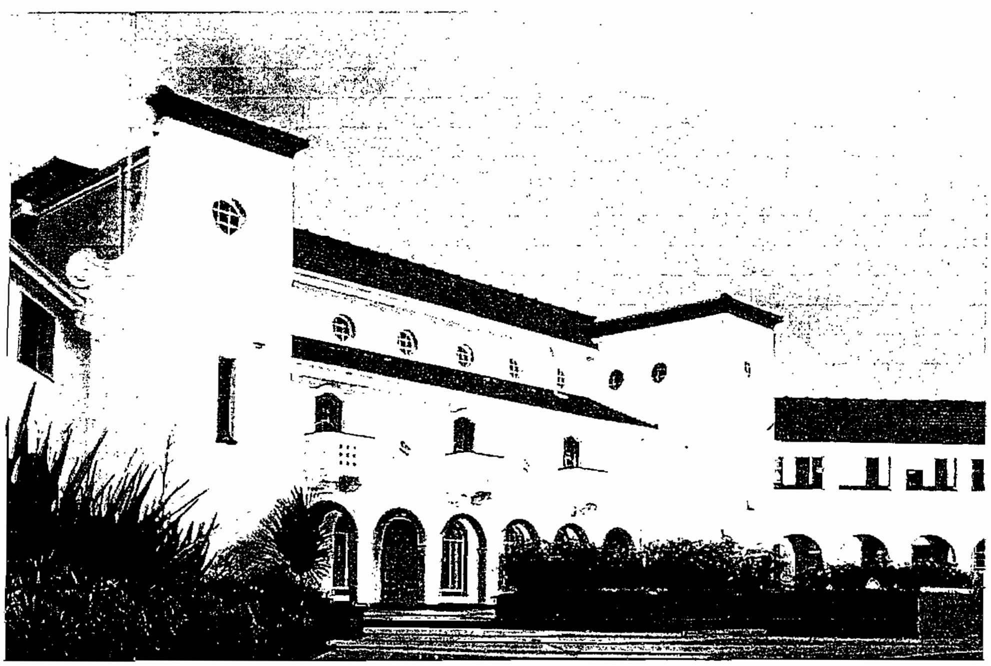

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OPSOMMING

Agtergrond

Suid-Afrika ondervind 'n unieke dubbele las van siekte as gevolg van die voedingtransisie en word gekonfronteer met siektes wat verband hou met beide onder- sowel as oorvoeding. Kinderobesiteit, geassosieer met swak diëte en fisiese onaktiwiteit, neem progressief pandemiese afmetings aan. Daarom is die bevordering van gesonde eetpatrone en gereelde fisieke aktiwiteit noodsaaklike komponente van lewenstylveranderinge van kinders. 'n Obesiteitsvoorkomende program met elemente van musiek en dans gemik op verbeterde voiding kennis om onkunde aangaande gesonde diëte te verbeter en belang van fisieke aktiwiteit te onderskryf het 'n ideale oplossing geblyk te wees.

Doelwit

Die doelwit van hierdie studie was om die effek van 'n nuwe voedingprogram gebaseer op die Suid-Afrikaanse voedselgebasseerde dieetriglyne (SAVGR; musiekspel) op die oordrag van voedingkennis ten einde 'n gesonde leefstyl (gesonde dieetgewoontes en fisieke aktiwiteit) in primêre skoolkinders, te ondersoek.

Metodes

Kinders (n=203; seuns=93; dogters=110), 6 tot 12 jaar oud, van verskillende etniese groeperinge, is gewerf. Deelname was vrywillig. Slegs kinders wie se ouers/voogde geskrewe ingeligte toestemming gegee het, is ingesluit. Kinders is ewekansig toegewys aan 'n kontrole groep (n=99) wat aan die standaard skoolvoedingkurrikulum blootgestel was of aan 'n eksperimentele groep (n=104), wat ook deelgeneem het aan 'n musiekspel met kort boodskappe gebaseer op die SAVGR vir twee sessies 'n week vir vyf weke. Na elke sessie is pamflette oor die relevante SAVGR boodskap vir die kinders gegee om huis toe te neem. Aan die einde van die intervensie het die kinders die musiekspel voor hulle ouers/voogde opgevoer. Met basislyn is demografiese inligting versamel, antropometriese afmetings geneem, 'n gevalideerde voedingkennis vraelys geadministreer en 'n 24-uur-herroep dieetopname voltooi. Al hierdie meetings, behalwe die demografiese vraelys, is na die intervensie herhaal.

Resultate

Totale voedingkennis van die kinders wat blootgestel was aan die musiekspel het met statistiese en praktiese betekenisvolheid [11.9% ($p < 0.05$) teenoor 11.1% ($d > 0.5$)] verbeter. Kinders 6 tot 12 jaar het meer grane en minder suiwel, groente, vrugte, en vleis ingeneem as die aanbevole innames. Geen meetbare veranderinge in voedselgroepinname het na die intervensie plaasgevind nie, behalwe vir vrugte-inname van dogters 8 tot 10 jaar in die eksperimentele groep wat toegeneem het ($p < 0.05$). Seuns en dogters 6 tot 12 jaar oud het ontoereikende hoeveelhede (< 67% van die aanbevole dieettoelaes) kalsium, vitamiene A, C, D en B_{12}, folaat en yster ingeneem. Geen statisties betekenisvolle veranderinge in die antropometriese afmetings is na die intervensie waargeneem nie. Volgens z-tellings was daar gevind dat kinders in die laer grade (graad 1 - 3) 'n groter risiko het vir groeivertraging terwyl kinders in die hoër grade (graad 4 - 6) 'n groter risko het vir obesiteit. 'n Hoë voorkoms in oorgewig en obesiteit onder blanke seuns en groeivertarging onder swart seuns en dogters is gevind.

Gevolgtrekking

Die resultate van die studie het getoon dat die musiekspel gebaseer op die SAVGR totale voedingkennis in 'n groep primêre skoolkinders verbeter het. Dieetkwaliteit gebaseer op die voeselgroepaanbevelings en nutriëntinname het laag gebly, wat aandui dat ander faktore as voedingkennis voedselkeuses en dus dieetkwaliteit in hierdie groep kinders beïnvloed het.

Sleutelterme

Kinderobesiteit; voedingprogram; voedingkennis; gedrag; musiek; fisieke aktiwiteit.

SUMMARY

Background

South Africa is experiencing a unique double burden of disease due to the nutrition transition, facing diseases related to both under and over nutrition. Childhood obesity is associated with a poor childhood diet, physical inactivity and sedentary lifestyle. Promoting healthy eating and physical activity is important. Promoting healthy eating patterns and regular activity are essential components of lifestyle modification of children. An obesity prevention programme with elements of music and dance for children aimed at improved nutritional knowledge to combat ignorance of healthy diets and highlight the importance of physical activity seemed to be an ideal solution.

Aim

The aim of this study was to investigate the effect of a novel nutrition intervention programme based on the South African food-based dietary guidelines (SAFBDG; musical play) on the transfer of nutritional knowledge towards a healthy lifestyle (healthy dietary behaviour and physical activity) in primary school children.

Methods

Children (n=203; boys=93; girls=110), aged 6 to 12 years from different ethnic groups were recruited. Participation was voluntary. Only children whose parents/guardians gave written informed consent were included. Children were randomly assigned to a control group (n=99) exposed to the standard school nutrition curriculum and to an experimental group (n=104) who also participated in a musical play with short messages based on the SAFBDG for two sessions a week for five weeks. After each session pamphlets on the relevant SAFBDG message were given to the children to take home. At the end of the intervention the children performed the musical play for their parents/guardians. At baseline demographic information was obtained, anthropometrical measurements taken, a validated nutritional knowledge questionnaire administered and a 24-hour dietary recall completed. All measurements except the demographic questionnaire were repeated after the intervention.

Results

Overall nutritional knowledge of the children exposed to the musical play increased with statistical and practical significance [11.9% ($p < 0.05$) versus. 11.1% ($d > 0.05$)]. Children 6 to 12 years consumed more grains and less dairy, vegetables, fruit and meat than the recommended intakes. No measurable changes occurred in food group consumption after the intervention except for fruit intake which increased in girls aged 8 - 10 years in the experimental group (p <

0.05). Boys and girls aged 6 - 12 years have inadequate intakes (< 67% of the Recommended Dietary Allowances (RDA)) of calcium, vitamins A, C, D, and B_{12}, iron and folate. No statistically significant changes in anthropometrical measurements were found after the intervention. Z-scores showed that children from the lower grades (grade 1 - 3) were more prone to stunting while children from the higher grades (grade 4 - 6) were more prone to be obese. Furthermore, a high prevalence of overweight and obesity was found amongst white boys, whereas stunting was more prevalent amongst black boys and girls.

Conclusion

The results of the study showed that the musical play based on the SAFBDG improved overall nutritional knowledge in a group of primary school children. Diet quality based on food group recommendations and nutrient intakes remained low which suggests that other factors apart from nutritional knowledge influenced food choices and, therefore, the diet quality in this group of children.

Keywords

Childhood obesity; nutrition intervention; nutritional knowledge; behaviour; music; physical activity.

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LIST OF ABREVIATIONS

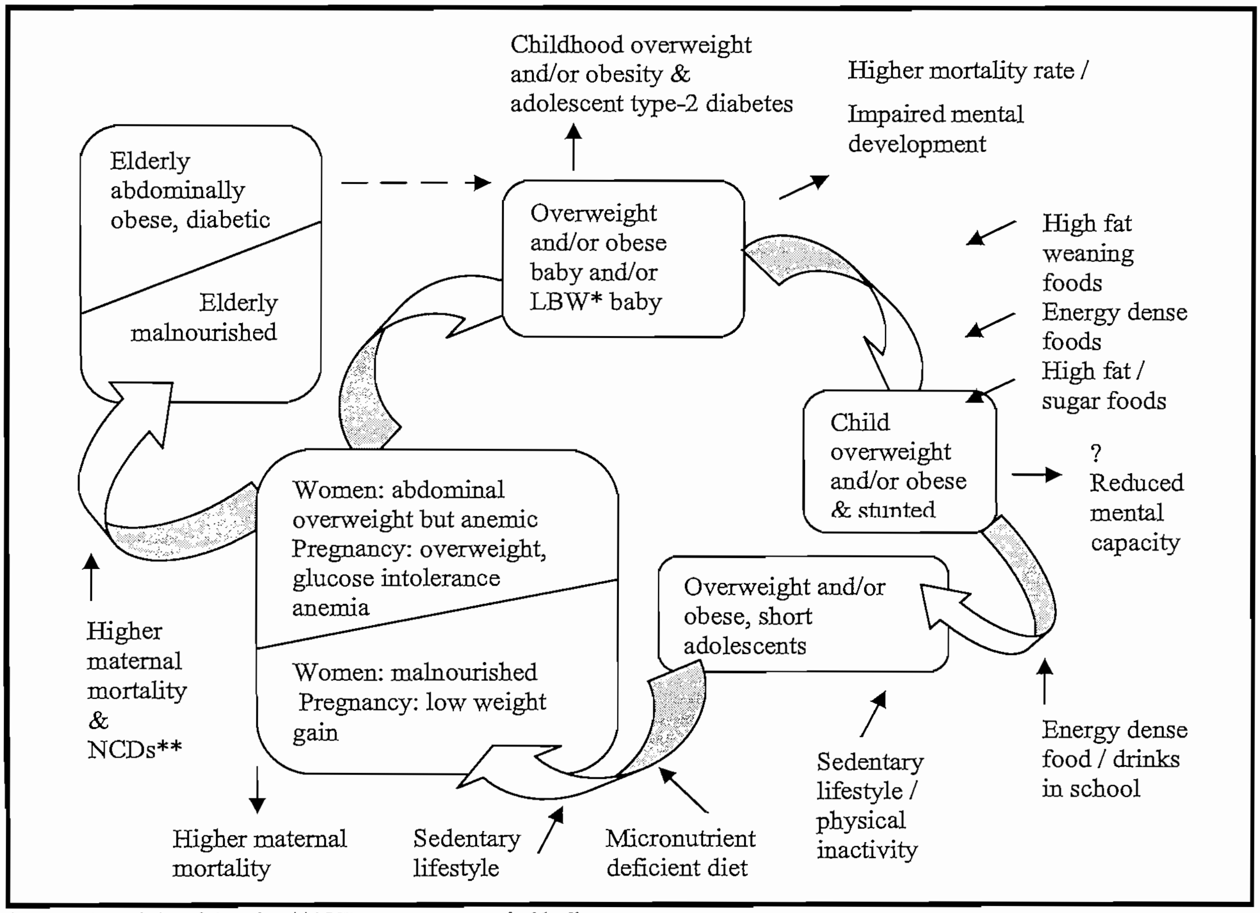
AI	Adequate intake
BMI	Body mass index
BT10	Birth-to-Ten
BT20	Birth-to-Twenty
CATCH	Child and Adolescent Trial for Cardiovascular Health
CI	Confidence Interval
CD	Compact disc
CVD	Cardiovascular Disease
DNA	Deoxyribonucleic acid
DRI	Daily recommended intake
FFQ	Food frequency questionnaire
IOTF	International Obesity Taskforce
ISAK	International Society for the Advancement of Kinanthropometry
KAB	Knowledge-attitude-behaviour
KYB	Know your body
LBW	Low-birth weight
MUFA	Mono-unsaturated fatty acids
NCDs	Non-communicable disease
NHANES	National Health and Nutrition Examination Survey
NFCS	National Food Consumption Survey
PE	Physical education
RDA	Recommended daily allowance
SAFBDG	South African food-based dietary guidelines
SFA	Saturated fatty acids
SD	Standard deviation
WHO	World Health Organization

CHAPTER 1: MOTIVATION OF THE STUDY

1.1 Background and problem statement

Most developing countries including South Africa are currently in the process of nutrition transition due to urbanisation, and are suffering from the double burden of both communicable and non-communicable diseases (Rutengwe *et al.*, 2001). Chronic non-communicable diseases (NCDs) are caused by preventable and adaptable risk factors such as under nutrition, overweight and/or obesity (Puoane *et al.*, 2008). Under nutrition in adults is defined according to the World Health Organization (WHO) as a body mass index (BMI) of $< 18.5\ kg/m^2$, overweight as a BMI between 25 and 30 kg/m^2 and obesity as a BMI of $\geq 30\ kg/m^2$ (WHO, 2009a). Under nutrition in children is classified according to z-scores as < -2 standard deviations of the mean for weight-for-age and height-for-age, childhood overweight ≥ 2 standard deviations of the mean for weight-for-age as well as BMI-for-age and childhood obesity as ≥ 3 standard deviations of the mean for weight-for-age as well as BMI-for-age (Cole *et al.*, 2000; Chowdhury *et al.*, 2007; WHO, 2009a). Under nutrition, overweight and/or obesity commonly co-exist in developing countries that are currently undergoing a health transition (Rutengwe *et al.*, 2001). The link between fetal malnutrition and adult overweight and/or obesity was first described by Barker (1992) and is illustrated in Figure 1.1.

Briefly, the Barker hypothesis is that low-birth weight (LBW: ≤ 2.5kg at birth) babies born from undernourished mothers are programmed through epigenetic changes in gene-expression to carry a higher risk for NCDs later on in life (Sallout & Walker, 2003; Godfrey & Barker, 2001). As shown in Figure 1.1, malnourished mothers give birth to overweight and/or obese or LBW babies. These babies gain weight when introduced to high fat weaning foods, resulting in overweight and/or obese children with an increased risk for NCDs (especially type II diabetes mellitus) during adolescence and adulthood. Furthermore, these overweight and/or obese children grow up with a propensity to give birth to fatter babies (Philip *et al.*, 2004). The LBW babies subsequently gain weight rapidly when introduced to high fat weaning foods (thrifty phenotyping), thus leading to increased fat deposition. An accelerated "catch up" growth has also been observed in LBW babies as a crucial factor for the causal association between early under nutrition and later overweight and/or obesity (Cabalerro, 2006). Additionally, these LBW babies have shown to be stunted and often develop into adults of low human capital due to poor development of the frontal lobe of the brain (responsible for cognitive abilities). Due to the continuous exposure to low quality diets (micro-nutrient and/or macro-nutrient insufficient diets) throughout life, these LBW babies grow up to give birth to malnourished children. Both the abovementioned situations lead to a continuous cycle of poverty and malnutrition.



*LBW = low birth weight baby; ** NCDs = non-communicable diseases

Figure 1.1 The double burden of fetal malnutrition: a continuous cycle of poverty and malnutrition (Adapted from Philip *et al.*, 2004).

According to Kruger *et al.* (2005), the shift from energy deficiency (under nutrition) to energy excess (over nutrition) increases the risk of overweight and/or obesity with age. Overweight and/or obesity occur in boys and girls, younger children, adolescents as well as adults, across all socio-economic strata, and among all ethnic groups (Koplan *et al.*, 2005). This rapid increase in the prevalence of overweight and/or obesity in general (Rutengwe *et al.*, 2001) has progressed childhood obesity into a serious public health epidemic in both developed and developing countries (Ding & Hu, 2008) which acts as one of the greatest challenges of the 21st century (Swinburn *et al.*, 2004; Wardle, 2005; Shetty & Schmidhuber, 2006; Flynn *et al.*, 2006). If this threat is ignored, obesity will become the main 'preventable' cause of death (Allison *et al.*, 1999); therefore, urgent preventable innovative strategies and interventions are necessary to tackle this problem (Rutengwe *et al.*, 2001).

1.2 Approach to the problem

For the prevention of obesity, one of the most particular global strategies is changing lifestyle behaviour amongst populations at risk. Changing lifestyle behaviour entails the promotion of healthy eating and regular physical activity which seem to be pivotal components of lifestyle modification (Crawford, 2002; Swinburn *et al.*, 2004; Skidmore & Yarnell, 2004; Kruger *et al.*, 2005). Research shows that lifestyle can be altered through implementing good nutrition education initiatives (Friel *et al.,* 1999; Skidmore & Yarnel, 2004; McKindley *et al.*, 2005; Wardle, 2005); consequently, modifying behaviour through increasing nutritional knowledge (Kruger, 2007). According to Nzewi (2005), the perfect medium for increasing knowledge is music due to the fact that it creates a co-operative spirit which in turn increases learning ability. Additionally, music through dance is also the perfect medium to increase physical activity (Nzewi, 2005).

For this reason, the researcher hypothesized that to prevent obesity through lifestyle modification using music and dance as key elements in an obesity prevention programme seem to be an ideal vehicle to transfer nutritional knowledge. This led to the development of a nutrition education programme (referred to as the **musical play** from here onwards) aimed at primary school children, which was transferred through the use of music and dance [Addendum I on Compact Disc (CD)]. This musical play is based on the South African food-based dietary guidelines (SAFBDG) aiming to increase children's knowledge on healthy dietary behaviour as well as physical activity. It is also hypothesized that this increased knowledge will motivate children to move towards more healthy food choices and to modify lifestyle behaviour regarding healthy eating and physical activity.

The development of the FBDGs has been provoked through the worldwide burden of diet-related diseases (Gibney and Vorster, 2001). The South African FBDG was developed in a highly participatory and consultative manner, over a period of 4 years, in order to optimize nutritional status in both underprivileged and wealthy communities (Gibney & Vorster, 2001). The South African FBDGs were written with the intension to execute an educational role (Gibney & Vorster, 2001) and was proposed as basis of the national education curriculum of the department of Education (Vorster *et al.*, 2001). Added to these FBDGs are 3 additional guidelines proposed by Scott (2006) for children. At the time of the development of the musical play that is based on the SAFBDG there were no accepted SAFBDG for children. Therefore a total of thirteen FBDGs were included within the musical play:

1. Enjoy a variety of foods
2. Be active
3. Make starchy foods the basis of most meals
4. Eat plenty of fruits and vegetables
5. Eat dry beans, split peas, lentils and soya often
6. Meat, fish, chicken or eggs can be eaten every day
7. Drink milk every day (Scott, 2006)
8. Eat fats sparingly
9. Use salt sparingly
10. Drink lots of clean, safe water
11. If you drink alcohol, drink it sensibly
12. Use foods and drinks containing sugar sparingly and not between meals (Scott, 2006)
13. Eat 5 small meals a day (Scott, 2006)

The musical play was developed by the master student Ms. K. Kruger (2007) as part of her Baccalaureus Honours degree. It was decided to implement the musical play and to test the outcome thereof on nutrition knowledge during school hours or within after-school care services, since these are natural learning environments and therefore the ideal setting for the implementation of childhood obesity prevention interventions in a controlled manner (Dehghan *et al.*, 2005; Flynn *et al.*, 2006; Salmon *et al.*, 2006). According to Rozmajl (1986), musical growth within children takes place at different levels. These levels are each connected to different age groups: level 1 (5 – 7 years), level 2 (6 – 8 years), level 3 (9 – 11 years) and level 4 (10 – 12 years). Due to the fact that primary school starts from age 6, the researchers only made use of levels 2, 3 and 4 (children age 6 – 12 years) when implementing the musical play. The overlapping age parameters of levels 3 and 4 lead to further adaptation of the age limits of these groups. Level 3 was adapted to the age group 9 – 10 years whereas level 4 was adapted to the age group 11 – 12 years.

1.4 Study design

The implementation of the musical play was part of a larger study. The aim of the broad study was to investigate the effect of a musical play, based on the SAFBDG, on the transfer and implementation of nutritional knowledge as well as attitude towards healthy dietary behaviour and physical activity amongst 6 – 12 year old school children in the city of Potchefstroom. Two master students participated in the broad study, each with a different focus area.

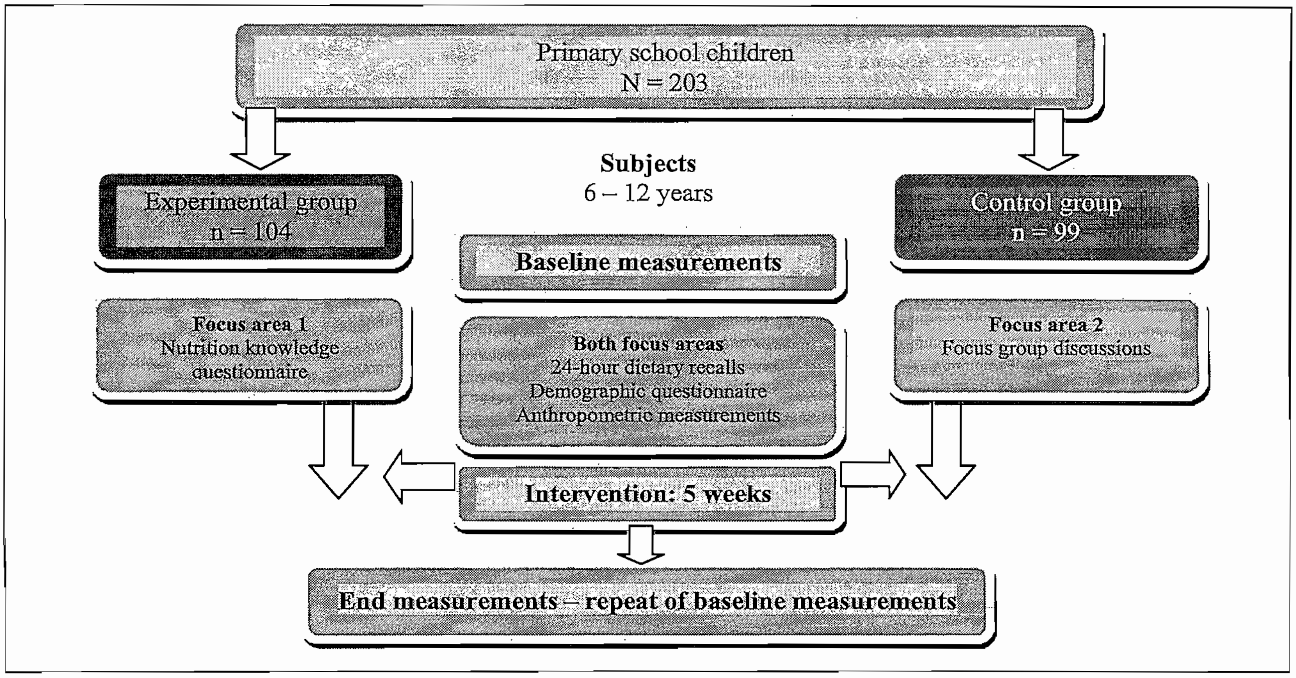


Figure 1.2 Schematic presentation of the broad study design.

As shown in Figure 1.2, this broad study was divided into two focus areas. The first area focused on increasing nutritional knowledge and changing lifestyle behaviour whereas the second area focused on attitude towards healthy eating and hurdles in facilitating change. This dissertation addresses the first mentioned focus area.

1.4.1 Aim of this dissertation (focus area 1; Figure 1.2)

The main aim of this dissertation was to investigate the effect of a nutrition intervention programme based on the SAFBDG (musical play) on the transfer of nutritional knowledge towards a healthy lifestyle (healthy dietary behaviour and physical activity) in primary school children.

1.4.2 Objectives of this dissertation

- To evaluate how the musical play increase nutritional knowledge of primary school children,
- To evaluate the diet quality of primary school children,
- To assess changes in diet quality of primary school children after the intervention, and
- To evaluate anthropometric measurements of primary school children.

1.5 Significance of the broad study

If using music and dance succeeds to increase children's knowledge on the SAFBDG and thereby facilitate change to healthier lifestyle behaviours, this study will positively add to the knowledge-base on how to prevent obesity amongst primary school children.

1.6 Outline of the dissertation

This dissertation is divided into five chapters:

- Chapter 1 consists of the background and problem statement of the study, the approach to the study problem, the aim of both the broad study and this dissertation, as well as the significance of the study.
- Chapter 2 provides a comprehensive literature survey, covering all the relevant aspects concerning childhood obesity, including the prevention thereof through the transfer of nutritional knowledge and lifestyle behaviour modification.
- Chapter 3 indicates how the musical play was implemented in this intervention study.
- Chapter 4 provides results obtained with the intervention.
- Chapter 5 gives the discussion, conclusion and recommendations related to the study findings.

1.7 List of co-workers

In Table 1.1 co-workers of the broad study is summarized as well as each one's main responsibilities.

Table 1.1 List of co-workers

Name	**Affiliation**	**Responsibility**
Dr HH Wright	Researcher in the Centre of Excellence for Nutrition	Study leader for Ms. K. Kruger and Ms. M. Harris
Prof HH Vorster	Director of the Centre of Excellence for Nutrition	Co-study leader for Ms. K. Kruger
Prof A Kruger	Director of AUTHeR	Co-study leader for MS. M. Harris
Fieldworkers	Co-workers, research assistants and 4th year dietetic students	Complete the nutrition questionnaire, demographic questionnaire, 24-hour dietary recall, focus group discussions and take down anthropometrical measurements
Mrs. V. Kruger	Co-worker	Data capturing: Nutrition questionnaire, demographic questionnaire and anthropometrical data
Ms. K. Pieterse	Co-worker	Data capturing: 24-hour dietary recall
Ms K Kruger	Master student	Focus area 1 of the broad study Development and implementation of the musical play
Ms M Harris	Master student	Focus area 2 of the broad study Implementation of the musical play Data capturing: focus group discussions

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter provides a focused literature survey regarding the prevalence, causes and consequences of childhood obesity, as well as the prevention thereof through the transfer of nutritional knowledge and lifestyle behaviour modification.

2.2 Background

South Africa is currently in the process of rapid urbanisation (people moving from rural to urban areas) which is characterised by a health transition. Due to this rapid rate of urbanisation during which traditional diets are rapidly being displaced by Westernised diets (Steyn *et al.*, 2009), South Africa is suffering from both communicable diseases and NCDs (Rutengwe *et al.*, 2001). These diseases in turn relate to both under nutrition and over nutrition (overweight and/or obesity) which are linked to genetic and epigenetic adaptive responses to the intrauterine and postnatal environment (Caballero, 2006). These adaptive responses could lead to programming of a vulnerability to visceral adiposity (Phillip *et al.*, 2004). As illustrated in Figure 1.1 (Chapter 1), malnourished women give birth to overweight and/or obese or LBW babies which both result in increased fat deposition during childhood. Further exposure to an energy dense diet during infancy and childhood exacerbates the development of overweight and/or obesity. This rapid increase in the prevalence of overweight and/or obesity during childhood has progressed into a severe public health pandemic (Ding & Hu, 2008), also in the developing world. Therefore, childhood overweight and/or obesity need to be addressed urgently through prevention initiatives (Wardle, 2005).

2.3 Childhood obesity

This dissertation focuses on childhood obesity, but will also discuss childhood overweight where appropriate.

2.3.1 Definition of childhood obesity

Childhood obesity can be defined as either an excess of body fat (Dehghan *et* al., 2005) or a persistent positive energy balance (Wardle, 2005), which impairs health (Skidmore & Yarnell, 2004).

According to Koplan *et al.* (2005), the BMI can be used to classify children as overweight or obese. When using BMI, childhood overweight is classified as ≥ the 85th percentile and childhood obesity as ≥ the 95th percentile of BMI according to the WHO growth charts (WHO, 2009a; Himes & Dietz, 1994; Flodmark, 2004; Koplan *et al.*, 2005). When using z-scores to classify children as overweight or obese, childhood overweight is classified as ≥ 2 standard deviations of the mean for weight-for-age as well as BMI-for-age and childhood obesity as ≥ 3 standard deviations of the mean for weight-for-age as well as BMI-for-age (WHO, 2009b; Cole *et al.*, 2000).

2.3.2 Prevalence of childhood obesity

Childhood obesity has manifested in both developed and developing countries (Ebbeling *et al.*, 2002; Swinburn *et al.*, 2004; Salmon *et al.*, 2006; Flynn *et al.*, 2006). Recent national estimates for the prevalence rates of childhood obesity within developed countries indicate that 17.6% of children are above the 95th percentile of BMI for age and sex, of which approximately 70% will grow up to become obese adults (Pourhassan & Taravat, 2009). The prevalence rates for childhood obesity within developing countries have also intensified (Popkin, 2001; Dehghan *et al.*, 2005; Kruger *et al.*, 2005). In South Africa, the prevalence rates of childhood overweight and obesity among 1 to 9-year olds and 13-year olds are approximately 17% and 16 % respectively (Steyn *et al.*, 2009), which is equivalent to other developing countries such as China (7%), Egypt (14%), India (16%), Brazil (14%) and Iran (6.7 – 9.2%) (Flynn *et al.*, 2006; Jazayeri, 2005).

2.3.3 Causes of childhood obesity

Various mechanisms by which obesity can develop have been proposed. According to Wardle (2005), there are two factors which cause the development of childhood obesity namely: (1) the child has an inherited bio-behavioural system which increases the risk of positive energy balance behaviours; and/or (2) the child's environment allows the expression of these behavioural tendencies. Therefore, there are both genetic (Ebbeling *et al.*, 2002; Skidmore & Yarnell, 2004; Flynn *et al.*, 2006) and environmental (Ebbeling *et al.*, 2002; Skidmore & Yarnell, 2004; Kruger *et al.*, 2005; Wardle, 2005; Flynn *et al.*, 2006) causes to the development of childhood obesity.

Results from a large twin study indicated that more or less 70% of the development of obesity within an individual is caused by genetic factors; consequently, the environmental factors should explain approximately 30% of the variance in the development of obesity (Wardle, 2005). The question remaining is, however, if genetic factors dominate the development of childhood obesity to such an extent that it cannot be treated or if environmental factors impact on childhood obesity to such an extent so that changes in the environment can prevent the development thereof. In the following part the genetic and environmental factors will be discussed in more detail.

2.3.3.1 Genetic causes of childhood obesity

As mentioned above, childhood obesity has genetic, epigenetic and environmental links (Reyes and Mañalich, 2005). "Epigenetics" is defined as methylation of deoxyribonucleic acid (DNA) during fetal development due to a nutritional unfavourable environment (De Boo & Harding, 2006). Involving the epigenetic phenomena, it is said that the link between fetal growth and adult onset disease must ultimately involve changes in gene expression (Reyes & Mañalich, 2005). Gene expression is changed by means of alterations in DNA as well as through other epigenetic mechanisms, finally resulting in increased susceptibility to chronic diseases during adulthood (Waterland & Jirtle, 2004). This occurrence is known as the 'developmental origins of adult disease' also known as the 'Barker hypothesis' (De Boo & Harding, 2006).

Barker's theory is based on epidemiological associations between premature morbidity and mortality in adult life and fetal malnutrition during early years (Reyes & Mañalich, 2005). According to De Boo and Harding (2006), the fetus responds to its environment through physiological adaptations in order to prepare itself for postnatal life. Therefore, it is believed that an individual with impaired growth before birth has an increased risk for NCDs later on in life if exposed to an obesogenic environment during childhood (McKinley *et al.,* 2005; Reyes & Mañalich, 2005; Flynn *et al.*, 2006).

2.3.3.2 Environmental causes of childhood obesity

There are several environmental factors influencing an individual's lifestyle behaviour which seem to play an important role in the development of obesity (Dehghan *et al.*, 2005). Although most of the environmental influences on weight are found to be unique to individuals (Wardle, 2005), poor dietary behaviour combined with a lack of physical activity (Swinburn *et al.*, 2004; Dehghan *et al.*, 2005; Kruger *et al.*, 2005; Shariff *et al.*, 2008) and increased sedentary lifestyle (Swinburn *et al.*, 2004) are said to be primarily involved in childhood obesity (Dehghan *et al.*, 2005; Shariff *et al.*, 2008).

(i) Poor dietary behaviour

For the purpose of this dissertation, unhealthy foods and snacks are defined as energy-rich, micronutrient poor foods. Poor dietary behaviour can be directly linked to the intake of unhealthy foods and snacks and is seen as a risk factor for the development of childhood obesity (Swinburn *et al.*, 2004). Therefore, adequate nutrition is an essential part of children's everyday lives for maintaining a healthy weight and preventing childhood obesity (Variyam & Blaylock, 1998; Skidmore & Yarnell, 2004). Unfortunately, adequate nutrition is not standardized practice amongst modern children due to either a lack of the appropriate nutritional knowledge (Triches & Giugliani, 2004) or poor implementation thereof (Dehghan *et al.*, 2005; Kruger *et al.*, 2005).

Although nutritional knowledge is an important factor in explaining variations in food choices (Wardle *et al.*, 2000; European Food Information Council, 2004), it is not the only factor influencing dietary behaviour (Pirouznia, 2001). Physiological needs, body image, food preferences and tastes, appearance of food, time of food preparation, parental practices, peer pressure, rebellion, maintenance of dietary change, personal experiences, media, food prices, social norms, food insecurity and household characteristics such as socio-demographic background, income, race, ethnicity, education of parent, and family size could also influence dietary behaviour (Variyam & Blaylock, 1998; Pirouznia, 2001; Variyam 2001; Cooke & Wardle, 2005; McKindley *et al*, 2005; Burns, 2004; European Food Information Council, 2004). These factors consistently represent a barrier to healthier eating (European Food Information Council, 2004); however, these factors can be addressed to some extent through increasing nutritional knowledge (Friel *et al.*, 1999, Shariff *et al.*, 2008).

When investigating food preferences and tastes of children it is apparent that children 'eat what they want' and several children are known as 'picky eaters'. Children also prefer sweet tastes and energy-dense foods rather than sour or bitter foods (Cooke & Wardle, 2005). According to Cooke and Wardle (2005), the foods that children like most are unfortunately rarely of high nutritional value, therefore indicating the possible risk for low dietary quality in children. Research has also shown that obese children are particularly prone to risky dietary behaviour (Hoppin, 2004), consuming irregular meals (Yuhki *et al.*, 2003) and unhealthy foods (Swinburn *et al.*, 2004). The consumption of unhealthy foods can contribute to weight gain, leading to an energy imbalance (Ludwig *et al.*, 2001; Schumacher, 2006). According to Dehghan *et al.* (2005), even a small energy imbalance is enough over the long term to lead to childhood obesity. Food preferences and tastes as well as dietary quality differ for age and gender (Cooke & Wardle, 2005). Boys tend to have less healthful food preferences compared to girls, which go hand in hand with boys' poor dietary quality in comparison to girls (Cooke & Wardle, 2005). Furthermore, negative changes in food preferences and tastes (liking to disliking) occurs at around age 10; therefore, one needs to change these preferences and tastes at a young age before they are established (McKinley *et al.*, 2005).

Another factor influencing dietary behaviour is food insecurity. Food insecurity is associated with several socio-economic variables (Foley *et* al., 2009). According to Drewnowski and Darmon (2005), people aiming to limit food costs will first select less expensive but more energy dense foods to meet energy needs. The relationship between food insecurity and overweight is believed to be attributable to health related knowledge (Burns, 2004). Therefore, Burns (2004) hypothesized that education level influences the effect of socio-economic variables on diet quality and lifestyle behaviours.

When investigating the effect of parental practices on dietary behaviour of children it can be seen that children's food preferences are subjective to parental dietary behaviours (Varuyam, 2001). According to Scaglioni *et al.* (2008), several studies have shown that a child's dietary behaviour is strongly influenced by the family environment. Parents create environments for children that may foster the development of healthy dietary behaviours and healthy body weight, or that may promote overweight and/or obesity as well as aspects of disordered eating.

(ii) Physical inactivity and sedentary lifestyle

Physical inactivity and a sedentary lifestyle are well known risk factors for childhood obesity (Swinburn *et al.*, 2004; Kruger *et al.*, 2005; Davison *et al.*, 2006) and can also be linked with obesity in adulthood (Kruger *et al.*, 2005). According to Salmon *et al.* (2006), an inverse relationship exists between physical activity and a sedentary lifestyle. Therefore, it is not unexpected that a worldwide increased trend is seen towards sedentary lifestyle (Kruger *et al.*, 2005) together with a decline in physical activity (Skidmore & Yarnell, 2004; Dehghan *et al.*, 2005). It is also hypothesized that sedentary activities such as television viewing and computer games replace physical activity (Davison *et al.*, 2006). Davison *et al.* (2006) found that television viewing exceeding 2 hours per day increases the risk of overweight; therefore, physical inactivity and increased sedentary activities such as television viewing and computer games are associated with a greater likelihood of being overweight (Janssen *et al.*, 2005; Steyn *et al.*, 2009).

Steyn *et al.* (2009) reported that at least 25% of South African children watch television for three or more hour's daily, which affect physical activity of South African children tremendously. South African children's physical activity patterns are also influenced by personal safety (Bennett, 2007). According to Bennett (2007), children living in an unsafe neighbourhood are less active than children living in a safe neighbourhood. Another factor causing a decline in physical activity among South African children is the lack of physical activity and physical education in schools (WHO, 2009c).

2.3.4 Consequences of childhood obesity

Childhood obesity is associated with considerable physical and psycho-social health risks (Edwards *et al.*, 2005). A child's social well-being can be influenced through weight-related teasing (Edwards *et al.*, 2005; Wardle, 2005) or discrimination and prejudice (Wardle, 2005). This may cause obese children to be socially excluded, while suffering from low self esteem and depression (Wardle, 2005).

Evidence suggests that overweight and/or obesity during childhood will not only contribute to adverse health consequences in childhood (psychological or psychiatric problems, asthma, systemic inflammation, high blood pressure, hyperinsulinemia and/or insulin resistance, dislipidaemia, type I and II diabetes mellitus, sleep apnoea) but also track into adulthood and increase the risk for development of chronic NCDs later in life (Reilly *et al.*, 2003; Whitlock *et* al., 2005; Shariff *et al.*, 2008; Steyn *et al.*, 2009).

Some of the physical health disorders (NCDs) which develop as a result of childhood obesity include coronary heart disease (Reilly *et al.*, 2003; Shariff *et al.*, 2008), hyperlipidaemia (Dehghan *et al.*, 2005; Edwards *et al.*, 2005; Steyn *et al.*, 2009), hypertension (Reilly *et al.*, 2003; Dehghan *et al.*, 2005; Edwards *et al.*, 2005; Steyn *et al.*, 2009), abnormal glucose tolerance (Young-Hyman & Schlundt, 2001; Dehghan *et al.*, 2005; Edwards *et al.*, 2005), type 2 diabetes mellitus (Ebbeling *et al.*, 2002; Swinburn *et al.*, 2004; Edwards *et al.*, 2005; Steyn *et al.*, 2009), some type of cancers (Swinburn *et al.*, 2004), arthritis (Swinburn *et al.*, 2004), orthopaedic complications (Edwards *et al.*, 2005), gall bladder disease and/or gall stones (Swinburn *et al.* 2004), and infertility (Dehghan *et al.*, 2005).

In order to prevent both the physical and psycho-social consequences of childhood obesity, prevention efforts should start early within childhood (Shariff *et al.*, 2008). The question, however, is not just when exactly to intervene, but also how should childhood obesity be prevented.

2.6 Prevention of childhood obesity

A child's environment plays a significant role in the prevention of childhood obesity (Skidmore and Yarnell, 2004). Promoting healthy dietary behaviour and regular physical activity in young children have shown to benefit the health of children during childhood and later on in life (Shariff *et al.*, 2008). A child's eating and physical activity behaviours can be positively changed through nutrition education (Friel *et al.*, 1999; Shariff *et al.*, 2008). The transfer of nutritional knowledge through nutrition education is often part of childhood obesity prevention programmes (Reinehr *et al.*, 2003; Wareham *et al.*, 2005). Nutrition education will therefore be discussed in more detail.

2.6.1 Conveying nutrition education

Nutrition education is defined as 'any set of learning experiences designed to assist voluntary adoption of eating and other nutrition-related behaviour encouraging health and well-being' (Contento, 1995; Shariff *et al.*, 2008).

The aim of nutrition education is to increase nutritional knowledge through learning. How one conveys this message will depend on the target populations or group of learners. However, the nutritional knowledge used as basis for nutrition education as well as the method to be used for conveying the particular nutritional knowledge should be identified and should be aligned to the needs and existing behaviours of the target population.

2.6.1.1 Nutritional knowledge used as basis for nutrition education

Gibney and Vorster (2001) recommend that the SAFBDG should form the basis of nutrition education since it is scientifically based on existing eating patterns of South Africans. The SAFBDG were developed in a highly participatory and consultative manner, over a period of 4 years, in order to optimize nutritional status in both underprivileged and wealthy communities (Gibney & Vorster, 2001).

The availability of nutrition education material based on the SAFBDG particularly aimed at school children is limited. There is, however, currently some material for the purpose of nutrition education being developed, aimed at pre-school and primary school children at the Durban University of Technology (Napier, 2009). It includes an activity book that teachers can use to guide learners through a number of learning outcomes and activities, as well as supplementary tools such as a food group puzzle, card games and board games to teach the learners the basic concepts of nutrition in a fun and creative way.

2.6.1.2 Method used for conveying nutritional knowledge

According to Steyn *et al.* (2009), the perfect setting for nutrition education is schools due to the fact that schools have the theoretical advantage of influencing health-related beliefs and behaviours early in life in order to establish beliefs and behaviours before adulthood. For this reason it is recommended that nutrition education should be conveyed within schools (Kruger, 2007).

Research indicates that several education programmes entail class room setup education (Coutsoudis & Coovadia, 2001). According to Dickinson *et al.* (1997), the ideal learning environment is provided when learning is accomplished through music, dance, drama and visual arts; implicating learning in an environment opposite from dull, boring, rigid environments where children are the passive recipients of information. Nzewi (2005) also reports that giving children the chance to learn in a fun way is the best way of learning. Learning through music is, therefore, said to be most effective when it includes play, games, conversations and pictorial imagery (The National Association for Music Education, 2007) whereas movement, in the form of dance, is believed to be the key to learning. This statement is based on research showing that children learn a concept much easier through forming that concept with their bodies in order to make abstract ideas understandable (Dickinson *et al.*, 1997).

2.6.1.3 Success factors for nutrition education

From the literature it is evident that there are a few characteristics (success factors) of a successful school-based nutrition education programme which is summarized in Table 2.1.

Table 2.1 Key components of a successful school-based nutrition education programme

References	**Key components**
Steyn *et al.* (2009) Pérez-Rodrigo & Aranceta, 2003	(1) a nutrition-based curriculum offered at schools by trained teachers improving behavioural outcomes
	(2) a physical activity programme associated with improved clinical and behavioural outcomes
	(3) a parental and family component
	(4) modify school environment through implementing a food service component
Pérez-Rodrigo & Aranceta, (2001)	(5) address the needs and interests of the students, the teachers and the school in a understandable manner through adequate teaching methods
	(6) be relevant to the programme goals;
	(7) be culturally appropriate
Pérez-Rodrigo & Aranceta, 2003	(8) theory-driven strategies
	(9) adequate time and intensity
	(10) evaluation

2.6.1.4 Nutrition education within the present study

Based on recommendations made in other studies, it was decided to develop a nutrition education programme using visual aids, music and dance movements to facilitate the transfer of nutritional knowledge to the identified study population (6-12 year old children) for this project. The SAFBDG was chosen as basis for the nutrition education programme as recommended by researchers to effectively bring across the message of a healthy lifestyle (Kruger, 2007; Vorster et al., 2001).

2.6.2 Lifestyle behaviour modification

Research suggests that when nutrition education increases nutritional knowledge, behaviour changes can occur (Shariff *et al.*, 2008). According to the Knowledge-Attitude-Behaviour (KAB) model, knowledge is seen as a prerequisite to the intentional performance of health related behaviours (Lin *et al.*, 2007). This model entails that as knowledge in the health behaviour domains increases, changes in attitudes are initiated and accumulate over a period of timewhich results in behavioural changes (Lin *et al.*, 2007). Therefore, within this dissertation it is proposed that by increasing nutritional knowledge, lifestyle behaviour changes might occur which in turn may prevent childhood obesity.

2.6.3 The implementation of a childhood obesity prevention programme

In order to prevent childhood obesity, it is not enough to only improve a child's dietary behaviour and to increase his/her physical activity through adequate nutrition education, but a healthy environment supporting lifestyle behaviour modification should also be created (European Food Information Council, 2004). Several guidelines and principles have already been developed to support the prevention of childhood obesity, which ought to be incorporated within childhood obesity prevention programmes (Koplan *et al.*, 2005). In this dissertation only two of the mentioned guidelines and principles are discussed, but it is imperative to keep in mind that a childhood obesity prevention programme cannot be implemented without a supporting environment; therefore, all of the existing guidelines and principles should be enforced in order to successfully implement a childhood obesity prevention programme.

2.6.3.1 The Sydney Principles

The International Obesity Taskforce (IOTF) is promoting global action on commercial marketing to children through two complementary initiatives. The IOTF Working Group developed a set of recommendations on the marketing of food and beverages to children as well as a set of underlying principles to guide national and trans-national action to substantially reduce commercial promotions that target children. The first draft of these principles was launched at the International Congress on Obesity in Sydney in September 2006. The second draft of these 'Sydney Principles' was developed from November 2006 to April 2007 (Anon, 2009).

The musical play was not specifically designed according to the Sydney Principles; however, some of the principals are incorporated into the programme. The musical play is, therefore, compatible with the Sydney Principles, which are listed below (Anon, 2009).

1. SUPPORT THE RIGHTS OF CHILDREN. Regulations need to be aligned with and support the United Nations Convention on the Rights of the Child and the Rome Declaration on World Food Security which endorse the rights of children to adequate, safe and nutritious food.
2. AFFORD SUBSTANTIAL PROTECTION TO CHILDREN. Children are particularly vulnerable to commercial exploitation, and regulations need to be sufficiently powerful to provide them with a high level of protection. Child protection is the responsibility of every section of society – parents, governments, civil society, and the private sector.
3. BE STATUTORY IN NATURE. Only statutory regulations have sufficient authority to substantially reduce the current high volume of marketing to children and the negative impact that this has on their diets. Industry self regulation is not designed to achieve this goal.
4. TAKE A WIDE DEFINITION OF COMMERCIAL PROMOTIONS. Regulations need to encompass all types of commercial targeting of children (e.g. television advertising, print, sponsorships, competitions, loyalty schemes, product placements, relationship marketing, Internet) and be sufficiently flexible to include new marketing methods as they develop.
5. GUARANTEE COMMERCIAL-FREE CHILDHOOD SETTINGS. Regulations need to ensure that childhood settings such as schools, child care, and early childhood education facilities are free from commercial promotions that specifically target children.

6. INCLUDE CROSS BORDER MEDIA. International agreements will be needed to regulate cross-border media such as Internet, satellite and cable television, and free-to-air television broadcast from neighbouring countries.
7. BE EVALUATED, MONITORED AND ENFORCED. The regulations need to be evaluated to ensure the expected effects are achieved, independently monitored to ensure compliance, and fully enforced.

The musical play supported principle 1 through empowering children with adequate knowledge regarding good nutrition and lifestyle practices. When comparing principles 2, 3, 4 and 5 regarding all aspects of marketing and commercial exploitation, it can be concluded that children within this project were not exposed to commercial exploitation through the musical play due to the fact that no specific products were marketed or forced upon the children. Principle 7 was supported by the musical play by means of evaluating the success of the musical play on improving food choices and increasing nutrition knowledge.

2.6.3.2 Physical activity within schools

Physical activity education within South African schools was officially removed from the school curriculum in 1994 (Du Toit *et al.*, 2006). Despite the steady worldwide progress towards health during the past decade, an epidemic of childhood obesity has set back health nationally and globally (Koplan *et al.*, 2005). South Africa reacted to this set back through recently reinstating physical activity education as part of the subject Life Orientation within the South African school curriculum (Du Toit *et al.*, 2006). Additionally, a charter for physical activity, sport, play and well-being for all children and youth in South Africa was developed (Anon, 2010).

The charter for physical activity, sport, play and well-being for all children and youth in South Africa aims to contribute to nation building, to enhance the general well-being and to improve the quality of life of all young South Africans through ensuring that (i) all South African children and youth have the right to be physically active, (ii) opportunities and facilities to participate in physical activity, sport and play to be equally accessible and available to all, (iii) children and youth are active participants in promoting participation in physical activity, sport and play, (iv) the diversity of South African children and youth is recognised and embraced, and (v) the successful promotion of this message is achieved through partnerships among parents, sporting organisations, provincial, local and national government, non-government and non-profit organisations, higher education institutions, clubs, schools, faith-based organisations, the youth sector, the private sector and other key role players.

The charter for physical activity, sport, play and well-being for all children and youth in South Africa include the following (Anon, 2010):

1. FUNDAMENTALS: all South African children and youth have a fundamental right to participate in physical activity, sport and play regardless of their gender, disability or ability, HIV/AIDS status or socio-economic, nutritional and/or cultural backgrounds.
2. DIVERSITY AND NATION BUILDING: physical activity, sport and play can assist in nation building and in overcoming barriers to integration and the de-racialisation of our society.
3. WELL-BEING: physical activity, sport and play form an essential element of integrated development and growth, leading to lifelong positive lifestyles.
4. HEALTH: all children and youth should be encouraged to participate in physical activity, sport and play to improve physical fitness and, as a way to (i) prevent chronic diseases of lifestyle, (ii) develop knowledge and life skills, (iii) encourage optimal nutrition and (iv) foster health promoting behaviour.
5. PARTNERSHIPS: parents, sporting organisations, provincial, local and national government, non-government and non-profit organisations, higher education institutions, clubs, schools, faith-based organisations, the youth sector, the private sector and other key role players should work together to provide opportunities for children and youth to participate safely in physical activity, sport and play.
6. EDUCATION AND TRAINING: the education system should assume responsibility for the provision of appropriate formal movement education programmes, physical activity, sport and play for all children and youth in safe and healthy environments.
7. FACILITIES AND INFRASTRUCTURE: government, in partnership with the youth sector, the private sector, communities and key role players should provide a sustainable infrastructure that includes safe access, facilities, equipment and, where appropriate, transport for all children and youth.
8. PROTECTION: National Sporting Federations and regulating bodies should provide guidelines for key role players to support the delivery of programmes that have a positive impact on physical, mental, social, and emotional well-being on all children and youth. These guidelines should address the protection of children and youth participating in

organised physical activity and sport at all levels, including those performing at an elite level.

9. MEDIA: recognizing the value of communication, all media should strive to become a positive influence on participation of children and youth in physical activity, sport and play.
10. RESEARCH: research should inform the decision-making processes surrounding the provision of facilities, equipment and development of appropriate physical activity, sport and play guidelines and programmes for all children and youth.

The musical play was not specially designed according to the charter for physical activity, sport, play and well-being for all children and youth in South Africa; however, the musical play is compatible to the charter for physical activity, sport, play and well-being for all children and youth in South Africa.

The musical play supported article 1 through providing children of all socio-economic status, gender and culture with the right to participate in physical activity in a playful manner. When comparing articles 2, 3 and 4 it can be concluded that this project can assist in nation building and increasing health and well-being of all children. Article 6 can be supported by the musical play if the musical play is implemented within South African primary schools over the long term in order to create co-operation between all relevant parties for the maintenance of children's health and well-being while participating in physical activity. Articles 7 and 8 are supported by the musical play through the fact that the musical play is developed for the school environment which itself provides the safest environment with the most appropriate equipment for children to be physically active. Articles 9 and 10 are met by the musical play through means of proper research regarding physical activity, nutrition and childhood obesity as well as communication to a wide spectrum of people (from the children within the schools to the department of education, industry and government) regarding the need for physical activity and nutrition education within the primary school setting.

2.7 Summary

This literature review focused on the complexity of the causes of childhood overweight and/or obesity. It showed that although there is a substantial genetic/epigenetic component to the development of childhood overweight and/or obesity, environmental influences dictating dietary behaviour and physical activity during childhood also play an important role in the development of childhood overweight and/or obesity. This fact forms the motivation for this intervention study in which music and dance (physical activity) were used to transfer nutritional knowledge to young (primary school) children. Lastly, it has shown that this study is in alliance with both the Sydney Principles and the charter for physical activity, sport, play and well-being for all children and youth in South Africa.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter describes how the musical play was implemented. Within this chapter the study design, research setting, subjects, process of data collection and ethical consideration of the study are discussed.

3.2 Study design and research setting

This was a randomized control intervention study. The study took place over a 3-month period during one of two occasions (April-June or July-September 2008). Four primary schools with similar socio-economic status in the city of Potchefstroom in the North West Province, South Africa, were selected on the basis of availability and representation of various ethnic groups. The intervention took place in either the second or third quarter of the school year, according to the school's preference.

Volunteer children from all schools were included and were randomized into either an experimental or a control group. The experimental group received a musical play intervention as well as the standard school nutrition education curriculum, while the control group only received the standard school nutrition education curriculum (see Figure 1.3: Chapter 1). The musical play was applied to all children in the experimental group over a 5-week period with two one-hour sessions per week during or after school hours. The children, therefore, had a total of 10 hours exposure to the musical play of which approximately 15 minutes per session were spent on nutrition education. After each training session an information pamphlet on the specific SAFBDG taught during the session was sent home to each child's parent/guardian (Addendum II on CD). As shown in Figure 1.3 (Chapter 1), both groups in each school underwent baseline and end-measurements after the 5 week intervention period.

3.3 Selection and sampling of subjects

The target population of the study was primary school children between the ages of 6 and 12 years. Children were recruited from four primary schools (President Pretorius, M.L. Fick, Potchefstroom Primary and the Christian School) and were verbally informed of the study protocol. All the grades 1 to 6 learners (aged 6 – 12 years) from two of the four schools as well as the grades 1 to 6 learners within the after care centres of the two remaining schools were approached for inclusion within this study. All the learners were supplied with a written information sheet on the project as well as an informed consent form for the parents/guardians to sign which they took home.

Only the learners that returned a signed informed consent form were included into the study (286 subjects). Of these, 83 subjects dropped out of the study due to school related circumstances that could not have been prevented. After the dropouts were taken into account, the control group added up to 99 children and the experimental group to 104 children. Therefore, the total number of subjects who completed the study amounted to 203 children (boys=93; girls=110). Approximately 76 subjects per group were needed to meet the power calculated for a 90 % Confidence Interval (CI) within this study (see section 3.7).

3.4 Ethical considerations

Ethical guidelines exist to ensure the safety, rights, dignity and well-being of the participant and of the researcher.

It is widely accepted that any research involving humans or human samples should be undertaken according to a pre-specified protocol that is submitted for consideration, comment, guidance, and where appropriate, approval by an ethical review committee (Draper & Wilson, 2007). Ethical approval was obtained from the Ethics Committee of the North-West University (Nr 07M06) before conducting this study. The North West Department of Education was informed, in writing, about the study and approval to execute the study in schools was obtained. School principals as well as parents/guardians of the primary school children were also informed in writing of the purpose and methodology of the research study. All head masters of selected schools gave verbal consent and subjects were only allowed to participate in the study after a parent/guardian gave written, informed consent.

3.5 Data collection

Data was collected before and after the 5 week intervention in both groups. Anthropometrical measurements were taken and questionnaires used to collect data on nutritional knowledge, lifestyle behaviour and demographic background.

3.5.1 Measurements

3.5.1.1 Anthropometrical measurements

Subjects were measured in light clothing by trained fieldworkers. Weight was measured to the nearest 0.5kg on a portable electronic scale (Precision, A&D Company, Japan). Height was measured with an upright stadiometer to the nearest 0.5cm. BMI (kg/m_2) was calculated from height and weight. Measurements were evaluated with the WHO growth charts using z-scores for age (WHO, 2009b).

The standardised method (cross-hand technique) of the International Society for the Advancement of Kinanthropometry (ISAK) was used for the measurement of mid-waist circumference. The mid-waist circumference was taken at the level of the narrowest point between the lower costal (10^{th} rib) and the iliac crest (ISAK, 2001). Additionally, mid-waist circumference was taken in line with the naval. All measurements were taken during baseline en end and were repeated three times in order to calculate a mean value (Addendum III).

3.5.2 Questionnaires

3.5.2.1 Demographic questionnaire

A demographic questionnaire (Addendum IV) was completed by the subjects' parents/guardians only at baseline. Information obtained through this questionnaire included, among others, mean monthly income, education level of the parent/guardian, occupation of the parent/guardian, food preparation, average monthly food budget, and physical activity.

3.5.2.2 Nutritional knowledge and behaviour questionnaire

A standardised nutritional knowledge questionnaire adapted from Whati *et al.* (2005), was completed at baseline and at the end of the study by all subjects (Addendum V). The questionnaire was tested in another group of children from the same age group for face validity prior to the study. Unclear questions were rewritten. Fieldworkers were trained to administer the questionnaire to children in groups of five. This was done to help those who did not understand questions or had difficulty reading.

3.5.2.3 24-Hour recalls

In total two 24-hour dietary recalls per subject were obtained (one at baseline and one at the end), by trained dietetic and nutrition students or fieldworkers (Addendum VI). The 24-hour dietary recalls were taken on two different days of the week, thereby ensuring that the data provide a representative picture of the children's weekly dietary intakes. Students and fieldworkers were trained in the *multiple pass 24-hour dietary recall method.* This technique increases retrieval of the requested information by allowing the participant to review the food and beverage intake of the previous 24 hours several times. The fieldworker firstly investigates which foods the participant ate during the past 24-hour period, then collects more detail about the foods consumed, preparation methods, and finally the portion sizes. The multiple-pass, 24-hour dietary recall method was developed to minimize underreporting of dietary intake by providing respondents with multiple cues and opportunities to recall food intake (Gibson, 2005).

Photo books and food models were used to assist subjects in estimating food portion sizes. FoodFinder III version 1.0.0 (Medical Research Council, South Africa) was used to analyse the 24-hour dietary recalls. The mean macro- and micro-nutrient intakes for each child were calculated from the two 24-hour dietary recalls. The mean energy and nutrient intakes of the two groups were compared to the daily recommended intakes (DRI's) (Shaw & Lawson, 2007; Vliet *et al.*, 2007; Escott-Stump, 2008; Width & Reinhard, 2009) and the recommended daily allowances/adequate intakes (RDA/AI) values (Whitney & Rolfes, 2002) for children aged 6-12 years.

3.6 Validity and reliability of the nutritional knowledge questionnaire and 24-hour dietary recalls

Validity can be defined in many different ways. It can be defined as an instrument which measures the intended concept accurately (De Vos *et al.,* 2005) and/or an issue of whether the data collected are a true picture of what is being achieved (Mongwa, 2005). Furthermore, validity itself has two aspects: (1) that of the instrument actually measuring the concept in question, and (2) that of the concept being measured accurately (De Vos *et al.*, 2005). Reliability on the other hand can be defined as stability, accuracy, consistency, predictability, reproducibility and repeatability of measurements (De Vos *et al.*, 2005; Mongwa, 2005). According to De Vos *et al.* (2005), the same variable must be measured under the same conditions in order to ensure reliability of measurements and, therefore, reliability of the study outcome.

In the present study all data was collected by the same team of trained fieldworkers according to consistent, predetermined, standardised methods. The nutritional knowledge questionnaire was tested for face validity. After the nutritional knowledge questionnaire was administered during baseline and end measurements, the data were statistically analysed. Cronbach's Alpha was determined in order to assess which questions were fully understood and correctly interpreted by the subjects. Results showed that 6 out of 31 questions within the questionnaire (3, 13, 18, 19, 26, and 27) were unreliable. The remaining questions, however, scored a value of 0.7 which indicates an acceptable reliability coefficient (Reynaldo & Santos, 1999). Therefore, it can be concluded that this nutritional knowledge questionnaire is reliable. To increase reliability of the 24-hour dietary recalls, fieldworkers were trained in the *multiple pass 24-hour dietary recall method* (Gibson, 2005).

3.7 Statistical analysis

The SPSS-16.0 statistical package was used (SPSS Inc., Chicago, IL, USA) for all calculations. Data were screened for normal distribution. It was found that the data were not normally distributed. Therefore, non-parametric statistical tests were used for analyses. Differences between the control and experimental groups were tested using the Mann-Whitney U Test for non-parametric data. Differences within groups were tested using the Wilcoxon Signed Rank Test for non-parametric data. Variables were expressed as means and standard deviations and categorical data were expressed as frequencies and/or percentages. FoodFinder III version 1.0.0 (Medical Research Council, South Africa) was used to analyse the 24-hour dietary recalls. Before the analyses of the 24-hour recalls were performed, data were screened for outliers. Children with an energy intake less than 3 000kJ and exceeding 20 000kJ were excluded. Nutritional knowledge as well as food and nutrient intakes were expressed as "of practical significance" (Ellis & Steyn, 2003; Steyn, 2005).

3.7.1 Practical significance

Practical significance can be understood as a large enough effect to be important in practice and is indicated by effect size which itself is independent of sample size (Ellis & Steyn, 2003). According to Steyn (2005), there is a small (d=0.2), medium (d=0.5) and large effect size (d=0.8) for mean values indicating the level of practical significance of data. Literature suggests that a medium effect size (d=0.5) should be used for human studies (Steyn & Ellis, 2009). Therefore, a medium effect size was used to determine practical significance within this study.

3.7.2 Power calculation

Subject sample size was calculated by using power calculations, using the formula of Snedecor & Cochran (1967):

$$N \geq N / \{1 + N\,({}^{L}/Z_p{}^{s})^2\} \qquad \text{therefore} \qquad n \geq (Z_p{}^{s} / {}_{L})^2$$

where
L = maximum difference with 95% or 90 % chance between the mean of the population and the sub-population (cm/100)
s = standard deviation
m = mean of the sub-population
c = percentage
Z_p = 1,64 for p = 90% chance (p=0.10).

Micronutrients from the National Food Consumption Survey (NFCS; Labadarios *et al.*, 2000) for South African children between the ages 7 and 9 years were used for power calculations. It was decided to use micronutrient intake, since micronutrient intakes within children have greater variability, therefore, demanding sufficient power within the study. The researchers decided to use the 90% chance for Thiamine as guidance for the least number of subjects to be included per group (control group = 76; experimental group = 76).

When investigating power needed for analysis of nutritional knowledge, literature reported that at least 40 subjects per group (control group = 40; experimental group = 40) were required with a 90% chance to detect a significant difference ($p<0.05$) in nutritional knowledge between the two groups (Shariff *et al.*, 2008).

Within this study all volunteers who met the inclusion criteria were included. Therefore, it can be concluded that both the control (99 children) and the experimental group (104) met the power calculation criteria.

3.7.3 Calculation of dietary quality

Dietary quality was determined from each subject's 24-hour dietary recalls to determine whether there was a change from baseline to end. A serving score was calculated using portions consumed from five food groups (Kant *et al.*, 1991). The serving score added up to 20 (a maximum score of 4 allocated to each of the 5 different food groups). The five food groups included were (1) grain, (2) vegetables, (3) fruit, (4) dairy and (5) meat. A portion of grain scored 1 whereas a portion of vegetables, fruit, dairy or meat scored 2. The minimum amount of grains considered as a portion was 15g whereas the minimum amount of vegetables, fruit, dairy and meat was 30g. Furthermore, the number of portions was rounded up to the nearest portion before determining a score. Portion sizes were also evaluated according to the food guide pyramid (Gavin, 2008)

3.8 The musical play (intervention)

The musical play was developed in 2007 by the researcher as an Honours project (Kruger, 2007) and portrays nutritional and lifestyle messages based on the SAFBDG for adults and children (Addendum I on CD). The musical play was developed as an educational tool; giving children the chance to learn in a fun way. The different dance movements were specifically developed by Kruger (2007) to help portray the different SAFBDG (food and nutrition messages). The movements and songs representing each of these guidelines were identified and chosen during workshop sessions with children during the developmental phase of the musical play as described by Kruger (2007) in Addendum I on CD.

In this study, the musical play as developed and described by the researcher (Kruger, 2007) was used to educate children in order to increase their knowledge regarding healthy eating and positively contribute towards changes in their food choices and lifestyle behaviour. After the 5-week intervention period children performed the musical play to their parents/guardians. At the concert of the musical play, all parents/guardians received a programme book containing all the information pamphlets explaining each of the SAFBDG (Addendum II on CD) in more detail. This concert of the musical play was held after end measurements were taken.

3.9 Limitations and problems encountered in this study

- Although the total number of participants in the control and experimental groups were sufficient to ensure enough statistical power to explore changes in nutritional knowledge and to conclude on total nutrient intakes, it was not always sufficient when the groups were subdivided into different age groups and/or gender groups. Therefore, no comparisons between smaller groups could be done.
- There was a large number of drop-out (83) children from the study due to school related circumstances that could not have been prevented or foreseen.
- The timeframe for implementation of the musical play was short in duration due to the fact that the researchers only had 7 weeks (1 week for baseline measurements, 5 weeks for the intervention and 1 week for end measurements) at their disposal between school holidays and examinations. This might be seen as a limitation to the study, but even with such a limited timeframe, the results of the study indicate a positive impact. It can, however, be speculated that the impact of the musical play might be bigger if the timeframe of exposure to the musical play increases or the weekly contact sessions increase. Since the musical play was not part of the current school curriculum it had to be taught to children outside of official school periods. At some schools the physical activity period was given to the researchers to implement the musical play, but at other schools school breaks also had to be used for this, which limited the weekly exposure time to the nutrition intervention programme.
- Only one 24-hour dietary recall was taken at baseline and one at the end for each child. Future studies should increase the number of 24-hour recalls to three per child at both baseline and end to get a more representative picture of how nutrient and energy intake change (Conway et al, 2004).

- Due to other extra-curricular activities, some of the children were unable to attend all the musical play practice sessions which were held at some schools in the afternoons at the after-care centre.
- Due to the fact that the control and experimental groups were selected within the same school, cross-contamination might have occurred. Once again it can be speculated that the cross-contamination might have shadowed the true effect of the intervention on the nutritional knowledge increase of the control group versus the experimental group. Future studies should rather select the control and experimental group within different schools in order to prevent cross-contamination.

CHAPTER 4: RESULTS

4.1 Introduction

Chapter four presents the results of the study. This chapter is divided into four sections: demographic information, nutrition knowledge, dietary behaviour, and anthropometrical data.

4.2 Demographic information

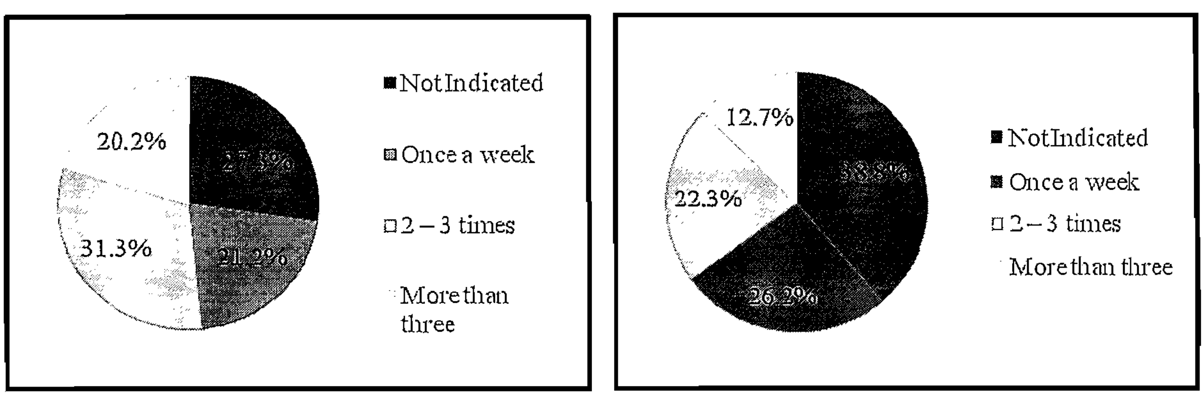
Demographic information was analysed in order to determine specific study population characteristics. These characteristics are summarised in Table 4.1 and in Figures 4.1 – 4.3. As indicated in Table 4.1, no significant differences were found between the subject characteristics of the control and experimental groups at baseline which makes them comparable. According to the reported socio-economic indicators, it can be concluded that the two groups were comparable regarding socio-economic background.

It is evident that these two groups existed mostly out of black and white children of similar gender distribution. Less children of age 11 – 12 years were included into the study than of the other two age groups. When investigating the education level of the parents/guardians, it was found that 43.4% and 45.1% of the parents/guardians within the control and experimental groups respectively completed at least grade 10 whereas 45.5% and 38.2% are qualified at tertiary level. Of the control and experimental groups' parents/guardians only 71.4% and 69.1% respectively earn a weekly or monthly salary. Approximately half of the study population has a mean monthly income of less than R5 000. The mean monthly income was in most cases a fixed monthly income supporting three to six people.

Table 4.1 Demographic information

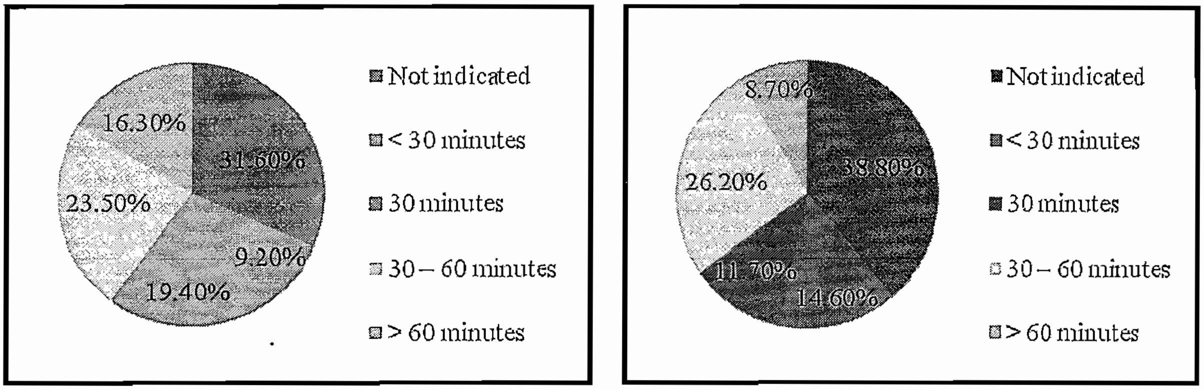
Characteristics		Control group n=99 Percentage (%)	Experimental group n=104 Percentage (%)
Age:	6 – 8 years	42.4	32.7
	9 – 10 years	36.4	42.3
	11 – 12 years	21.2	25.0
Gender:	Male	48.5	43.3
	Female	51.5	56.7
Ethnicity:	White	25.7	35.1
	African	60.8	54.5
	Not Indicated	13.5	10.4
Education level of parent / guardian:	Grade 11 - 12	43.4	45.1
	Tertiary education	45.5	38.2
	Other	11.1	16.7
Occupation of parent / guardian	No work	10.2	5.2
	Pension	5.1	8.2
	Salary	71.4	69.1
	Other	8.1	11.3
	Not Indicated	4.1	6.2
Mean monthly income:	R100 – R1000	11.2	13.6
	R1000 – R3000	18.4	10.7
	R3000 – R5000	18.4	17.5
	R5000+	49.0	52.4
	Not Indicated	3.0	5.8
Fixed monthly income:	Yes	87.8	85.6
	No	9.2	6.7
	Not indicated	3.0	7.7
Number of people living of the monthly income	1 - 2 people	8.2	4.3
	3 - 4 people	48.8	60.7
	5 - 6 people	29.1	30.8
	7 - 8 people	10.4	3.1
	8+ people	3.5	1.1

Figure 4.1 shows that the majority of children exercised 1 – 3 times per week. From Figure 4.2 it can be seen that most children exercised between 30 to 60 minutes each time.



[A] Percentage of Control group exercising [B] Percentage of Experimental group exercising

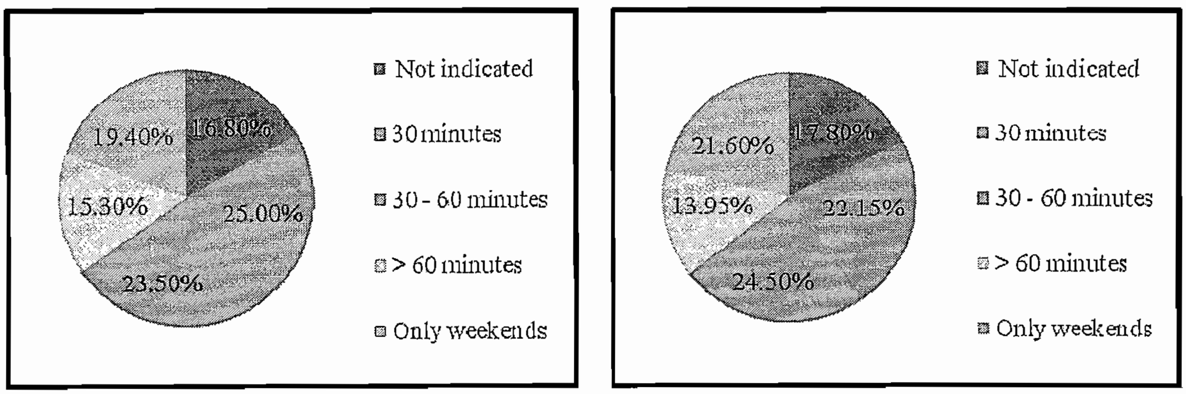
Figure 4.1 Frequency of weekly exercise; [A] represents the control group and [B] represents the experimental group.



[A] Percentage of Control group [B] Percentage of Experimental group

Figure 4.2 Duration of exercise session per day; [A] represents the control group and [B] represents the experimental group.

In Figure 4.3 time spent watching television and time spent playing television and/or computer games are illustrated in both the control and experimental groups. It is apparent that 15.3% and 13.95% of children within the control and experimental groups respectively were engaged in sedentary behaviour for more than an hour a day.



[A] Percentage of Control group [B] Percentage of Experimental group

Figure 4.3 Time of sedentary behaviour; [A] represents the control group and [B] represents experimental groups.

The percentage of data not indicated within Figure 4.1 -4.3 is due to incomplete demographic questionnaires. The demographic questionnaires were send home for parents/guardians to complete, but several parents did not fill in the questions regarding physical activity and sedentary lifestyle.

4.3 Nutritional knowledge

Table 4.2 shows the number of the control and experimental groups' children providing a correct answer to the nutrition knowledge questions asked at baseline and the end, and indicates the percentage change in nutritional knowledge of both the control and experimental group from baseline to end. From tables 4.2 it is apparent that the nutritional knowledge of the control group regarding questions 20, 21 and 26 increased with statistical significance ($p < 0.05$). The nutritional knowledge of the experimental group regarding questions 3, 6, 9, 10, 11, 12, 14, 15, 17, 20, 21 and 28 also increased with statistical significance ($p < 0.05$). It is evident from Table 4.2 that overall nutritional knowledge increased with statistical significance within the experimental group (11.9%). The overall nutritional knowledge of the control group also increased (2.3%), although not with statistical significance.

Question 16 is not included in Table 4.2 and reports on the source of nutrition information for children. Question 16 shows that 45.2% of the children receive nutritional information from school and 41.2% of these children receive nutritional information from their parents/guardians.

The musical play was initially developed according to the musical growth of children (Rozmajl, 1986) and therefore the changes in nutrition knowledge were explored within different age groups (Table 4.3). Both the control and experimental groups were divided into sub-groups of age (6 - 8 years, 9 - 10 years and 11 - 12 years) as described in Chapter 1. Table 4.3 indicates the number of children within each age group providing a correct answer to the nutrition knowledge questions asked at baseline and end and shows on the percentage change within nutritional knowledge of the different age groups from baseline to end. Although these sub-groups are small, it is evident from Table 4.3 that nutritional knowledge increased with practical significance in all the age groups within the experimental group (age 6 - 8 years: ↑ 15.5%; age 9 - 10 years ↑ 8.8%; age 11 - 12 years ↑8.9%; $d>0.5$) and in the 11 - 12 year old children within the control group (↑ 3.7%). Children aged 6 - 8 years within the control group showed a practical significant increase in nutritional knowledge on question 3 whereas the experimental group of the same age group showed a practical significant increase in nutritional knowledge on questions 2, 6, 8, 10, 12, 14, 15 and 20. Children aged 9 - 10 years within the experimental group showed a practical significant increase in nutritional knowledge on questions 14 and 15. Children aged 11 - 12 years within the control group showed a practical significant increase in nutritional knowledge on questions 7, 13 and 26 whereas the experimental group aged 11 - 12 years showed a practical significant increase in nutritional knowledge on questions 3, 12, 14, 15 and 17.

Table 4.2 Number of children within the both groups providing a ***correct answer*** to each question and changes in nutritional knowledge from baseline to end

Question (Q)			**Control group** n=99 Number (%)		**Experimental group** n=104 Number (%)	
Which statement is true about starches (e.g. Bread, porridge, rice, potato)? A. *Not important for health, B. eating small amounts cause weight gain, C. cause diseases,* ***D. none of the above.***	Q1	baseline end	47 (47.5) 46 (46.5)	↓1.0	53 (51.0) 62 (59.6)	↑8.6
Which food has the most fibre (roughage)? A. *White bread,* ***B. whole-wheat.***	Q2	baseline end	79 (79.8) 82 (82.8)	↑3.0	84 (80.8) 91 (87.5)	↑6.7
How many fruit and vegetables should you eat a day? A. *1 fruit and/or vegetable, B. 3-4 fruits and/or vegetables,* ***C. 5 or more fruits and/or vegetable****, D. no need to eat fruits and /or vegetables.*	Q3	baseline end	22 (22.2) 29 (29.3)	↑7.1	55 (34.6) 58 (55.8)	↑21.2*
Being physically active (to exercise) means…A. *going to the gym, B. walking a lot, C. playing sports like soccer or netball,* ***D all of the above.***	Q4	baseline end	37 (37.4) 43 (43.4)	↑6.0	51 (52.9) 58 (55.8)	↑2.9
Do you agree or disagree with the following statement: Exercise is good for your health. ***A. Agree****, B. disagree, C. don't know.*	Q5	baseline end	84 (84.8) 83 (83.8)	↓1.0	90 (86.5) 92 (88.5)	↑2.0
Which foods contain a lot of calcium? A.*Chicken and eggs, B.milk and yoghurt, C. canned fish with bone e.g. pilchards,* ***D. b and c are both correct.***	Q6	baseline end	15 (15.2) 22 (22.2)	↑7.0	17 (16.3) 31 (29.8)	↑13.5*
The reason why dry beans, peas, lentils and soy are good for you is that they: A. *contain only small amounts of fat, B. contain a lot of fibre, C. can protect you from some diseases,* ***D. all of the above.***	Q7	baseline end	36 (36.4) 36 (36.4)	↔	45 (43.3) 41 (39.4)	↓3.9
Which of the following is a low fat snack? A..*"Simba chips",* ***B. popcorn****, C. fried chips, D. 'Niknaks".*	Q8	baseline end	25 (25.3) 27 (27.3)	↑2.0	37 (35.6) 48 (46.2)	↑10.6
Which of the following foods contain little fat? A. *Whole-wheat toast with thinly spread margarine, B. wheet-bix with 2% low-fat milk, C. fried bacon and egg,* ***D. a and b are both correct.***	Q9	baseline end	25 (25.3) 27 (27.3)	↑2.0	19 (18.3) 40 (38.5)	↑20.2*
How old must you be before you can drink alcohol? A. *6-12 years, B. 12-17 years,* ***C. 18 years and older.***	Q10	baseline end	84 (84.8) 91 (91.9)	↑7.1	67 (64.4) 99 (95.2)	↑30.8*
What can too much alcohol do to a person? *A. Makes you become aggressive, B. harm your liver and brain, C. makes you become happy and joyful,* ***D. a and b are borth correct.***	Q11	baseline end	38 (38.4) 38 (38.4)	↔	35 (33.7) 53 (51.0)	↑17.3*
The key to a healthy way of eating is to: *A. Eat many different kinds of foods, B. Do not eat too much of any of these foods, C. Eat only certain kinds of foods,* ***D. A and b are both correct.***	Q12	baseline end	26 (26.3) 30 (30.3)	↑4.0	19 (18.3) 42 (40.4)	↑22.1*
Choose the most correct picture that presents the composition of a well-balanced diet. *See Addendum V.*	Q13	baseline end	17 (17.2) 23 (23.2)	↑6.0	21 (20.2) 20 (19.2)	↓1.0
How many times a day should you eat? *A. 1-2 times,* ***B. 3-5 times.***	Q14	baseline end	43 (43.4) 49 (49.5)	↑6.1	53 (51.0) 87 (83.7)	↑32.7*
How much water should you drink a day? *A. 1-3 glasses,* ***B. 4-8 glasses****, C. More than 8 glasses.*	Q15	baseline end	34 (34.4) 29 (29.3)	↓5.1	32 (30.8) 66 (63.5)	↑32.7*

Table 4.2 Number of children within the both groups providing a ***correct answer*** to each question and changes in nutritional knowledge from baseline to end (continue)

Question (Q)			Control group n=99 Number (%)		Experimental group n=104 Number (%)	
True or false questions (Q17 – Q31):						
Starchy foods (bread, potatoes, rice) are energy giving foods. ***True.***	Q17	baseline end	81 (81.8) 85 (85.9)	↑ 4.1	78 (75.0) 94 (90.4)	↑ 15.4*
Cooked vegetables are healthier than raw vegetables. ***False.***	Q18	baseline end	28 (28.3) 34 (34.3)	↑ 6.0	33 (31.7) 38 (36.5)	↑ 4.8
Vegetables can be eaten in the place of meat because it also builds the body. ***False.***	Q19	baseline end	31 (31.3) 27 (27.3)	↓ 4.0	19 (18.3) 22 (21.2)	↑ 2.9
Vegetables are foods that protect your body against diseases. ***True.***	Q20	baseline end	77 (77.8) 90 (90.9)	↑ 13.1*	84 (80.8) 95 (91.3)	↑ 10.5*
People who are overweight (fat) should not exercise. ***False.***	Q21	baseline end	74 (74.7) 84 (84.8)	↑ 10.1*	74 (71.2) 90 (86.5)	↑ 15.3*
If you are eating a healthy diet there is no need for you to exercise. ***False.***	Q22	baseline end	61 (61.6) 69 (69.7)	↑ 8.1	64 (61.5) 70 (67.3)	↑ 5.8
It is necessary to drink fresh milk or maas every day. ***True.***	Q23	baseline end	78 (78.8) 79 (79.8)	↑ 1.0	82 (78.8) 75 (72.1)	↓ 6.7
You can eat as much meat as you want every day. ***False.***	Q24	baseline end	73 (73.7) 72 (72.7)	↓ 1.0	69 (66.3) 71 (68.3)	↑ 2.0
Dry beans, peas, lentils and soy should be eaten often. ***True.***	Q25	baseline end	65 (65.7) 62 (62.6)	↓ 3.1	73 (70.2) 79 (76.0)	↑ 5.8
Dry beans, peas, lentils and soy can be eaten instead of meat. ***True.***	Q26	baseline end	55 (55.6) 69 (69.7)	↑ 14.1*	72 (69.2) 70 (67.3)	↑ 1.9
You should add extra salt to your cooked food before you eat it. ***True.***	Q27	baseline end	58 (58.6) 62 (62.6)	↑ 4.0	66 (63.5) 66 (63.5)	↔
You should eat little sugar and / or foods containing sugar (e.g. sweets and candy). ***True.***	Q28	baseline end	67 (67.7) 68 (68.7)	↑ 1.0	61 (58.7) 74 (71.2)	↑ 12.5*
It is not healthy to eat lots of fat or fatty foods. ***True.***	Q29	baseline end	76 (76.8) 74 (74.7)	↓ 2.1	78 (75.0) 84 (80.8)	↑ 5.8
I should eat different kinds of foods every day, but not too much of any of them. ***True.***	Q30	baseline end	78 (78.8) 77 (77.8)	↓ 1.0	83 (79.8) 92 (88.5)	↑ 8.7
All water is safe to drink. ***False.***	Q31	baseline end	71 (71.7) 63 (63.6)	↓ 8.1	69 (66.3) 78 (75.0)	↑ 8.7
Total				↑ 2.3		↑ 11.9*

* statistical significant difference between baseline and end measurements ($p < 0.05$); % ↑ increase in nutrition knowledge; % ↓ decrease in nutrition knowledge; ↔ no change in nutrition knowledge

Table 4.3 Number of children within each age group providing a correct answer to each question and changes in nutritional knowledge from baseline to end

Question (Q)		**Control group**						**Experimental group**					
		6 – 8 years n=42 Number (%)		**9 – 10 years** n=36 Number (%)		**11 – 12 years** n=21 Number (%)		**6 – 8 years** n=34 Number (%)		**9 – 10 years** n=44 Number (%)		**11 – 12 years** n=26 Number (%)	
Q1	B	23 (54.8)	↔	12 (33.3)	↔	12 (57.1)	↓4.7	17 (50.0)	↑17.6	22 (50.0)	↓4.5	14 (53.8)	↑19.3
	E	23 (54.8)		12 (33.3)		11 (52.4)		23 (67.6)		20 (45.5)		19 (73.1)	
Q2	B	30 (71.4)	↑9.6	31 (86.1)	↓8.3	18 (85.7)	↑9.5	25 (73.5)	↑20.6 **	35 (79.5)	↔	24 (92.3)	↔
	E	34 (81.0)		28 (77.8)		20 (95.2)		32 (94.1)		35 (79.5)		24 (92.3)	
Q3	B	8 (19.0)	↑21.5 **	10 (27.8)	↓2.8	4 (19.0)	↓4.7	11 (32.4)	↑14.7	16 (36.4)	↑18.1	9 (34.6)	↑23.1 *
	E	17 (40.5)		9 (25.0)		3 (14.3)		16 (47.1)		24 (54.5)		15 (57.7)	
Q4	B	17 (40.5)	↑9.5	11 (30.6)	↔	9 (42.9)	↑9.5	14 (41.2)	↑14.7	20 (45.5)	↓2.3	17 (65.4)	↑11.5
	E	21 (50.0)		11 (30.6)		11 (52.4)		19 (55.9)		19 (43.2)		20 (76.9)	
Q5	B	35 (83.3)	↓4.7	28 (77.8)	↑5.5	21 (100.0)	↓4.8	27 (79.4)	↑5.9	37 (84.1)	↑2.3	26 (100.0)	↓3.8
	E	33 (78.6)		30 (83.3)		20 (95.2)		29 (85.3)		38 (86.4)		25 (96.2)	
Q6	B	6 (14.3)	↑4.7	5 (14.0)	↑2.8	4 (19.0)	↑19.1	4 (11.8)	↑23.5 **	9 (20.5)	↑9.0	4 (15.4)	↑7.7
	E	8 (19.0)		6 (16.7)		8 (38.1)		12 (35.3)		13 (29.5)		6 (23.1)	
Q7	B	18 (42.9)	↓9.6	10 (27.8)	↑2.8	8 (38.1)	↑14.3 *	18 (52.9)	↓2.9	15 (34.1)	↓2.3	12 (46.2)	↓7.7
	E	14 (33.3)		11 (30.6)		11 (52.4)		17 (50.0)		14 (31.8)		10 (38.5)	
Q8	B	9 (21.4)	↑2.4	9 (25.0)	↔	7 (33.3)	↑4.8	10 (29.4)	↑32.4 **	16 (36.4)	↓9.1	11 (42.3)	↑15.4
	E	10 (23.8)		9 (25.0)		8 (38.1)		21 (61.8)		12 (27.3)		15 (57.7)	
Q9	B	4 (9.5)	↑16.7	12 (33.3)	↓16.6 *	9 (42.9)	↑4.7	4 (11.8)	↑14.4	4 (9.1)	↑29.5 *	11 (42.3)	↑11.5
	E	11 (26.2)		6 (16.7)		10 (47.6)		9 (26.5)		17 (38.6)		14 (53.8)	
Q10	B	29 (69.0)	↑14.3	34 (94.4)	↑5.6	21 (100.0)	↓4.8	20 (58.8)	↑29.4 **	41 (93.2)	↑4.5	26 (100.0)	↔
	E	35 (83.3)		36 (100.0)		20 (95.2)		30 (88.2)		43 (97.7)		26 (100.0)	
Q11	B	14 (33.3)	↓4.7	12 (33.3)	↑13.9	12 (57.1)	↓14.2	11 (32.4)	↑17.6	14 (31.8)	↑15.9	10 (38.5)	↑19.2
	E	12 (28.6)		17 (47.2)		9 (42.9)		17 (50.0)		21 (47.7)		15 (57.7)	
Q12	B	9 (21.4)	↑4.8	11 (30.6)	↑2.7	6 (28.6)	↑4.7 *	5 (14.7)	↑32.4 **	10 (22.7)	↑13.7	4 (15.4)	↑23.1 **
	E	11 (26.2)		12 (33.3)		7 (33.3)		16 (47.1)		16 (36.4)		10 (38.5)	
Q13	B	10 (23.8)	↔	5 (13.9)	↔	2 (9.5)	↑28.6 *	10 (29.4)	↓8.8	8 (18.2)	↓2.3	3 (11.5)	↑11.6
	E	10 (23.8)		5 (13.9)		8 (38.1)		7 (20.6)		7 (15.9)		6 (23.1)	
Q14	B	20 (47.6)	↑16.7	15 (41.7)	↓5.6	8 (38.1)	↑4.8	24 (70.6)	↑20.6 **	16 (36.4)	↑36.3 **	13 (50.0)	↑42.3 **
	E	27 (64.3)		13 (36.1)		9 (42.9)		31 (91.2)		32 (72.7)		24 (92.3)	
Q15	B	12 (28.6)	↓4.8	14 (38.9)	↓2.8	8 (38.1)	↓9.5	11 (32.4)	↑23.5 *	11 (25.0)	↑36.4 **	10 (38.5)	↑38.4 **
	E	10 (23.8)		13 (36.1)		6 (28.6)		19 (55.9)		27 (61.4)		20 (76.9)	

Table 4.3 Number of children within each age group providing a correct answer to each question and changes in nutritional knowledge from baseline to end (continue)

Question (Q)		Control group						Experimental group					
		6 – 8 years n=42 Number (%)		9 – 10 years n=36 Number (%)		11 – 12 years n=21 Number (%)		6 – 8 years n=34 Number (%)		9 – 10 years n=44 Number (%)		11 – 12 years n=26 Number (%)	
True or false questions (Q17 – Q31):													
Q17	B E	31 (73.8) 35 (83.3)	↑ 9.5	33 (91.0) 31 (86.1)	↓ 4.9	17 (81.0) 19 (90.5)	↑ 9.5	24 (70.6) 29 (85.3)	↑ 14.7	33 (75.0) 40 (90.9)	↑ 15.9 *	21 (80.8) 25 (96.2)	↑ 15.4 **
Q18	B E	10 (23.8) 13 (31.0)	↑ 7.2	10 (27.8) 13 (36.1)	↑ 8.3	8 (38.1) 8 (38.1)	↔	8 (23.5) 10 (29.4)	↑ 5.9	10 (22.7) 13 (29.5)	↑ 6.8	15 (57.7) 15 (57.7)	↔
Q19	B E	17 (40.5) 14 (33.3)	↓ 7.2	12 (33.3) 10 (27.8)	↓ 5.5	2 (9.5) 3 (14.3)	↑ 4.8	12 (35.3) 13 (38.2)	↑ 2.9	4 (9.1) 7 (15.9)	↑ 6.8	3 (11.5) 2 (7.7)	↓ 3.8
Q20	B E	31 (73.8) 37 (88.1)	↑ 14.3	29 (80.6) 33 (91.7)	↑ 11.1	17 (81.0) 20 (95.2)	↑ 14.2	19 (55.9) 28 (82.4)	↑ 26.5 **	39 (88.6) 41 (93.2)	↑ 4.6	26 (100.0) 26 (100.0)	↔
Q21	B E	26 (61.9) 33 (78.6)	↑ 16.7	27 (75.0) 30 (83.3)	↑ 8.3	21 (100.0) 21 (100.0)	↔	19 (55.9) 26 (76.5)	↑ 20.6	31 (70.5) 38 (86.4)	↑ 15.9 *	24 (92.3) 26 (100.0)	↑ 7.7
Q22	B E	19 (45.2) 24 (57.1)	↑ 11.9	24 (66.7) 26 (72.2)	↑ 5.5	18 (85.7) 19 (90.5)	↑ 4.8	16 (47.1) 15 (44.1)	↓ 3.0	27 (61.4) 32 (72.7)	↑ 11.3	21 (80.8) 23 (88.5)	↑ 7.7
Q23	B E	32 (76.2) 34 (81.0)	↑ 4.8	27 (75.0) 26 (72.2)	↓ 2.8	19 (90.5) 19 (90.5)	↔	22 (64.7) 25 (73.5)	↑ 8.8	36 (81.8) 31 (70.5)	↓ 11.3	24 (92.3) 19 (73.1)	↓ 19.2
Q24	B E	26 (61.9) 27 (64.3)	↑ 2.4	30 (83.3) 27 (75.0)	↓ 8.3	17 (81.0) 18 (85.7)	↑ 4.7	15 (44.1) 19 (55.9)	↑ 51.8	33 (75.0) 31 (70.5)	↓ 4.5	21 (80.8) 21 (80.8)	↔
Q25	B E	30 (71.4) 24 (57.1)	↓ 14.3	20 (55.6) 23 (63.9)	↑ 8.3	15 (71.4) 15 (71.4)	↔	24 (70.6) 25 (73.5)	↑ 2.9	27 (61.4) 31 (70.5)	↑ 9.1	22 (84.6) 23 (88.5)	↓ 3.9
Q26	B E	25 (59.5) 28 (66.7)	↑ 7.2	20 (55.6) 25 (69.4)	↑ 13.8	10 (47.6) 16 (76.2)	↑ 28.6 *	24 (70.6) 24 (70.6)	↔	30 (68.2) 28 (63.6)	↓ 4.6	18 (69.2) 18 (69.2)	↔
Q27	B E	23 (54.8) 26 (61.9)	↑ 7.1	23 (63.9) 23 (63.9)	↔	12 (57.1) 13 (61.9)	↑ 4.8	23 (67.6) 26 (76.5)	↑ 8.9	29 (65.9) 25 (56.8)	↓ 9.1	14 (53.8) 15 (57.7)	↑ 3.9
Q28	B E	30 (71.4) 26 (61.9)	↓ 9.5	22 (61.1) 26 (72.2)	↑ 11.1	15 (71.4) 16 (76.2)	↑ 4.8	24 (70.6) 27 (79.4)	↑ 8.8	23 (52.3) 32 (72.7)	↑ 20.4 *	14 (53.8) 15 (57.7)	↑ 3.9
Q29	B E	28 (66.7) 31 (73.8)	↑ 7.1	31 (86.1) 24 (66.7)	↓ 19.4 *	17 (81.0) 19 (90.5)	↑ 9.5	25 (73.5) 28 (82.4)	↑ 8.9	30 (68.2) 33 (75.0)	↑ 6.8	23 (88.5) 23 (88.5)	↔
Q30	B E	29 (69.0) 30 (71.4)	↑ 2.4	31 (86.1) 28 (77.8)	↓ 8.3	18 (85.7) 19 (90.5)	↑ 4.8	21 (61.8) 28 (82.4)	↑ 20.6	38 (86.4) 38 (86.4)	↔	24 (92.3) 26 (100.0)	↑ 7.7
Q31	B E	29 (69.0) 23 (54.8)	↓ 14.2	25 (69.4) 22 (61.1)	↓ 8.3	17 (81.0) 18 (85.7)	↑ 4.7	20 (58.8) 21 (61.8)	↑ 3.0	30 (68.2) 35 (79.5)	↑ 11.3	19 (73.1) 22 (84.6)	↑ 11.5
Total			**↑ 3.6**		**↓ 0.3**		**↑ 3.7 ***		**↑ 15.5 ****		**↑ 8.8 ****		**↑8.9 ****

B = Baseline E = End; * statistical significant difference between baseline and end measurements ($p < 0.05$); * practical significant difference between baseline and end measurements ($d > 0.5$); % ↑ increase in nutrition knowledge; % ↓ decrease in nutrition knowledge; ↔ no change in nutrition knowledge

4.4 Dietary behaviour

From Table 4.4 it is apparent that the majority of households spend between R500 and R2 500 on food each month. In most cases the person responsible for food purchase and preparation is the mother and in some instances the grandmother within both the control and experimental groups. No significant differences were found between the control and experimental groups, with regard to mean monthly spending on food, person responsible for buying food and person responsible for food preparation.

Table 4.4 Factors that could influence food choices of children within the control and experimental groups

Influencing factors		Control group n=99 Percentage (%)	Experimental group n=104 Percentage (%)
Mean monthly amount spend on food:	R500	16.2	13.7
	R500 – R1000	36.4	33.3
	R1500 - R2500	30.3	32.4
	R2500 – R3000	11.1	9.8
	R3000+	5.1	4.9
	Not indicated	0.9	5.9
Person responsible for buying the food:	Mother	75.8	75.0
	Grandmother	10.1	12.5
	Other	14.1	12.5
Person responsible for food preparation:	Mother	78.8	76.9
	Grandmother	13.1	12.5
	Other	8.1	10.6

No statistical significant difference between baseline and end measurements ($p > 0.05$)

4.4.1 Diet quality

A serving score was calculated in order to determine changes in dietary quality of children aged 6 - 12 years. For the calculation of the dietary quality score the age and gender groups within both the control and experimental groups were kept separate due to the fact that the dietary quality of young children is influenced by gender and age (see section 2.3.3.3, (i): Chapter 2).

According to the serving score in Tables 4.5 and 4.6 the boys (baseline score: 1.3; end score: 0.9) and girls (baseline score: 2.0; end score: 1.0), respectively aged 11 - 12 years within the control group scored statistically significantly ($p < 0.05$) lower for dairy intake during end measurements compared to baseline measurements. The control group girls aged 6 - 8 years (baseline score: 1.1; end score: 1.6) however, scored statistically significantly more for dairy intake during end measurements compared to baseline measurements. The experimental group girls aged 6 - 8 years (baseline score: 1.6; end score: 2.9) and 9 - 10 years (baseline score: 0.8; end score: 1.8) scored statistically significantly more for fruit intake during end measurements compared to baseline measurements.

Table 4.5 Serving scores of the five food groups for boys in the control and experimental groups

Food group	Control group						Experimental group					
	6 – 8 years n=18 Score/20		9 - 10 years n=16 Score/20		11 - 12 years n=9 Score/20		6 - 8 years n=17 Score/20		9 - 10 years n=14 Score/20		11 – 12 years n=11 Score/20	
	B[1]	E[2]	B[1]	E[2]	B[1]	E[2]	B[1]	E[2]	B[1]	E[2]	B[1]	E[2]
Dairy	1.2	1.6	0.9	1.3	1.3	0.9*	1.5	1.7	1.4	1.5	1.3	1.1
Meat	3.3	3.4	3.6	3.6	4.0	2.9	3.1	3.5	3.5	3.4	3.6	3.6
Grain	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Fruit	1.2	0.8	2.1	1.8	1.3	0.9	1.2	1.6	1.2	0.9	0.7	1.1
Vegetables	1.3	1.8	2.1	1.6	0.9	1.4	1.2	0.9	1.8	1.4	1.0	1.6
Total score	11.1	11.6	12.7	12.3	11.6	10.1	10.9	11.7	11.7	11.2	10.6	11.5

* statistical significant difference between baseline and end measurements ($p < 0.05$); [1]B = baseline measurements; [2]E = end measurements

Table 4.6 Serving scores of the five food groups for girls in the control and experimental groups

Food group	Control group						Experimental group					
	6 – 8 years n=18 Score/20		9 - 10 years n=13 Score/20		11 - 12 years n=9 Score/20		6 - 8 years n=11 Score/20		9 - 10 years n=25 Score/20		11 – 12 years n=14 Score/20	
	B[1]	E[2]	B[1]	E[2]	B[1]	E[2]	B[1]	E[2]	B[1]	E[2]	B[1]	E[2]
Dairy	1.1	1.6*	1.5	0.9	2.0	1.0*	1.6	1.4	1.2	1.3	1.3	1.8
Meat	3.5	2.8	3.5	3.2	3.9	3.6	4.0	3.1	3.4	3.5	3.6	3.4
Grain	4.0	4.0	4.0	4.0	4.0	4.0	3.8	4.0	3.9	4.0	3.7	4.0
Fruit	1.1	1.2	1.6	1.5	0.9	0.8	1.6	2.9*	0.8	1.8*	1.1	1.6
Vegetables	1.2	1.4	1.5	1.5	1.4	1.3	1.5	0.8	1.2	0.9	1.5	1.1
Total score	10.9	10.9	12.2	11.2	12.2	10.6	12.5	12.2	10.5	11.4	11.3	11.9

* statistical significant difference between baseline and end measurements ($p < 0.05$); [1]B = baseline measurements; [2]E = end measurements

In Tables 4.7 and 4.8 mean food group intakes of boys and girls are reported. In order to compare the mean intake of the five food groups for both the control and experimental groups with the recommended intakes, the mean intakes of the five food groups were also analysed in accordance to age and gender. The occurrence of large standard deviations within Table 4.7 and 4.8 are due to the large variance in the mean food intake of boys and girls within this study population.

According to Table 4.7, boys aged 11 - 12 years within the control group took in statistically significantly less dairy at end measurements compared to baseline measurements. No statistical significant differences were seen among boys within the experimental group.

From Table 4.8 it is evident that there were no statistical significant differences found among girls within the control group in terms of food group consumption. The experimental group girls aged 9 - 10 years, however, consumed statistically significantly more fruits at end measurements compared to baseline measurements.

Table 4.7 Mean intake of the five food groups for boys in the control and experimental groups

Food group	Control group						Experimental group					
	6 – 8 years n=18 Mean (±SD[1])		9 – 10 years n=16 Mean (±SD)		11 – 12 years n=9 Mean (±SD)		6 – 8 years n=17 Mean (±SD)		9 – 10 years n=14 Mean (±SD)		11 – 12 years n=11 Mean (±SD)	
	B[2]	E[3]	B[2]	E[3]	B[2]	E[3]	B[2]	E[3]	B[2]	E[3]	B[2]	E[3]
Dairy (g/day)	141.6 (128.7)	195.3 (143.1)	85.8 (77.5)	165.1 (215.6)	146.1 (134.3)	107.1 (93.7)	205.2 (140.6)	226.5 (190.9)	213.1 (255.0)	205.6 (211.0)	147.6 (92.2)	164.8 (80.8)
Meat (g/day)	129.8 (87.0)	137.7 (122.7)	139.3 (108.0)	128.3 (84.0)	225.1 (176.2)	94.1 (79.5)	85.4 (73.8)	115.7 (73.9)	111.8 (74.9)	135.9 (91.8)	140.6 (80.9)	184.7 (119.7)
Grain (g/day)	589.8 (316.6)	644.1 (381.6)	493.1 (269.3)	548.5 (220.5)	649.9 (237.0)	437.7* (134.8)	592.0 (324.9)	596.7 (296.2)	527.5 (259.4)	632.6 (250.0)	440.6 (236.2)	574.2 (249.9)
Fruit (g/day)	78.3 (149.0)	46.1 (100.1)	114.7 (125.5)	97.2 (142.0)	74.4 (124.4)	48.3 (100.1)	88.2 (177.5)	104.1 (127.9)	61.8 (103.9)	61.3 (138.0)	52.7 (120.3)	64.6 (127.4)
Veg[4] (g/day)	52.8 (63.0)	82.7 (99.3)	90.2 (80.7)	63.2 (57.4)	42.0 (83.6)	69.4 (87.1)	56.5 (98.3)	41.9 (67.0)	111.8 (74.9)	111.1 (157.9)	60.9 (112.8)	83.8 (114.9)

* statistical significant difference between baseline and end measurements ($p < 0.05$); [1]SD = standard deviation; [2]**B** = baseline measurements; [3]**E** = end measurements; [4]Veg = vegetables

Table 4.8 Mean intake of the five food groups for girls in the control and experimental groups

Food group	Control group						Experimental group					
	6 – 8 years n=18 Mean (±SD[1])		9 – 10 years n=13 Mean (±SD[1])		11 – 12 years n=9 Mean (±SD[1])		6 – 8 years n=11 Mean (±SD[1])		9 – 10 years n=25 Mean (±SD[1])		11 – 12 years n=14 Mean (±SD[1])	
	B[2]	E[3]	B[2]	E[3]	B[2]	E[3]	B[2]	E[3]	B[2]	E[3]	B[2]	E[3]
Dairy (g/day)	153.7 (224.2)	186.8 (172.7)	186.3 (118.3)	123.7 (120.5)	232.2 (191.8)	137.7 (155.2)	176.1 (157.1)	163.8 (148.2)	117.9 (113.3)	176.6 (191.0)	157.6 (172.6)	226.4 (174.7)
Meat (g/day)	121.7 (74.3)	89.9 (82.5)	123.9 (93.7)	82.7 (54.4)	143.3 (95.7)	174.0 (108.3)	187.9 (94.1)	154.2 (207.5)	147.4 (104.4)	114.9 (89.7)	154.2 (90.4)	171.5 (169.7)
Grain (g/day)	457.8 (218.1)	559.8 (329.3)	461.5 (212.6)	424.2 (239.9)	498.0 (286.6)	499.4 (269.1)	487.0 (304.4)	376.3 (151.3)	530.5 (342.7)	502.9 (266.4)	427.9 (242.3)	600.9 (321.4)
Fruit (g/day)	68.3 (117.3)	102.8 (206.4)	166.9 (240.6)	122.7 (223.1)	63.3 (129.8)	35.6 (76.7)	110.5 (143.0)	176.4 (126.6)	41.2 (90.3)	136.1* (177.4)	109.3 (230.8)	101.1 (147.7)
Veg[4] (g/day)	46.6 (61.7)	86.0 (158.3)	56.5 (64.7)	76.0 (110.0)	68.9 (86.5)	80.6 (147.5)	72.7 (104.0)	28.0 (50.4)	46.8 (54.7)	39.7 (61.1)	52.1 (52.5)	42.1 (53.0)

* statistical significant difference between baseline and end measurements ($p < 0.05$); [1]SD = standard deviation; [2]**B** = baseline measurements; [3]**E** = end measurements; [4]Veg = vegetables

4.4.2 Energy and nutrient analysis

Energy and nutrient analyses are reflected in Tables 4.9 – 4.20. The mean of selected nutrients is given for the entire control and experimental groups due to the fact that the mean nutrient intakes are compared to the recommended intakes for selected nutrients. The total energy intake, however, is not given for the entire control and experimental groups because each age group has a different energy recommendation.

According to Table 4.9 no statistical significant differences in any of the macro-nutrients, fatty acids, cholesterol, sugar or fibre of children 6 - 12 years between the control and experimental groups were found.

Table 4.10 summarize mean macronutrient intakes expressed as a percentage of total daily energy intakes for the control and experimental groups. From Table 4.10 it is clear that no statistical significant differences in macro-nutrient, fatty acids and sugar percentages between the control and experimental groups were found.

Table 4.9 Mean macro-nutrient, fatty acid, cholesterol, sugar and fibre intakes in the control and experimental groups

Macro-nutrient	**Control group** **6 – 12 years** n=83 Mean (±SD[1])	**Experimental group** **6 – 12 years** n=92 Mean (±SD[1])
Total protein (g/day)	93.7 (29.7)	97.6 (29.1)
Total fat (g/day)	111.2 (44.7)	114.4 (46.2)
SFA[2] (g/day)	34.9 (14.7)	37.3 (14.9)
MUFA[3] (g/day)	38.0 (16.5)	38.4 (15.9)
PUFA[4] (g/day)	28.3 (15.1)	28.3 (15.3)
Cholesterol (mg/day)	394.3 (112.9)	415.8 (114.9)
Carbohydrate (g/day)	394.3 (112.9)	415.8 (114.9)
Total sugar (g/day)	58.2 (33.6)	60.9 (35.2)
Added sugar (g/day)	71.5 (39.3)	79.3 (42.4)
Total dietary fibre (g/day)	25.4 (7.4)	25.5 (8.7)

* statistical significant difference between baseline and end measurements ($p < 0.05$); [1]SD = standard deviation; [2]SFA = Saturated Fatty Acid; [3]MUFA = Mono-unsaturated Fatty Acid; [4]PUFA = Poly-unsaturated Fatty Acid

Tables 4.10 Mean macro-nutrient, fatty acids and sugar intakes expressed as a percentage of total daily energy intakes in the control and experimental groups

Macro-nutrient	**Control group** **6 – 12 years** n=83 Mean (±SD[1])	**Experimental group** **6 – 12 years** n=92 Mean (±SD[1])
Total protein (% of Energy)	12.5 (1.9)	12.7 (1.9)
Total fat (% of Energy)	32.4 (4.2)	31.9 (6.1)
SFA[2] (% of Total fat)	10.2 (1.9)	10.5 (1.8)
MUFA[3] (% of Total fat)	11.0 (1.9)	10.7 (1.8)
PUFA[4] (% of Total fat)	8.2 (2.0)	7.8 (2.0)
Carbohydrate (% of Energy)	52.5 (4.6)	53.1 (4.6)
Total sugar (% of Energy)	8.0 (2.7)	8.0 (2.8)

[1]SD = standard deviation; [2]SFA = Saturated Fatty Acid; [3]MUFA = Mono-unsaturated Fatty Acid; [4]PUFA = Poly-unsaturated Fatty Acid

The mean macro-nutrients including total energy intake are given in subgroups for boys and girls separately for each age group. From Table 4.11 it is evident that there were no statistical significant differences between boys within both groups for energy, macro-nutrient, fatty acids, cholesterol, sugar and fibre intakes.

Girls aged 9 - 10 years (Table 4.12) within the control group on the other hand consumed statistically significantly lower amounts of total fat, saturated fatty acids (SFA), and mono-unsaturated fatty acids (MUFA) than the experimental group ($p < 0.05$).

In Tables 4.13 – 4.14 mean macro-nutrient, fatty acid and sugar intakes expressed as a percentage of total daily energy intakes for boys and girls in each age group within both the control and experimental groups are summarized.

From Table 4.13 it is apparent that no statistical significant differences in macro-nutrient percentages for boys within the control and experimental groups were found. From Table 4.14 it is also evident that no statistical significant differences in macronutrient percentages for girls within the control and experimental groups occurred.

Table 4.11 Mean energy, macro-nutrient, fatty acids, cholesterol, sugar and fibre intakes for boys in the control and experimental groups

Macro-nutrient	Control group			Experimental group		
	6 – 8 years n=18 Mean (±SD[1])	9 – 10 years n=16 Mean (±SD[1])	11 – 12 years n=9 Mean (±SD[1])	6 – 8 years n=17 Mean (±SD[1])	9 – 10 years n=14 Mean (±SD[1])	11 – 12 years n=11 Mean (±SD[1])
Energy (kJ)	13129.8 (3432.4)	11850.5 (3456.9)	15783.5 (3773.3)	12951.4 (3046.2)	14323.1 (3641.2)	14117.2 (3836.1)
Total protein (g)	99.5 (28.5)	87.0 (32.3)	115.7 (31.7)	89.4 (24.0)	98.6 (25.9)	108.5 (23.5)
Total fat (g)	108.0 (37.7)	101.3 (46.2)	141.5 (56.2)	103.8 (45.4)	118.2 (44.9)	122.7 (51.4)
SFA[2] (g)	33.8 (12.7)	30.8 (14.1)	42.8 (17.5)	34.4 (13.7)	38.7 (15.1)	40.3 (19.2)
MUFA[3] (g)	36.4 (15.4)	35.1 (16.1)	49.1 (19.1)	33.9 (16.1)	40.0 (15.8)	40.7 (15.4)
PUFA[4] (g)	26.9 (15.5)	25.1 (14.8)	38.1 (20.8)	26.6 (15.6)	28.5 (14.5)	29.7 (18.6)
Cholesterol (mg)	288.5 (137.1)	297.1 (233.8)	291.1 (101.0)	216.4 (144.2)	207.9 (93.1)	413.0 (221.3)
Carbohydrate (g)	413.2 (114.7)	365.7 (118.7)	476.3 (116.5)	419.7 (96.1)	459.3 (128.1)	429.7 (118.3)
Total sugar (g)	52.9 (25.0)	56.9 (27.8)	64.7 (27.6)	58.8 (33.6)	61.3 (29.8)	66.6 (36.2)
Added sugar (g)	73.0 (41.5)	65.1 (31.1)	90.3 (55.4)	71.6 (30.1)	91.5 (58.7)	77.2 (37.0)
Total dietary fibre (g)	24.7 (5.5)	24.2 (8.9)	28.4 (9.6)	26.8 (8.6)	27.6 (5.7)	25.3 (8.8)

[1]SD = standard deviation; [2]SFA = Saturated Fatty Acid; [3]MUFA = Mono-unsaturated Fatty Acid; [4]PUFA = Poly-unsaturated Fatty Acid

Table 4.12 Mean energy, macro-nutrient, fatty acids, cholesterol, sugar and fibre intakes for girls in the control and experimental groups

Macro-nutrient	Control group			Experimental group		
	6 – 8 years n=18 Mean (±SD[1])	9 – 10 years n=13 Mean (±SD[1])	11 – 12 years n=9 Mean (±SD[1])	6 – 8 years n=11 Mean (±SD[1])	9 – 10 years n=25 Mean (±SD[1])	11 – 12 years n=14 Mean (±SD[1])
Energy (kJ)	12779.5 (3017.1)	10927.9 (2059.7)	13803.6 (4471.7)	13203.7 (3591.7)	13326.6 (4310.4)	13567.2 (4542.4)
Total protein (g)	86.0 (25.1)	83.9 (24.6)	102.8 (34.3)	102.6 (33.9)	92.4 (34.4)	111.3 (26.3)
Total fat (g)	117.3 (42.9)	86.2* (25.5)	127.1 (58.0)	118.0 (46.6)	116.6* (45.6)	122.9 (51.6)
SFA[2] (g)	37.8 (14.6)	27.6* (9.7)	40.3 (20.2)	37.4 (13.6)	37.6* (15.4)	41.3 (18.3)
MUFA[3] (g)	39.8 (15.7)	27.8* (9.9)	42.8 (20.9)	41.4 (15.4)	38.9* (15.9)	40.9 (17.6)
Cholesterol (mg)	257.7 (174.1)	220.5 (124.5)	265.4 (116.4)	421.3 (454.5)	232.2 (122.8)	372.9 (160.8)
Carbohydrate (g)	385.4 (102.7)	345.9 (81.9)	406.6 (128.3)	395.2 (93.4)	413.3 (136.2)	392.1 (158.4)
Total sugar (g)	57.8 (40.0)	66.9 (50.5)	56.2 (24.0)	73.6 (42.0)	53.3 (26.6)	52.3 (44.7)
Added sugar (g)	68.4 (35.2)	61.8 (35.4)	81.7 (49.4)	81.0 (31.8)	86.1 (52.6)	74.8 (67.1)
Total dietary fibre (g)	25.4 (7.6)	25.6 (7.9)	25.9 (6.6)	22.3 (6.8)	24.6 (10.9)	27.2 (10.0)

*statistical significant difference between control and experimental groups ($p < 0.05$); [1]SD = standard deviation; [2]SFA = Saturated Fatty Acid; [3]MUFA = Mono-unsaturated Fatty Acid; [4]PUFA = Poly-unsaturated Fatty Acid

Table 4.13 Mean energy, macro-nutrient, fatty acids, cholesterol, sugar and fibre intakes expressed as a percentage of total daily energy intakes for boys in different age groups of the control and experimental groups

Macro-nutrient	Control group			Experimental group		
	6 – 8 years n=18 Mean (±SD[1])	9 – 10 years n=16 Mean (±SD[1])	11 – 12 years n=9 Mean (±SD[1])	6 – 8 years n=17 Mean (±SD[1])	9 – 10 years n=14 Mean (±SD[1])	11 – 12 years n=11 Mean (±SD[1])
Total protein (% of Energy)	13.1 (2.8)	12.7 (3.4)	12.6 (3.0)	12.1 (3.6)	11.9 (2.2)	13.7 (4.0)
Total fat (% of Energy)	30.9 (5.5)	32.0 (9.5)	33.5 (8.7)	29.6 (7.8)	31.0 (8.2)	32.2 (6.7)
SFA[2] (% of Total fat)	9.6 (2.6)	9.7 (3.6)	10.2 (2.3)	9.8 (2.7)	10.1 3.7)	10.6 (2.7)
MUFA[3] (% of Total fat)	10.4 (2.4)	11.1 (3.8)	11.6 (3.6)	9.7 (2.7)	10.5 (2.8)	10.7 (2.6)
PUFA[4] (% of Total fat)	7.7 (3.3)	7.9 (3.2)	9.0 (4.0)	7.6 (3.4)	7.5 (2.6)	7.8 (3.3)
Carbohydrate (% of Energy)	53.5 (5.5)	52.7 (9.8)	51.7 (6.8)	55.6 (7.9)	54.6 (7.4)	51.8 (5.0)
Total sugar (% of Energy)	7.3 (3.8)	8.3 (3.4)	7.1 (2.8)	7.8 (3.9)	7.5 (3.4)	8.2 (4.4)

[1]SD = standard deviation; [2]SFA = Saturated Fatty Acid; [3]MUFA = Mono-unsaturated Fatty Acid; [4]PUFA = Poly-unsaturated Fatty Acid

Table 4.14 Mean energy, macro-nutrient, fatty acids, cholesterol, sugar and fibre intakes expressed as a percentage of total daily energy intakes for girls in different age groups in the control and experimental groups

Macro-nutrient	Control group			Experimental group		
	6 – 8 years n=18 Mean (±SD[1])	9 – 10 years n=13 Mean (±SD[1])	11 – 12 years n=9 Mean (±SD[1])	6 – 8 years n=11 Mean (±SD[1])	9 – 10 years n=25 Mean (±SD[1])	11 – 12 years n=14 Mean (±SD[1])
Total protein (% of Energy)	11.4 (2.4)	13.2 (3.2)	12.9 (3.5)	13.3 (2.6)	11.8 (2.4)	14.6 (3.0)
Total fat (% of Energy)	34.5 (8.3)	29.9 (6.1)	34.3 (7.5)	33.3 (5.1)	32.5 (7.5)	34.5 (7.4)
SFA[2] (% of Total fat)	11.1 (3.2)	9.6 (2.5)	10.9 (2.2)	10.6 (2.0)	10.5 (2.7)	11.7 (2.6)
MUFA[3] (% of Total fat)	11.7 (3.4)	9.7 (2.5)	11.6 (3.0)	11.7 (2.2)	10.9 (3.0)	11.5 (2.4)
PUFA[4] (% of Total fat)	8.8 (3.6)	7.7 (2.0)	8.6 (3.8)	8.1 (2.7)	8.1 (3.3)	8.3 (2.9)
Carbohydrate (% of Energy)	51.7 (7.9)	53.8 (7.5)	50.4 (5.3)	51.4 (5.6)	53.3 (7.9)	48.3 (7.9)
Total sugar (% of Energy)	7.7 (5.1)	10.2 (6.9)	7.2 (2.9)	9.7 (5.4)	7.2 (3.5)	6.8 (5.5)

[1]SD = standard deviation; [2]SFA = Saturated Fatty Acid; [3]MUFA = Mono-unsaturated Fatty Acid; [4]PUFA = Poly-unsaturated Fatty Acid

The mean of selected micro-nutrients is given according to age and gender in order to compare with the RDA/AI values for micro-nutrients. From Table 4.15 it is clear that statistically significant differences were found between the control and experimental groups regarding iron, folate, and vitamin C intake ($p<0.05$).

Table 4.15 Mean micro-nutrient intakes in the control and experimental groups

Micro-nutrient	Control group		Experimental group	
	6 – 8 years n=36 Mean (±SD[1])	9 – 12 years n=47 Mean (±SD[1])	6 – 8 years n=28 Mean (±SD[1])	9 – 12 years n=64 Mean (±SD[1])
Calcium (mg/day)	722.1 (397.3)	692.1 (372.5)	771.8 (350.2)	770.0 (360.7)
Iron (mg/day)	13.5 (4.5)	12.9* (4.5)	14.0 (4.2)	14.9* (4.5)
Zinc (mg/day)	12.3 (4.2)	12.7 (5.0)	12.2 (3.9)	13.4 (4.5)
Vitamin A (μg/day)	905.2 (1533.1)	718.3 (659.3)	877.5 (1254.3)	708.4 (874.0)
Thiamine (mg/day)	1.8 (0.6)	1.7 (0.7)	1.7 (0.5)	1.9 (0.6)
Riboflavin (mg/day)	2.6 (2.2)	2.5 (2.6)	3.1 (2.3)	2.4 (1.6)
Niacin (mg/day)	23.1 (8.3)	22.5 (9.3)	24.0 (7.7)	25.9 (8.3)
Vitamin B6 (mg/day)	2.1 (1.0)	2.1 (1.1)	2.2 (1.1)	2.4 (1.1)
Folate (μg/day)	335.0 (146.1)	295.2* (122.6)	320.0 (134.3)	366.7* (207.6)
Vitamin B12 (μg/day)	3.6 (2.2)	4.9 (6.5)	6.4 (12.4)	4.8 (3.9)
Vitamin C (mg/day)	145.1 (170.5)	107.5* (112.5)	146.3 (145.9)	177.8* (196.5)
Vitamin D (μg/day)	5.0 (3.1)	5.3 (4.5)	5.4 (5.7)	4.8 (3.5)

*statistical significant difference between control and experimental groups ($p < 0.05$); [1]SD = standard deviation

Table 4.16 presents the percentage children within the control and experimental groups that take in less than 67% of the RDA/AI for selected micro-nutrients. According to Table 4.16, children aged 6 - 12 years took in less than 67% of the RDA/AI for calcium, folate and vitamin A, B12, C and D. Children 6 - 8 years took in less than 67% of the RDA/AI for iron whereas children aged 9 - 12 years took in less than 67% of the RDA/AI for zinc, thiamine, riboflavin and niacin.

Mean micro-nutrient intakes (Table 4.17) indicate that boys aged 9 - 10 years within the experimental group took in statistically significantly more calcium, iron, thiamine, riboflavin, niacin and folate than the control group ($p < 0.05$).

Table 4.16 Percentage of children grouped according to age in the control and experimental groups consuming < 67% of the RDA/AI of selected micro-nutrients

Micro-nutrient	RDA/AI		Control group		Experimental group	
	6 – 8 years	9 – 12 years	6 – 8 years n=36	9 – 12 years n=47	6 – 8 years n=28	9 – 12 years n=64
			Percentage (%) under 67% RDA[1]/AI[2]	Percentage (%) under 67% RDA[1]/AI[2]	Percentage (%) under 67% RDA[1]/AI[2]	Percentage (%) under 67% RDA[1]/AI[2]
Calcium (mg)	800.0	1300.0	36.1	75.9	29.3	69.6
Iron (mg)	10.0	8.0	2.4	1.0	3.3	0.0
Zinc (mg)	5.0	8.0	0.0	1.2	0.0	1.1
Vitamin A (µg)	400.0	600.0	16.9	36.1	17.4	31.5
Thiamine (mg)	0.6	0.9	0.0	1.2	0.0	1.1
Riboflavin (mg)	0.6	0.9	2.4	3.6	0.0	2.2
Niacin (mg)	8.0	12.0	0.0	1.2	0.0	1.1
Vitamin B6 (mg)	0.6	1.0	0.0	2.4	0.0	0.0
Folate (µg)	200.0	300.0	6.0	22.9	4.3	9.8
Vitamin B12 (µg)	1.2	1.8	3.6	12.0	2.2	3.3
Vitamin C (mg)	25.0	45.0	15.7	31.3	14.1	29.3
Vitamin D (µg)	5.0	5.0	38.6	38.6	41.3	41.3

[1]RDA = The average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group (Whitney & Rolfes, 2002); [2]AI = Adequate intake which is the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate-used when an RDA cannot be determined (Whitney & Rolfes, 2002).

Girls aged 11 - 12 years (Table 4.18) within the experimental group had a statistically significantly higher intake of Vitamin C than the girls in the control group ($p < 0.05$).

Tables 4.19 – 4.20 report the percentage of boys and girls in each of the different age groups within the control and experimental groups that took in less than 67% of the RDA/AI for selected micro-nutrients. It can be seen from Table 4.19 that boys aged 6 - 12 years within both the control and experimental groups took in less than 67% of the RDA/AI for calcium, vitamin A, C and D. Boys aged 9 - 10 years took in less than 67% of the RDA/AI for vitamin B12.

According to Table 4.20, girls aged 6 - 12 years within both the control and experimental groups took in less than 67% of the RDA/AI for calcium, vitamin A, folate, vitamin C and D. Girls aged 6 - 8 years took in less than 67% of the RDA for iron.

Table 4.17 Mean micro-nutrient intakes for boys grouped according to age in the control and experimental groups

Micro-nutrient	Control group			Experimental group		
	6 – 8 years n=18 Mean (±SD[1])	9 – 10 years n=16 Mean (±SD[1])	11 – 12 years n=9 Mean (±SD[1])	6 – 8 years n=17 Mean (±SD[1])	9 – 10 years n=14 Mean (±SD[1])	11 – 12 years n=11 Mean (±SD[1])
Calcium (mg)	685.3 (317.9)	587.0* (331.7)	799.7 (452.0)	803.0 (356.1)	850.5* (384.0)	773.8 (369.4)
Iron (mg)	13.6 (4.7)	11.3* (3.6)	16.2 (6.1)	13.5 (3.4)	14.2* (2.9)	17.7 (4.6)
Zinc (mg)	13.0 (4.8)	12.6 (5.8)	14.9 (5.3)	11.8 (3.8)	13.0 (4.5)	14.6 (3.8)
Vitamin A (µg)	608.6 (322.9)	838.6 (884.6)	599.9 (394.3)	1069.4 (1575.6)	550.8 (328.4)	1108.8 (1802.8)
Thiamine (mg)	1.8 (0.6)	1.5* (0.5)	2.2 (0.9)	1.7 (0.5)	2.0* (0.4)	2.0 (0.5)
Riboflavin (mg)	2.1 (1.6)	1.6* (1.0)	4.2 (3.1)	3.1 (2.5)	2.6* (1.4)	3.1 (1.9)
Niacin (mg)	24.3 (7.5)	18.4* (7.8)	28.4 (12.4)	23.3 (7.4)	24.5* (7.1)	26.9 (6.4)
Vitamin B6 (mg)	2.0 (0.8)	1.6 (0.8)	2.8 (1.3)	2.0 (0.7)	2.2 (1.0)	2.5 (1.1)
Folate (µg)	363.3 (170.5)	253.4* (115.71)	419.4 (70.8)	294.7 (64.1)	360.3* (151.4)	498.2 (340.9)
Vitamin B12 (µg)	4.1 (2.5)	5.4 (7.9)	7.7 (10.0)	7.3 (15.9)	3.6 (1.7)	7.5 (7.3)
Vitamin C (mg)	131.9 (167.0)	88.1 (78.8)	119.8 (110.6)	133.9 (138.3)	144.3 (213.2)	139.2 (137.6)
Vitamin D (µg)	4.8 (2.7)	5.4 (5.0)	8.7833 (6.0)	4.2 (2.9)	3.3 (2.5)	6.4 (3.9)

*statistical significant difference between control and experimental groups ($p < 0.05$); [1]SD = standard deviation

Table 4.18 Mean micro-nutrient intakes for girls grouped according to age in the control and experimental groups

Micro-nutrient	Control group			Experimental group		
	6 – 8 years n=18 Mean (±SD[1])	9 – 10 years n=13 Mean (±SD[1])	11 – 12 years n=9 Mean (±SD[1])	6 – 8 years n=11 Mean (±SD[1])	9 – 10 years n=25 Mean (±SD[1])	11 – 12 years n=14 Mean (±SD[1])
Calcium (mg)	758.9 (470.2)	704.0 (317.9)	754.4 (442.9)	723.5 (352.1)	660.4 (288.0)	882.3 (425.6)
Iron (mg)	13.4 (4.4)	11.8 (2.8)	14.2 (54.0)	14.7 (5.4)	14.0 (4.8)	14.8 (4.7)
Zinc (mg)	11.7 (3.6)	11.4 (3.8)	12.6 (4.9)	12.9 (4.3)	12.5 (4.9)	14.6 (4.3)
Vitamin A (µg)	1201.8 (2132.7)	760.2 (700.3)	562.3 (256.8)	581.1 (341.1)	517.9 (311.0)	891.9 (804.4)
Thiamine (mg)	1.7 (0.68)	1.5 (0.4)	1.9 (0.8)	1.7 (0.5)	1.8 (0.6)	1.9 (0.7)
Riboflavin (mg)	3.1 (2.6)	1.8 (2.0)	3.5 (4.0)	3.0 (2.1)	1.9 (1.5)	2.5 (1.3)
Niacin (mg)	21.8 (9.2)	21.8 (6.8)	25.0 (8.7)	25.1 (8.4)	23.0 (9.1)	27.4 (8. 8)
Vitamin B6 (mg)	2.2 (1.1)	2.0 (0.6)	2.5 (1.5)	2.5 (1.5)	2.4 (1.3)	2.3 (1.0)
Folate (µg)	306.6 (114.9)	257.9 (91.2)	299.1 (144.1)	359.1 (198.4)	304.1 (124.9)	381.7 (212.6)
Vitamin B12 (µg)	3.2 (1.8)	3.2 (1.7)	4.0 (2.2)	5.0 (2.9)	3.8 (2.1)	5.6 (3.2)

end. There were, however, no significant differences within the control group boys or in either groups of girls.

Table 4.21 Anthropometrical measurements from baseline to end for all boys and girls in the control and experimental groups

Measurement	Control group				Experimental group			
	6 - 12 years Boys Mean (±SD) n=48		6 – 12 years Girls Mean (±SD) n=51		6 – 12 years Boys Mean (±SD) n=45		6 – 12 years Girls Mean (±SD) n=59	
	B	E	B	E	B	E	B	E
Height (cm)	132.2 (9.5)	132.7 (12.0)	132.7 (10.6)	132.7 (10.6)	132.7 (10.6)	133.3* (10.8)	135.0 (11.3)	135.1 (11.0)
Weight (kg)	31.4 (8.4)	31.7 (10.8)	32.1 (12.6)	32.1 (12.6)	32.1 (12.6)	32.3* (12.6)	33.7 (11.2)	33.7 (11.3)
BMI (kg/m^2)	17.7 (3.2)	17.6 (3.7)	17.7 (4.2)	17.7 (4.2)	17.7 (4.2)	17.7 (4.1)	18.0 (4.0)	18.0 (4.2)
Mid-waist-circumference (mm)	58.4 (6.9)	57.7 (8.1)	58.6 (9.1)	58.6 (9.1)	58.6 (9.1)	59.1* (8.7)	58.6 (8.4)	58.7 (8.5)
Umbilical-circumference (mm)	60.6 (7.6)	61.1 (10.2)	64.6 (31.8)	64.6 (31.8)	64.6 (31.8)	61.0 (11.9)	62.3 (10.3)	62.8 (10.8)

* statistical significant difference between baseline and end measurements ($p < 0.05$); **B** = baseline measurements; **E** = end measurements

Z-scores were calculated from the height and weight measurements in Table 4.21. Due to the fact that no practical significant changes from baseline to end within anthropometrical measurements for both groups were found, it was decided to calculate baseline z-scores for the purpose of subject characteristics only.

From Table 4.22 it is apparent that 4.3% and 2.7% of all boys and girls respectively were underweight, 7.5% and 9.0% respectively were overweight and 4.3% and 4.5% respectively were obese. It is also evident that 6.5% and 4.5% of all boys and girls respectively were stunted. When the percentage underweight, stunting, overweight and obesity of white, black and coloured boys and girls are compared it is apparent that 8.6% of black boys and 2.2% of black girls were underweight whereas 9.5% white boys, 8.0% white girls and 6.5% black girls were obese. It can also be seen that 5.7% black boys and 2.2% black girls were stunted.

Table 4.18 Mean micro-nutrient intakes for girls grouped according to age in the control and experimental groups (continue)

Micro-nutrient	Control group			Experimental group		
	6 – 8 years n=18 Mean (±SD[1])	9 – 10 years n=13 Mean (±SD[1])	11 – 12 years n=9 Mean (±SD[1])	6 – 8 years n=11 Mean (±SD[1])	9 – 10 years n=25 Mean (±SD[1])	11 – 12 years n=14 Mean (±SD[1])
Vitamin C (mg)	158.2 (177.7)	142.8 (164.2)	78.4* (67.2)	165.5 (161.9)	159.7 (201.4)	274.0* (198.0)
Vitamin D (µg)	5.3 (3.6)	3.7 (2.7)	3.9 (2.2)	7.3 (8.2)	3.9 (2.6)	6.7 (4.3)

*statistical significant difference between control and experimental groups ($p < 0.05$); [1]SD = standard deviation

Table 4.19 Percentage of boys grouped according to age in the control and experimental groups that consume < 67% of the RDA/AI for selected micro-nutrients

Micro-nutrient	Control group			Experimental group		
	6 – 8 years n=18 Percentage (%) under 67% RDA[1]/AI[2]	9 - 10 years n=16 Percentage (%) under 67% RDA[1]/AI[2]	11 – 12 years n=9 Percentage (%) under 67% RDA[1]/AI[2]	6 – 8 years n=17 Percentage (%) under 67% RDA[1]/AI[2]	9 - 10 years n=14 Percentage (%) under 67% RDA[1]/AI[2]	11 – 12 years n=11 Percentage (%) under 67% RDA[1]/AI[2]
Calcium (mg)	33.3	87.5	77.8	17.6	57.1	72.7
Iron (mg)	0.0	6.3	0.0	5.9	0.0	0.0
Zinc (mg)	0.0	6.3	0.0	0.0	0.0	0.0
Vitamin A (µg)	11.1	43.8	44.4	17.6	28.6	36.4
Thiamine (mg)	0.0	6.3	0.0	0.0	0.0	0.0
Riboflavin (mg)	0.0	6.3	0.0	0.0	0.0	0.0
Niacin (mg)	0.0	0.0	0.0	0.0	0.0	0.0
Vitamin B6 (mg)	0.0	6.3	0.0	0.0	0.0	0.0
Folate (µg)	0.0	43.8	0.0	0.0	0.0	0.0
Vitamin B12 (µg)	0.0	25.0	0.0	5.9	7.1	0.0
Vitamin C (mg)	22.2	18.8	44.4	5.9	35.7	45.5
Vitamin D (µg)	38.9	50.0	11.1	47.1	50.0	18.2

[1]RDA = The average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group (Whitney & Rolfes, 2002). [2]AI = Adequate intake which is the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate-used when an RDA cannot be determined (Whitney & Rolfes, 2002).

Table 4.20 Percentage of girls grouped according to age in the control and experimental groups that take in less than 67% of the RDA/AI for micro-nutrients

Micro-nutrient	Control group			Experimental group		
	6 – 8 years n=18	9 - 10 years n=13	11 – 12 years n=9	6 – 8 years n=11	9 - 10 years n=25	11 – 12 years n = 14
	Percentage (%) under 67% RDA[1]/AI[2]	Percentage (%) under 67% RDA[1]/AI[2]	Percentage (%) under 67% RDA[1]/AI[2]	Percentage (%) under 67% RDA[1]/AI[2]	Percentage (%) under 67% RDA[1]/AI[2]	Percentage (%) under 67% RDA[1]/AI[2]
Calcium (mg)	33.3	84.6	66.7	36.4	76.0	64.3
Iron (mg)	5.6	0.0	0.0	9.1	0.0	0.0
Zinc (mg)	0.0	0.0	0.0	0.0	4.0	0.0
Vitamin A (µg)	11.1	30.8	22.2	18.2	32.0	14.3
Thiamine (mg)	0.0	0.0	0.0	0.0	0.0	7.1
Riboflavin (mg)	5.6	0.0	11.1	0.0	0.0	0.0
Niacin (mg)	0.0	0.0	0.0	0.0	0.0	0.0
Vitamin B6 (mg)	0.0	0.0	11.1	0.0	0.0	0.0
Folate (µg)	11.1	23.1	22.2	18.2	20.0	7.1
Vitamin B12 (µg)	11.1	7.7	11.1	0.0	0.0	0.0
Vitamin C (mg)	22.2	30.8	33.3	18.2	24.0	14.3
Vitamin D (µg)	38.9	46.2	33.3	45.5	52.0	21.4

[1]RDA = The average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group (Whitney & Rolfes, 2002). [2]AI = Adequate intake which is the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate-used when an RDA cannot be determined (Whitney & Rolfes, 2002).

4.5 Anthropometrical data

Although physical activity was not part of the main outcome of this study, but part of the vehicle for the transfer of nutritional knowledge (movements in musical play), anthropometrical measurements were taken before and after the intervention. For the purpose of this study the anthropometrical data provides background information regarding the study population, but it was also decided to evaluate the anthropometrical measurements at baseline and end to explore the possible impact of increased physical activity on body composition; although we acknowledge that the timeframe of the intervention was very short.

Mean weight, height, BMI, mid-waist circumference and umbilical circumference measurements for all subjects are given in Table 4.21. In the boys mean height, weight and mid-waist-circumference of the experimental group increased with statistical significance from baseline to

Table 4.22 The prevalence of underweight, stunting, overweight and obesity in the total group of children classified according to the WHO z-scores

Group	**Percentage (n)**		
	-2SD[1]	+2SD[1]	+3SD[1]
	BMI[2]-for-age		
All boys (n=93)	4.3 (4)	7.5 (7)	4.3 (4)
All girls (n=111)	2.7 (3)	9.0 (10)	4.5 (5)
White boys (n=21)	0	14.3 (3)	9.5 (2)
Black boys (n=35)	8.6 (3)	5.7 (2)	0
Coloured boys (n=2)	0	0	0
White girls (n=25)	0	12.0 (3)	8.0 (2)
Black girls (n=46)	2.2 (1)	13.0 (6)	6.5 (3)
Coloured girls (n=5)	0	0	0
	Height-for-age		
All boys (n=93)	6.5 (6)	-	-
All girls (n=111)	4.5 (5)	-	-
White boys (n=21)	0	-	-
Black boys (n=35)	5.7 (2)	-	-
Coloured boys (n=2)	0	-	-
White girls (n=25)	0	-	-
Black girls (n=46)	2.2 (1)	-	-
Coloured girls (n=5)	0	-	-
	Weight-for-age		
All boys (n=93)	2.2 (2)	-	-
All girls (n=111)	1.8 (2)	-	-
White boys (n=21)	0	-	-
Black boys (n=35)	2.9 (1)	-	-
Coloured boys (n=2)	0	-	-
White girls (n=25)	4.0 (1)	-	-
Black girls (n=46)	0	-	-
Coloured girls (n=5)	0	-	-

[1]SD = Standard Deviations; [2]BMI = Body Mass Index

When analyzing baseline z-scores according to the different age groups for boys and girls (Figure 4.4), 2.9% of the experimental group children aged 6 - 8 years, 8.8% of the control group children aged 9 - 10 years, 4.5% and 12% of the control and experimental groups children aged 11 - 12 years, respectively had a BMI-for-age z-score of greater than +3SD. Children who had a BMI-for-age z-score of less than -2SD included the control group children aged 6 - 8 years (4.7%) and 9 - 10 years (2.9%) as well as the experimental group children aged 6 - 8 years (2.9%), aged 9 - 10 years (4.4%) and aged 11 - 12 years (4.0%).

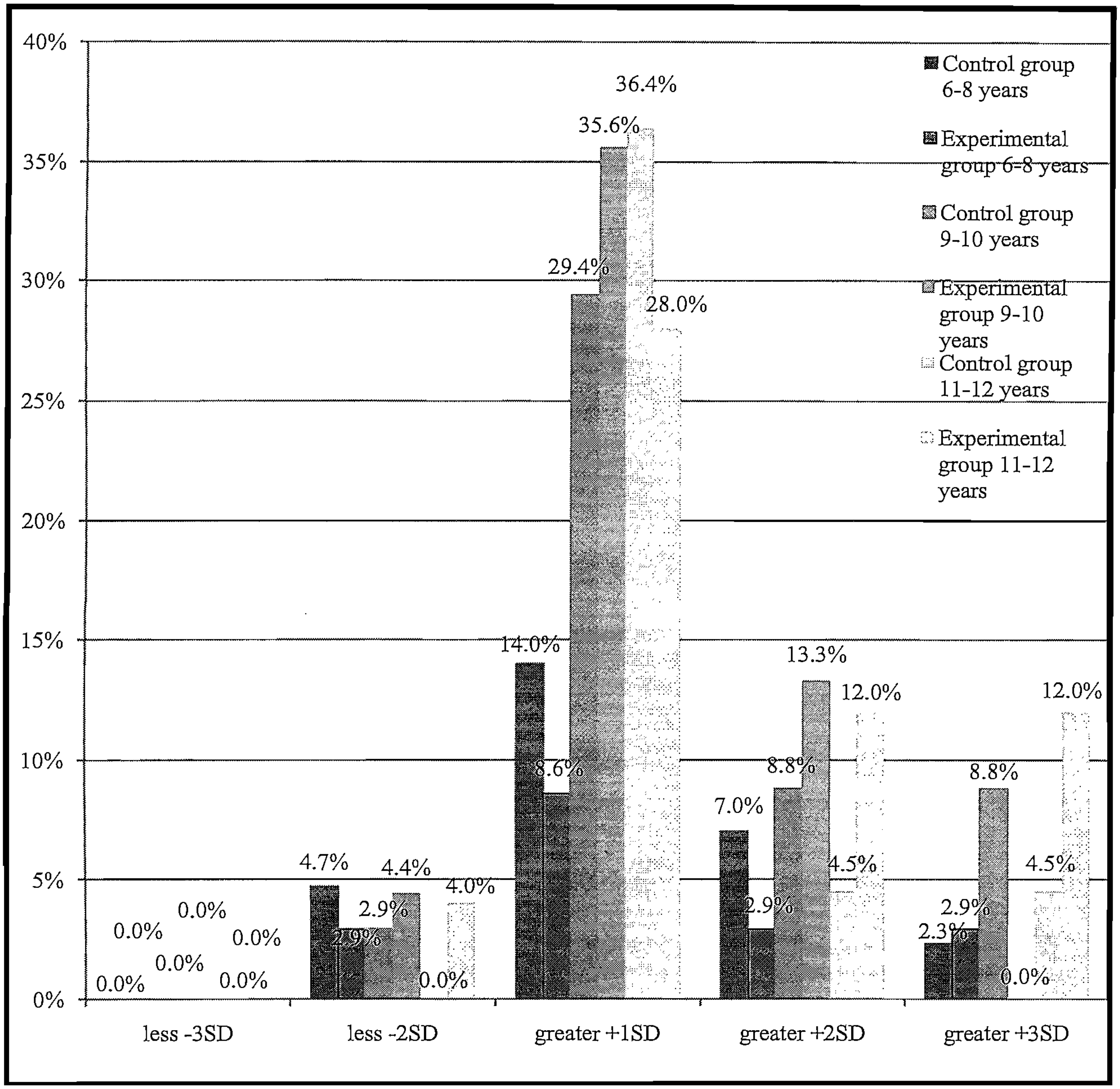


Figure 4.4 BMI-for-age z-scores of children for different age groups within the control and experimental groups at baseline

Height-for-age z-score data are illustrated in Figure 4.5. From this it is apparent that 11.8% and 13.6% of the control group children aged 6 - 8 years and 9 - 10 years respectively had a height-for-age z-score of less than -2SD. In the experimental group children aged 6 - 8 years (5.7%), 9-10 years (2.2%) and 11-12 years (4.0%) also had a height-for-age z-score of less than -2SD.

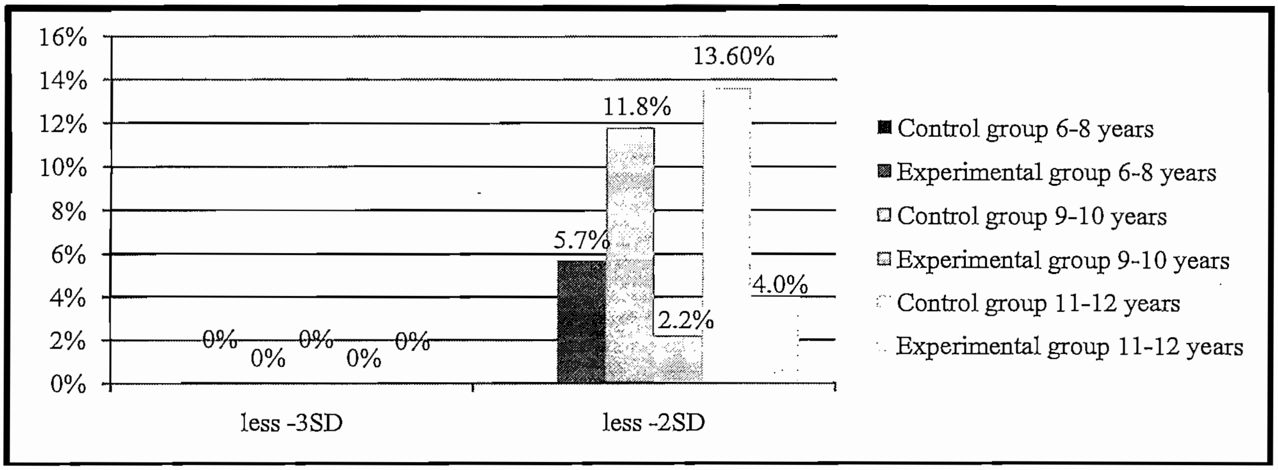


Figure 4.5 Height-for-age z-scores of children for different age groups within the control and experimental groups at baseline

Weight-for-age z-score data show (Figure 4.6) that of the experimental group children aged 9 - 10 years 55.6% fell under -3SD of weight-for-age z-scores and 2.9% aged 6 - 8 years fell under the -2SD. Of the control group children aged 6 - 8 years and 9 - 10 years, 4.7% and 2.9% fell under the -2SD weight-for-age z-score, respectively.

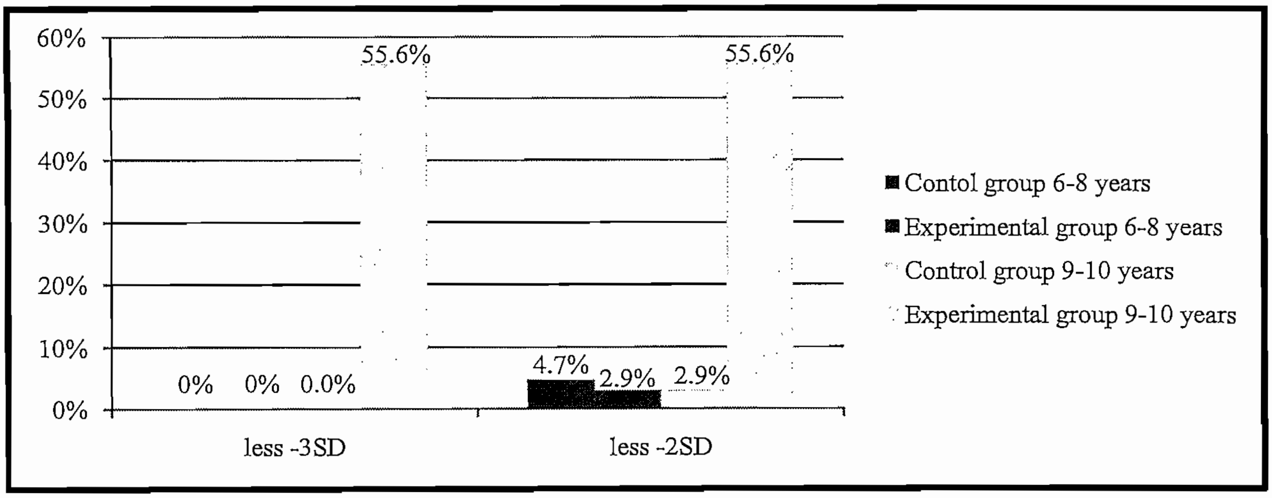


Figure 4.6 Weight-for-age z-scores of children for the different age groups within the control and experimental groups at baseline

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In chapter five the discussion, conclusion and recommendations related to the study findings are presented. The results are discussed with reference to the aim of this dissertation. In this dissertation it was aimed to investigate the effect of a nutrition intervention programme based on the SAFBDG on the transfer of nutritional knowledge towards a healthy lifestyle (healthy eating behaviour and physical activity) in primary school children aged 6 – 12 years.

5.2 Main findings of this study

The main findings of this study were that a nutrition intervention programme practically and statistically significantly increased nutritional knowledge of primary school children aged 6 – 12 years after only 10 hours of exposure over a period of 5 weeks. It did, however, not seem to influence food choices and dietary quality.

5.3 Nutritional knowledge

A review by Steyn *et al.* (2009) shows that key success factors of school-based nutrition education interventions are:

(i) a nutrition-based curriculum offered at schools by trained teachers which generally improves behavioural outcomes

(ii) a physical activity programme which is associated with improved clinical and behavioural outcomes,

(iii) a parental component and

(iv) a food service component.

When comparing the musical play to these success factors it was found that:

(i) it is a nutrition-based education programme for primary school children which is compatible with the curriculum; therefore, it could be implemented within schools and taught by teachers;

(ii) it uses physical activity as a vehicle for the transfer of nutritional knowledge in order to improve lifestyle behaviour of children;

(iii) it had a parental component; and lastly

(iv) it did not have a food service component since this was beyond the scope of the study's outcomes.

Furthermore, the key areas of a successful school-based nutrition education programme set by Pérez-Rodrigo and Aranceta (2001) include the following components:

(i) address the needs and interests of the students, the teachers and the school;

(ii) is relevant to programme goals;

(iii) take into account what children already know and can do;

(iv) is culturally appropriate;

(v) is delivered in a way children can understand; and

(vi) teach the skills and knowledge required to improve or strengthen healthy eating habits.

When the musical play is compared to these standards (Pérez-Rodrigo and Aranceta, 2001), it can be concluded that the musical play:

(i) addressed the needs and interests of the students, the teachers and the school (nutritional information is taught within the subject Life Orientation) and the fact that the musical play can effectively be implemented within schools and complies with school outcomes,

(ii) is relevant to the intended programme goals such as to increase nutritional knowledge of primary school children as well as to improve the lifestyle behaviour of these children in order to prevent childhood obesity,

(iii) was developed in consultation with children to help develop appropriate movements by which the nutrition related concepts can be transferred (Kruger, 2007);

(iv) was well received by white, black and coloured children which makes the musical play a multi-cultural/culturally appropriate nutrition education programme;

(v) was taught in a fun, playful, easily understandable manner; and

(vi) was based on the SAFBDG which are aimed at empowering children/adults with the appropriate knowledge and skills to improve dietary and lifestyle behaviour.

One of the major strengths of the musical play was that both the children and the teachers received the musical play with great enthusiasm. The experimental group children could not wait to start each day's musical activities. Children often reported back proudly to the researcher after some musical play sessions that they had successfully implemented a particular guideline at home. The children within the control group were also very interested in the musical play and indicated that they would like to take part in such a programme in the future. The control group children were told by their friends in the experimental group how much fun the musical play was and wanted to learn the movements and nutritional concepts there friends had learned. Several of the school teachers asked if they could perhaps borrow some of the musical play's information to use within their Life-Orientation classes. These teachers also suggested that it would be wonderful if the musical play could be implemented within the current school curriculum.

Previous intervention studies designed to increase nutritional knowledge of primary school children focused on one or two food groups i.e. fruit, vegetables and/or fats. As far as the researcher know, no other study aimed at improving the nutritional knowledge regarding the South African food-based dietary guidelines of primary school children (Nader *et al.*, 1999; Anderson *et al.*, 2004; Huang & Volpe, 2004).

A large school-based health promoting programme in the United States of America that has positively influenced healthy behaviour is the Know Your Body (KYB) programme (Cherry & Bozza, 2010). The KYB programme stresses the individual's responsibility for health, therefore providing the basis for making health-promoting and disease-preventing decisions. KYB's health curriculum is easily integrated into language arts, mathematics, social studies and science. It has been in schools for more than twenty-five years. The results of several longitudinal evaluations have demonstrated that the KYB programme has a significantly positive effect on children's health related knowledge, behaviour (diet and exercise habits), attitude and biomedical risk factors such as serum cholesterol levels, blood pressure, cardiovascular endurance, smoking and diet (Cherry & Bozza, 2010). Unfortunately, schools have implemented several individualized parts of the KYB programme, customized to teachers' needs and goals, to such an extent that it is unclear which part is responsible for which health promoting result (Alsup, 2010; Cherry & Bozza, 2010).

One such study that adapted the KYB programme was implemented in Greece (Manios & Kafatos, 1999). The study aimed at promoting healthy lifestyle habits of children aged 5.5 - 11.5 years in order to minimise the risk of developing cardiovascular disease (a consequence of childhood overweight and obesity) in adulthood. They reported a health knowledge score improvement ($p < 0.0005$) after the six-year intervention programme among the experimental group children. The programme consisted of 13 - 17 one hour curriculum-based health education sessions (focusing on diet, dental health hygiene, smoking, drinking and accident prevention) per year, 4 - 6 hours of classroom physical activity education sessions (regarding physical activity and fitness) per year as well as two 45 minute physical activity sessions per week. The effect of the programme was measured by means of a multiple-choice knowledge questionnaire, a food frequency questionnaire (FFQ), a three day weighed food record and a physical activity questionnaire-based structured interview.

Investigating the extensive programme that Manios and Kafatos (1999) implemented within the primary schools and considering the time frame of implementation, it was expected that an increase in health knowledge, which included nutritional knowledge, would take place. Our intervention programme was not part of the school curriculum and was implemented over a much shorter time frame than their programme. The researcher speculate that a possible reason for increasing children's nutritional knowledge over such a short period of time within our study might lie within the method (music and dance) used to convey the nutrition education instead of using a classroom setting which can be dull, boring and rigid according to Dickinson *et al.* (1997) and Nzewi (2005).

The largest school-based health education study ever funded in the United States was the Child and Adolescent Trial for Cardiovascular Health (CATCH; Hoelscher *et al.*, 2004). The CATCH study was the first multi-centred field trial incorporating a classroom curriculum, a complementary family component, a behavioural intervention focusing partly on nutrition, a physical education (PE) curriculum, a school foodservice component (Eat Smart), and a programme to promote smoke-free school policies in order to test the effectiveness of a population-based approach for reducing Cardiovascular Disease (CVD) risk (Lytle *et al.*, 1996). The CATCH study introduced a three-year nutrition education and physical activity programme in 56 elementary schools in California, Louisiana, Minnesota and Texas. Third graders trained using the exercise programme "Adventures of Hearty Heart and Friends" for five weeks. This was followed by the "Go for Health" curriculum, which was taught to fourth graders for twelve weeks and fifth graders for eight weeks, and was aimed at reducing fat and sodium consumption. The classroom nutrition education was supported by Eat Smart training for school food service aimed at reducing fat and sodium content of school meals (Prevention Institute, 2002).

The CATCH study had three phases namely a feasibility study of 2 schools in each of 4 sites (CATCH I), a 4-centre field trial that evaluated the effectiveness of a feasible, elementary school-based cardiovascular health promotion programme in 56 intervention schools and 40 control schools during grade 3 through to 5 (CATCH II), and a longitudinal study in which a 3-year follow-up of the CATCH II cohort of students was conducted (CATCH III; Nader *et al.*, 1999). According to the literature, the primary end points of interest of the CATCH III study included daily intakes of dietary fat and SFA, levels of moderate to vigorous physical activity and psychosocial factors of children aged 8 - 11 years. The CATCH III study also used classroom education as well as a physical activity programme. Scores for healthy food choices and knowledge regarding food were significantly higher among the intervention children compared to the control children. Additionally, it was established that knowledge changes as a result of the CATCH study were sustained for 3 years (Nader *et al.*, 1999).

In our study only 7 minutes of formal education was spent on teaching children what healthy fats are and how to decrease fat intake. Even with this short time frame and relative limited information on dietary fat intake, there was a statistical and practical significant increase in knowledge on the questions regarding dietary fat intake within the experimental group. This increase in knowledge within the experimental group is further accentuated by the fact that the nutritional knowledge regarding dietary fat intake among the control group decreased with statistical significance ($p < 0.05$).

A school-based nutrition education intervention on fruit and vegetable intake conducted by Anderson *et al.* (2004) found that classroom education increased knowledge scores regarding fruit and vegetables in children aged 6 - 11 years. The intervention programme was designed to increase the provision of fruit and vegetables in school and provided point-of-purchase material, newsletters and information for children, parents and teachers as well as developed curriculum materials. The dietary intake and the nutritional knowledge, behaviour and attitude were determined by means of a 3-day dietary record, an interview and cognitive and attitudinal measures.

The nutritional knowledge regarding fruit intake within the experimental group children aged 11 – 12 years of our study increased with practical significance ($d > 0.5$) while 6 – 10 year olds knowledge increase, although not with significance. Knowledge on vegetable intake increase amongst 6 – 10 year olds but stayed the same in 11-12 year olds. A possible explanation for this is the influence of the standard school curriculum regarding fruit and vegetables intake taught within Life Orientation during the grade 5 syllabuses.

A novel school-based intervention to improve nutrition knowledge in children aged 9 – 11 years within the UK was conducted by Lakshman *et al.* (2010). Twelve intervention and 13 control schools were used in this study. The intervention comprised a card game "Top Grub" and a package of classroom activities to teach the "healthy eating" curriculum during 9 weeks using these cards. The cards cover popular food choices made by primary school-aged children and each features one food item with its nutritional value. The nutritional value of each food is accompanied by a colour code indicating a bad or a good food choice. The primary outcome of this study was nutrition knowledge whereas the second sought to assess attitude towards healthy eating. A nutrition knowledge questionnaire was used to assess the nutrition knowledge of these children. The questions asked in this questionnaire comprised of knowledge regarding a balanced and healthy diet, the "Balance of Good Health Plate", healthy food choices, and recommended daily amount of fruit and vegetable portions. After the intervention, the total nutrition knowledge score of the intervention group statistically significantly increased by 1.1 (3.1%)(Lakshman *et al.*, 2010).

The above mentioned study is similar to our study in the sense that it also made use of a fun-based nutrition knowledge intervention programme for primary school children. The nutritional knowledge conveyed within our study (SAFBDG) also focused on a healthy diet and healthy food choices. The overall nutritional knowledge of the experimental group children within our study increased with statistical ($p < 0.05$) and practical ($d > 0.5$) significance; with an overall nutritional knowledge score increase of 11.9% over a 5 week period. Even though only 15 minutes per session were spent on formal education on each nutritional message, it was reinforced by the movements and music (30 minute sessions) which probably promoted the fixation of the nutritional message and contributed towards the increase in nutritional knowledge.

The overall nutritional knowledge score of the control group children aged 11 - 12 years within our study also showed a practical significant increase, although to a lesser extent than the experimental children. This increase in knowledge is possibly due to cross-contamination between the control and the experimental group children within each of the four schools. Although the cross-contamination can be seen as a limitation in this type of intervention study, it can also be seen as a benefit for possible implementation of the musical play as an education programme for increasing nutritional knowledge of primary school children. The reason for this statement is that it appears that children within the experimental group taught the musical play to their peers within the control group, indicating that children enjoyed this fun-based nutrition education programme. According to Dickinson *et al.* (1997) and Nzewi (2005), the ideal learning environment is provided when learning is accomplished through music and dance where children are given the chance to learn in a fun way compared to a dull, boring, rigid environment in which children are the passive recipients of information.

Another possible reason for the increase in knowledge among the control group children aged 11 – 12 years, was that the children might have learned related information within the standard school curriculum. According to the Revised National Curriculum textbook for the subject Life Orientation, children are taught nutrition and/or nutrition-related concepts between the ages 10 – 12 years. From these textbooks it is apparent that children aged 10 years learn about the food pyramid, the different food groups, a balanced diet. (Botha *et al.*, 2004), whereas children aged 11 – 12 years learn more detail regarding RDA values, certain illnesses, food labels. (Carstens *et al.*, 2004; Coe *et al.*, 2004). It is, therefore, possible that the standard school curriculum might have influenced the gain in nutritional knowledge of grade 4 learners (aged 10 years). Therefore, the increase in nutritional knowledge of the 11 – 12 year olds within the control group could have been due to information received during their past Life Orientation classes as well as from friends who were part of the intervention study (thus cross-contamination).

5.3.3 Conclusion regarding nutritional knowledge

To conclude this section on nutritional knowledge, the statement can be made that this study successfully increased nutritional knowledge of primary school children aged 6 to 12 years, indicating that the musical play has the potential of being implemented effectively as a nutrition education programme within the current primary school setup. Knowledge was gained regarding fats, fruits, vegetables, dairy foods, grains, sugar, alcohol, water and exercise. It can also be concluded that the musical play can be classified as a good nutrition education programme according to the characteristics of a good nutrition programme as reported by Steyn *et al.* (2009) and Pérez-Rodrigo and Aranceta (2001). Lastly, it is recommended that the time of exposure to the musical play should be increased to more than 6 weeks in order to improve the increase in nutritional knowledge scores even more (Keenan, 2002).

5.4 Dietary behaviour

The food intake and choices of children aged 6 - 12 years were investigated in order to determine to what extent the musical play influenced these children's dietary behaviour. The information was gathered through a demographic questionnaire and two 24-hour dietary recalls. The results obtained on nutrient intake and diet quality should, however, be interpreted with caution since only one 24-hour dietary recall was taken for each subject at baseline and after a five week intervention. Thus, dietary data gained from this might not be a representative indication on what these children usually eat (Champagne *et al.*, 2007). For the interpretation of the 24-hour dietary recall, a mean of the two 24-hour dietary recalls was used. There was no seasonal difference between the two taken 24-hour dietary recalls.

Diet quality and food choices of children are influenced by various factors including physiological needs, body image, food preferences and tastes, appearance of food, time of food preparation, parental practices and influences, peer pressure, rebellion, maintenance of dietary change, personal experiences, media, food prices, social norms, food insecurity and household characteristics such as socio-demographic background, income, race, ethnicity, education of parents, alcohol use/misuse, lack of parental care and family size (Variyam & Blaylock, 1998; Pirouznia, 2001; Variyam 2001; Cooke & Wardle, 2005; McKindley *et al*, 2005; Burns, 2004; European Food Information Council, 2004; Phometsi *et al.*, 2006). In our study it was found that although many parents had tertiary education, only a small amount of their monthly income was spent on food. The mean monthly amount spent on food was indicated as R500 – R2500 per month with 3 – 6 people living from this amount. With the rising food costs, financial means most probably played a major role in this study population's food choices and diet quality.

Since the mother or grandmother was mostly responsible for food purchase and preparation, it is important to educate them also on healthy eating and food choices. It is known that children's food intake and choices are subjective to parental eating habits and family environments (Varuyam, 2001; Scaglioni *et al.*, 2008), thereby highlighting the fact that parents should definitely be involved in nutrition education interventions. In this study it was aimed to involve parents/guardians in the education process of their children by means of regular nutrition education updates (pamphlets regarding the SAFBDG were sent home after every education session) as well as one educational session with the parents/guardians (the musical play was performed to the parents/guardians during a concert held at each of the schools). Although our study had a parental component it could have been improved; therefore, it is recommended for future studies that more regular educational contact sessions with parents/guardians should be established.

5.4.1 Dietary quality and nutrient intakes

Since only one 24-hour dietary recall was taken at baseline and one at end measurements, it is possible that increases in servings per food group as well as mean portion sizes per food group might reflect a real change in food choices, but it might also only represent day to day variations in food group or portion size consumption of these children. The two 24-hour dietary recalls taken for each subject was taken on two different days during a school week, therefore, portraying the usual dietary intakes during a school week for the study population.

Diet quality can be calculated by means of a serving score as described by Kant *et al.* (1991). A maximum serving score of 20 is achieved when the recommended portions for each food group are consumed. In our study the total scores ranged between 10.1 and 12.7, therefore, not reaching near the recommended serving score of 20. From this it is concluded that the diet quality (adapted from Kant *et al.*, 1991) of boys and girls in this study was sub-optimal. When mean portion sizes of food groups were compared to the recommended intakes it was clear that all children consumed more grains than recommended (more than the 120 – 180 g/day), but less dairy (less than the recommended 500 - 750 g/day), fruits (less than the recommended 250 – 375 g/day), vegetables (less than the recommended 375g to 625 g/day), and meat (less than the recommended 60 – 90 g/day) (Gavin, 2008).

5.4.1.1 Macro-nutrient intake

Overall, macro-nutrient intakes were within recommendations for all children (protein 10% – 30%; fat 25% - 35%; carbohydrate 45% - 65%) as well as sugar intake (± 10% of total energy; Shaw & Lawson, 2007; Vliet *et al.*, 2007; Escott-Stump, 2008; Width & Reinhard, 2009). Mean total daily energy intakes of all children were above recommended intakes (Shaw & Lawson, 2007; Vliet *et al.*, 2007; Escott-Stump, 2008; Width & Reinhard, 2009), possibly due to the large quantities of grains consumed by the children. A possible reason for consuming such high quantities of grains could be the low-income of our study population. According to Roux *et al.* (2000), low-income families tend to have a higher consumption of starchy foods. It can, therefore, be recommended that children and their families from a low-income group should be educated on choosing starchy foods that are nutrient-dense, but lower in energy (to prevent obesity) such as fortified maize meal.

5.4.1.2 Micro-nutrient intake

Micro-nutrient intake was low amongst most children and an intake of less than 67% of the RDA/AI values were found for calcium, vitamins C, B_{12}, D and A and folate (Whitney & Rolfes, 2002). The most probable reason for the low micro-nutrient intakes among our study population can be found within their actual food intake. If the micro-nutrient intake is compared to the portion sizes of the different food groups consumed, the following is evident: (i) dairy food intake is low, therefore, it is plausible that calcium intake should be low, (ii) fruit and vegetable intake is low contributing to the low intake of vitamins C and A, (iii) a low consumption of meats containing vitamin B_{12}, and (iv) lastly, a low intake of folate was found within our study population, which can be contributed to low vegetable intake.

According to the National Dairy Council, adequate dairy food intake (rich in calcium) may contribute to a healthy body weight (Anon, 2005d). This statement is supported by others (Melanson *et al.*, 2002; Skinner *et al.*, 2003) who reported that higher calcium intake (including calcium intake from dairy sources) is associated with higher rates of whole-body fat oxidation. Results from the National Health and Nutrition Examination Survey (NHANES, Burke & Deakin, 2010), the Quebec Family study and the Heritage study (Burke & Deakin, 2010) all support the inverse relationship between dietary calcium/dairy intake and BMI, body fat and incidence of obesity (Major *et al.*, 2008). A study done by Kruger *et al.* (2007) assessing the association between dietary calcium intake and body composition in black and white African women of the North West Province, showed that white women ingested significantly more dietary calcium and fat (1053.8mg and 103.1g per day) respectively compared to black women (523mg and 69.2g per day). After adjustment for age and total energy intake a negative correlation was found between the calcium:fat ratio of white women and BMI ($r=-0.328$, $p < 0.012$) as well as body fat percentage ($r=-0.336$, $p = 0.01$). It is, therefore, strongly recommended that the mothers of tomorrow (children) should be encouraged to regularly include calcium-rich foods and beverages regularly in their diets.

The exact mechanism underpinning weight-loss is uncertain, but a few probable biological mechanisms have been proposed. Possible mechanisms explaining the role of calcium and dairy products in weight management include the role of intracellular calcium in the regulation of adipocyte lipid metabolism and triglyceride storage (Zemel, 2003). A theoretical basis for the additional anti-obesity effects of dairy intake is also available through the regulation of intracellular calcium by calcitrophic hormones such as the parathyroid hormone and 1.25-dihydroxyvitamin D (Shi *et al.*, 2002). High dietary calcium intake has also been observed to enhance fecal fat excretion (Shi *et al.*, 2002). A positive influence of dietary calcium/dairy intake on the reduction of appetite may also contribute to weight management (Major *et al.*, 2008)

Apart from the possible beneficial role that dietary calcium plays in body fat loss, it is also an important mineral for bone health. Calcium intake in childhood helps to achieve genetically determined peak bone mass, decrease the risk of bone fractures during growth, and protect against osteoporosis and related fractures in later adult years (Burke & Deakin, 2010). Therefore, dairy products are not only important for children's growth and development, but also for their beneficial roles in a variety of chronic diseases such as obesity through their possible role in weight management. In our study the mean dairy portion ingested by all the children was less than one dairy portion/day. It is recommended that a child should ingest between two and three portions a day to meet their dietary calcium requirements. Our results are similar to those found by the Birth-to-Ten (BT10) and National Food Consumption Survey NFCS (Labadarios *et al.*, 2005) in which it was shown that dietary calcium intake of children in South African is less than 50% of the DRI.

In girls aged 9 - 10 years within the experimental group, fruit intake increased with statistical significance ($p < 0.05$) after exposure to the musical play. This finding complied with results reported by Anderson *et al.* (2004), who found a significant increase ($p < 0.05$) in their experimental group's fruit intake.

The BT10 study, followed by the Birth-to-Twenty (BT20) study, is the largest and longest running longitudinal cohort study in Africa. The BT10 study (MacKeown *et al.*, 2003) broadly surveyed children's health and development from birth to the age of ten years. These children are now further being followed-up until the age of twenty years with the aim to continue to collect a wide range of data related to young people's health and development, and is targeted towards answering specific questions related to risk associated with life-style, including sexual and reproductive disorders, cardiovascular disease and diabetes (Richter, 2004). The BT10 study enrolled 3275 children born to women who were residents in the Greater Johannesburg Metropolitan area for at least the first 6 months of the child's life.

MacKeown *et al.* (2003) reported on the energy, macro- and micro-nutrient intake of 163 black South African children from the BT10 study. It was found that the macro and micro-nutrients which children aged 5 - 10 years in general take in less than 67% of the DRI/RDA/AI recommended values, include protein, vitamin A, vitamin B12, calcium and iron. In the follow-up study (BT20) MacKeown *et al.* (2007) reported that these children (now aged 10 - 13 years) still consumed less than 67% of the RDA/AI values for vitamin A, calcium and iron.

Labadarios *et al.* (2005) reported the macro- and micronutrient intakes of children aged 1 – 9 years within the NFCS of South Africa. The aim of the NFCS was to determine the nutrient intakes and anthropometrical status of South African children aged 1 – 9 years as well as factors that influence their dietary intake (Labadarios *et al.*, 2005). According to Labadarios *et al.* (2005), energy intake of children aged 1 - 9 years was below two-thirds of the DRI values. It was also reported that protein intake was lower than 15% of the total daily energy consumed, although it was not stated that the intake was less than the DRI value. Calcium, iron, zinc, vitamins A, C, and D, riboflavin, niacin, vitamin B6 and folate intake were reported as less than the RDA/AI values of all the children (Labadarios *et al.*, 2005). Therefore, it can be concluded that our study's results are similar to the results of the NFCS of South Africa regarding calcium, vitamins A, C and D, vitamin B, iron and folate intake when compared to the RDA/AI values for children.

According to the literature all of the above mentioned micro-nutrients are of great importance to children (Zelman, 2009). Vitamin A is essential for the health and wellbeing of children and is especially important for good vision, protection against infections and adequate growth and development in children (Anon, 2001). Vitamin A deficiency is the main cause of preventable blindness in children and it also increases the risk for death and illness amongst children through decreasing children's resistance to infections and the recovery from infections (Anon, 2001). Vitamin B_{12} is important for normal metabolism of all cells, especially those of the gastro-intestinal tract, bone marrow and nervous tissue (Mahan & Escott-Stump, 2008). According to Mahan and Escott-Stump (2008), vitamin B12 deficiency causes impaired cell division, particularly in the rapid dividing cells of the bone marrow and intestinal mucosa, through the arrested synthesis of DNA. The anaemia of vitamin B12 deficiency can also cause progressive neuropathy (Mahan & Escott-Stump, 2008). Iron is an essential mineral that carries oxygen in the blood and helps keep children energized (Zelman, 2009). According to Whitney and Rolfes (2008), iron is also used to make neurotransmitters which regulate the ability to pay attention, which is crucial to a child's learning. Therefore, iron deficiency has widespread effects on children's behaviour and intellectual performance.

5.4.1.3 Conclusion regarding dietary behaviour

Results indicate that children aged 6 to 12 years consumed more grains and less dairy, vegetables, fruit and meat than the recommended intakes. No measurable changes occurred in food group consumption after the intervention except for fruit intake which increased in girls aged 8 - 10 years in the experimental group ($p < 0.05$). Boys and girls aged 6 - 12 years have inadequate intakes (< 67% of the Recommended Dietary Allowances (RDA)) of calcium, vitamins A, C, D, and B_{12}, iron and folate.

Even though nutritional knowledge increased, the diet quality of the children remained low, indicating that other factors apart from gains in nutritional knowledge influenced their food choices.

5.5 Physical activity and anthropometry

The minimum time recommended for a physical activity intervention programme to facilitate changes in anthropometric measurements is 6 months (Harris *et al.*, 2009). Since the main aim of our study was not to change anthropometric measurements and the intervention was only five weeks long, only the anthropometric data taken at baseline were discussed as cross-sectional data.

Underweight is defined in children as a weight-for-age less than 2 standard deviations (SD) below the median of the WHO (WHO, 2009). Stunting is defined as a height-for-age less than 2 SD below the median of the WHO standards, overweight as at or above 2 SD of the median of the WHO standards for weight-for-age as well as BMI-for-age, and childhood obesity as at or above 3 standard deviations of the median of the WHO standards for weight-for-age as well as BMI-for-age (WHO, 2009).

Popkin and co-workers (1996) described a relationship between stunting and overweight and/or obesity in children undergoing urbanisation and the nutrition transition in developing countries. According to Popkin *et al.* (1996), the underlying mechanisms for this phenomenon remain unexplored. Several hypotheses have been made regarding the association between stunted and overweight and/or obese children. These hypotheses entail that nutritional insults during pregnancy or infancy may have long-term effects on a broad range of metabolic and other physiological relationships (Barker, 1992). Factors caused by the nutrition transition which could lead to the development of overweight and/or obesity include the rapid shift of diet and physical activity patterns together with shifts in body composition (Popkin *et al.*, 1996).

In South Africa (currently undergoing a rapid nutrition transition), stunting remains one of the most common nutritional disorders. Within the North-West province, 21.6% of children aged 1 – 9 years are affected by stunting, whereas 17.1% of children aged 1 – 9 years are classified as overweight (Kruger, 2005). A study conducted by Kruger *et al.* (2005) investigated the determinants of overweight and obesity among 10 – 15 year old school children in the North West Province, South Africa. The researchers also evaluated weight status of these children by means of anthropometry and found that 6.3% of the total group of children were overweight and 1.6% were obese. It was also found that 11.6% white, 5.7% black and 2.9% coloured children were overweight and 2.6% white and 1.4% black children were obese. The prevalence of overweight was also higher in girls than in boys (Kruger *et al.*, 2005). Another study conducted by Kruger *et al.* (2004) reported on overweight and obese prevalence of girls aged 10 – 15 years within the North West Province, South Africa. It was found that 19% of the girls were stunted whereas 10.5% of the girls were overweight or obese (Kruger *et al.*, 2004).

Comparing the anthropometric results of this study with the above mentioned, a higher prevalence of overweight (boys: 7.5%; girls: 9.0%) and obesity (boys: 4.3%; girls: 4.5%) was found than reported by Kruger *et al.* (2005). The prevalence of obesity in this study seemed to be the highest amongst white boys. Stunting was more prevalent amongst the black boys and girls in our study population (black boys = 5.7% and black girls = 2.2%). Furthermore, children from the lower grades (grade 1 - 3) were more prone to stunting while children from the higher grades (grade 4 - 6) were more prone to be obese.

Physical inactivity as well as sedentary lifestyle are well known risk factors for childhood obesity (Swinburn *et al.*, 2004; Kruger *et al.*, 2005; Davison *et al.*, 2006) and can also be linked to obesity in adulthood (Kruger *et al.*, 2005), therefore, children should be encouraged to increase their physical activity and decrease their sedentary behaviour. According to the literature children should be active for 60 minutes or more each day of the week (Adams & Bagby, 2005; Anon, 2008a; Anon, 2008b). Sedentary behaviour including television viewing and playing television and/or computer games, on the other hand, should be limited to two hours per day (Adams & Bagby, 2005; Anon, 2005). In our study we only documented participation in organized sport or planned exercise and found that most children exercised between 30 and 60 minutes, 1 to 3 times per week. This could be seen as an increased risk factor for the development of childhood obesity, but must be interpreted with caution since we did not record time spent being physically active during the day e.g. walking to school, playing outside etc. Furthermore, approximately 15 % of children in our study were engaged in sedentary behaviour for more than one hour every day, which might also contribute towards the development of obesity (Adams & Bagby, 2005; Anon, 2005).

5.6 Overall conclusion

In this dissertation it was aimed to investigate the effect of a novel nutrition intervention programme (musical play) based on the SAFBDG on the transfer of nutritional knowledge towards a healthy lifestyle (healthy eating behaviour and physical activity) in primary school children aged 6 – 12 years.

Results indicate that the musical play was able to increase primary school children's overall nutritional knowledge; more specifically for fats, fruits, vegetables, dairy, grains, sugar, alcohol, water and exercise. The musical play was well received by teachers and scholars; indicating that the musical play has the potential of being implemented effectively as a nutrition education programme within the current primary school setup. A further increase in nutritional knowledge (significant increases in more of the nutritional knowledge questions) might be seen when the time of exposure to the musical play is increased to more than 5 weeks.

Even though nutritional knowledge increased, the diet quality of the children remained low, indicating that other factors apart from gains in nutritional knowledge influenced their food choices. Poverty and a lack of the appropriate nutritional knowledge of parents might have played a major role in this.

Overweight, obesity as well as underweight were present amongst the children of this study group. Also, stunting was found amongst lower-grade children, especially black children. It seems that the phenomena of catch-up growth combined with increased energy intake might have played a role in the higher prevalence of overweight and obesity in the higher grades. Also, high levels of sedentary behaviour might have contributed to this in our study group.

In summary, the effect of a novel nutrition intervention programme (musical play) based on the SAFBDG and on the transfer of nutritional knowledge towards a healthy lifestyle (healthy eating behaviour and physical activity) in primary school children aged 6 – 12 years was successfully investigated. It was found that the musical play successfully increased the nutritional knowledge regarding the SAFBDG of primary school children aged 6 – 12 years.

5.7 Recommendations

It is advised that the time frame of this type of intervention study should be increased and a larger parental component should be included in order to investigate the effect of increased nutritional knowledge on nutrition behaviour as well as anthropometrical measurements. Control and experimental groups should be in different schools in order to prevent cross-contamination and adding a foodservice component by involving the school kiosk or nearby school vendors should improve the quality of the data and increase the success of the musical play intervention programme.

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ADDENDUMS

ADDENDUM I (on CD)

Written manual for the Musical Play

ADDENDUM II (on CD)

Education material strengthening the Musical Play

(Programme book and Pamphlets)

ADDENDUM III

Anthropometric measurements

ANTHROPOMETRIC MEASUREMENT FORM

Subject number: ☐

Name of measurement	**Measurement 1**	**Measurement 2**	**Measurement 3**
BASELINE MEASUREMENTS			
Length (cm)			
Weight (kg)			
Mid-circumference (mm)	m = n =	m = n =	m = n =
END MEASUREMENTS			
Length (cm)			
Weight (kg)			
Mid-circumference (mm)	m = n =	m = n =	m = n =

ADDENDUM IV

Demographic questionnaire

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOMKAMPUS

DEMOGRAPHIC QUESTIONNAIRE

(All information in this questionnaire is kept confidential)

Subject number: ____________ **Birth date** (DD/MM/YY):______________

Interview date (DD/MM/YY):____ / ____ / ______

School: ____________________ **Grade:** ____________

NB: THE FOLLOWING QUESTIONS MUST BE COMPLETED BY THE CHILD'S PARENT/CAREGIVER

Child's Name: ______________________________ **Gender: M** _____ **F** ______

Address ___________________________________ **Religion:** _________________

____ **Home language:** __________

Tel No (H) ________________________________ **Ethnic group:** ____________

Tel No (W) ________________________________ **Cell No:** _________________

***If there is any uncertainty about a question, circle the question number and we will contact you to help complete it.**

Please mark where applicable:

1. **The caregiver is less than 18 years old.** ___
2. **The child does not eat and sleep at this house for 4 or more days a week.** ___
3. **The caregiver has been looking after the child for more than 3 months.** ____

Please complete the following questions in as much detail as possible:

1. **Relationship to child: (Please mark with a cross)**

Mother: ____ **Father:** _____ **Grandparent**_____ **Sibling** ______

Aunt/uncle: ________ **other:** ___________

2. Household composition:

Names of household members	Age (yrs)	Gender		Family relationship to the child	
		Male	Female	Relationship	Code*

* For office use only.

3. Marital status of mother (Tick one):

1	2	3	4	5	6	7
Unmarried	Married	Divorced	Widowed	Living together	Traditional marriage	Other. Please specify:

4.Marital status of father (Tick one):

1	2	3	4	5	6	7
Unmarried	Married	Divorced	Widowed	Living together	Traditional marriage	Other. Please specify:

Tick one block for every question	Father	Mother	Sibling	Grandma	Grandpa	Aunt	Uncle	Cousin	Friend	Other
5. Who is mainly responsible for food preparation in the house?	1	2	3	4	5	6	7	8	9	10
6. Who decides on what types of food are bought for the household?	1	2	3	4	5	6	7	8	9	10

7. Who is mainly responsible for feeding / serving the child?	1	2	3	4	5	6	7	8	9	10
8. Who is the head of the household?	1	2	3	4	5	6	7	8	9	10
9. Who decides how much is spent on food?	1	2	3	4	5	6	7	8	9	10

Tick one block for the following question.

	1	2	3	4
10. How often do you dine out or buy take-away food?	Daily	Weekly	Monthly	Seldom

Consider now the household where the child lives.

	1	2	3	4	5
11. Type of dwelling (You can tick more than one block if necessary)	Brick, concrete	Traditional mud	Tin	Plank, Wood	Other, (Specify)
12. Number of people sleeping in the house for at least 4 nights per week?					
13. Number of rooms in the house (Excluding bathroom, toilet and kitchen, if separate)					

	1	2	3
14. Number of people per living / sleeping room? (Tick one)	1-2 Persons	3-4 persons	More than 4

	1	2	3	4	5
15. Where do you get drinking water most of the time? (Tick one)	Own tap	Communal tap	River, dam	Borehole, well	Other (Specify)

	1	2	3	4
16. What type of toilet does the household have? (Tick one)	Flush	Pit	Bucket, Pot	Other (Specify)

	1	2	3	4	5
17. What fuel is used for cooking most of the time? (You can tick more than one)	Electric	Gas	Paraffin	Wood/ Coal	Other (Specify)

Tick one box only:

18. Does the child's home have a working:				
a. Refrigerator/Freezer	1	2	3	4
	Refrigerator	Freezer	Both	None
b. Stove	1	2	If yes, specify:	If yes, specify:
	1 Yes	2 No	☐ Gas ☐ Coal ☐ Electricity	☐ With oven ☐ Without oven
c. Primus or paraffin stove	1		2	
	Yes		No	
	1		2	
d. Microwave	Yes		No	
e. Hot plate	1		2	
	Yes		No	
f. Radio or television	1	2	3	4
	Radio	TV	Both	None

Please indicate the most appropriate answer with a cross

19. Education level of parent/caregiver (Tick one)	1	2	3	4	5	6
	None	Primary School	Std 6-8	Std 9-10	Tertiary Education	Don't know
20. Parent/caregiver's employment status (Tick one)	1	2	3	4	5	6
	At home by choice	Un-employed	Self-employed	Wage earner	Other Specify	Don't know
	1	2	3	4	5	
21. How many people contribute to the total income? (Tick one)	1 person	2 persons	3-4 persons	5-6 persons	More than 6	
22. Household income per month (including salary, wages, rent, state grants) (Tick one)	1	2	3	4	5	6
	None	R100-R500	R500-R1000	R1000-R3000	R3000-R5000	Over R5000

23. Is this the usual income of the household? (Tick one)	1 **Yes**	2 **No**
24. Is this more or less the income that you had over the past six months?	1 **Yes**	2 **No**

Answer question 25a or b according to your situation:

25. a) How much money is spent on food weekly?	1 **R0-R100**	2 **R100-R250**	3 **R250-R350**	4 **R350-R450**	5 **R450-R500**
b) How much money is spent on food monthly?	1 **R500**	2 **R500-R1000**	3 **R1500-R2500**	4 **R2500-R3000**	5 **More than R3000**

The following questions should be completed by the child with assistance from the parent / caregiver: (Please mark with a cross)

26.) a. Do you regard yourself as physically active?

Yes ☐ **No** ☐ **Don't know** ☐

b. Do you participate in any kind of sport?

Yes ☐ **No** ☐

c. If you have answer yes in question 26b, please indicate in what type of sport/s you participate?

1. Rugby		2. Netball	
3. Soccer		4. Athletics	
5. Cricket		6. Gymnastics	
7. Hockey		8. Other (Please, specify)	
9. Tennis			

d. Please indicate how often do you exercise or participate in the abovementioned sport/s per week?

1. Once a week.		2. 2 – 3 times a week.	
3. More than 3 times a week.			

e. How long do you exercise / participate in the chosen sport/s at one time?

1	2	3	4
‹ 30 minutes	30 minutes	30 - 60 minutes	› 60 minutes

f. Will you prefer to watch television or to play outside? (Tick one)

Watch television	
Play outside	

g. How long do you watch television and / or play, play station each day?

1	2	3	4
30 minutes	1-2 hours	More than 2 hours	Only during weekends

h. How long do you play computer games and / or use the internet per day?

1	2	3	4
30 minutes	1-2 hours	More than 2 hours	Only duringweekends

ADDENDUM V

Nutrition knowledge and behaviour questionnaire

NUTRITION KNOWLEDGE AND BEHAVIOUR QUESTIONNAIRE

Interview date: (DD/MM/YY) ___ / ___ / _____

NB: THE FOLLOWING QUESTIONS MUST BE COMPLETED BY THE CHILD

Please choose the most correct answer for each question

1. Which statement is true about starches (e.g. Bread, porridge, rice, potato)?

A	They are not important for your health
B	Even eating small amounts can cause weight gain
C	They cause diseases
D	None of the above

2. Which food has the most fibre (roughage)?

A	White bread
B	Whole-wheat bread

3. How many fruit and vegetables should you eat a day?

A	1 fruit and / or vegetable a day
B	3 - 4 fruits and /or vegetables a day
C	5 or more fruits and / or vegetables a day
D	There is no need to eat fruits and / or vegetables daily

4. Being physically active (to exercise) means…

A	Going to the gym
B	Walking a lot
C	Playing sports like soccer or netball
D	All of the above

5. Do you agree or disagree with the following statement: Exercise is good for your health.

A	Agree
B	Disagree
C	Don't know

6. Which foods contain a lot of calcium?

A	Chicken and eggs
B	Milk and yoghurt
C	Canned fish with the bone, e.g. pilchards
D	B and C are both correct

7. The reason why dry beans, peas, lentils and soy are good for you is that they:

A	contain only small amounts of fat
B	contain a lot of fibre
C	can protect you from some diseases
D	All of the above

8. Which of the following is a low fat snack?

A	"Simba" chips
B	Popcorn
C	Fried chips
D	"Niknaks"

9. Which of the following foods contain little fat?

A	Whole-wheat toast with thinly spread margarine
B	Weet-Bix with 2% low-fat milk
C	Fried bacon and egg
D	A and B are both correct

10. How old must you be before you can drink alcohol?

A	6 – 12 years
B	12 – 17 years
C	18 years and older

11. What can too much alcohol do to a person?

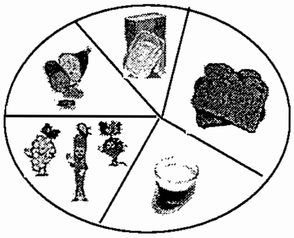
A	Makes you become aggressive
B	Harm your liver and brain
C	Makes you become happy and joyful
D	A and B are both correct

12. The key to a healthy way of eating is to:

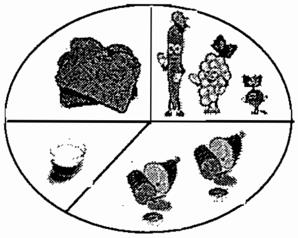
A	Eat many different kinds of foods
B	Do not eat too much of any of these foods
C	Eat only certain kinds of foods
D	A and B are both correct

13. Choose the most correct picture that presents the composition of a well-balanced diet.

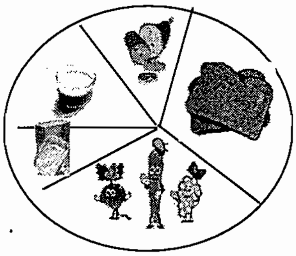
A



B



C



D None of the above

14. How many times a day should you eat?

A	1 - 2 times a day
B	3 - 5 times a day

15. How much water should you drink a day?

A	You don't have to drink water every day
B	1 to 3 glasses
C	4 to 8 glasses
D	More than 8 glasses

16. From where do you mostly get your information about nutrition? (Choose only one)

A	School
B	Peers / Friends
C	Mother and father
D	Radio / TV / Magazines
E	Other (specify)

Please choose true (correct) or false (incorrect) for the following questions:

17. Starchy foods (bread, potatoes, rice) are energy giving foods.

A	True
B	False

18. Cooked vegetables are healthier than raw vegetables.

A	True
B	False

19. Vegetables can be eaten in the place of meat because it also builds the body.

A	True
B	False

20. Vegetables are foods that protect your body against diseases.

A	True
B	False

21. People who are overweight (fat) should not exercise.

A	True
B	False

22. If you are eating a healthy diet there is no need for you to exercise.

A	True
B	False

23. It is necessary to drink fresh milk or maas every day.

A	True
B	False

24. You can eat as much meat as you want every day.

A	True
B	False

25. Dry beans, peas, lentils and soy should be eaten often.

A	True
B	False

26. Dry beans, peas, lentils and soy can be eaten instead of meat.

A	True
B	False

27. You should add extra salt to your cooked food before you eat it.

A	True
B	False

28. You should eat little sugar and / or foods containing sugar (e.g. sweets and candy).

A	True
B	False

29. It is not healthy to eat lots of fat or fatty foods.

A	True
B	False

30. I should eat different kinds of foods every day, but not too much of any of them.

A	True
B	False

31. All water is safe to drink.

A	True
B	False

ADDENDUM VI

24-Hour dietary recall questionnaire

Subject's nr:

24-HOUR RECALL QUESTIONNAIRE

Interviewer: ______________________ Date: ____/____/200__

School: ______________________

Tick what the day was yesterday:

Sun	Mon	Tue	Wed	Thur	Fri

Would you describe the food that you ate yesterday as typical of your habitual food intake?

Yes	No

Do you take a lunch box to school daily?

Yes	No

I want to find out about everything you ate or drank yesterday, including water. Please tell me everything you ate from the time you woke up to the time you went to sleep. I will also ask you where you ate the food and how much you ate.

Office use only

Time (approximately)	**Place** (home, school, etc.)	**Description of food and preparation method**	**Amount**	**Amount (g)**
From waking up to going to school, or starting the day's activities				
During the morning at school (Lunch box / Tax shop) or at home				
Lunch box				

Time (approximately)	Place (home, school, etc.)	Description of food and preparation method	Amount	Amount (*g*)
Tuck shop				
Middle of the day (lunch time)				
During the afternoon				

Time (approximately)	Place (home, school, etc.)	Description of food and preparation method	Amount	Amount (g)
At night (dinner time)				
After dinner, before going to sleep				

Do you take any vitamins or minerals (tablets or syrup)?	Yes	No
Give the brand name and dose of the vitamins or minerals:	**Name**	**Dose**