

**NUTRITIONAL STATUS OF TODDLERS ATTENDING DAY CARE
CENTRES IN NEWTON PARK, NELSON MANDELA BAY**

by

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DECLARATION

I, Carli Rauch, identity number 8703090079089, and student number 2005075532, declare that the dissertation hereby submitted by me for the Magister degree at the University of the Free State is my own independent work and has not previously been submitted by me to another university/faculty. I further cede copyright of this research report in favour of the University of the Free State.



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DEDICATION

I dedicate the work of this study to my loving mother.

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LIST OF ABBREVIATIONS

AA	Amino acids
AAP	American Academy of Paediatrics
AI	Adequate Intake
ALA	Alpha Linolenic Acid
ALSPAC	Avon Longitudinal Study for Parents and Children
AMDR	Acceptable Macronutrient Distribution Rate
AND	Academy of Nutrition and Dietetics
BMD	Bone mineral density
BMI	Body Mass Index
BP	Blood pressure
CCHIP	Community and Childhood Hunger Identification Project
CHO	Carbohydrates
CHD	Coronary heart disease
CNS	Central nervous system
CVD	Cardiovascular Disease
DBD	Double Burden of Disease
DBM	Double burden of malnutrition
DNA	Deoxyribonucleic acid
DRI	Dietary reference intake
DXA	Dual-energy X-ray absorptiometry
EAA	Essential amino acids
EAR	Estimated average requirements
EER	Estimated energy requirements
EFA	Essential fatty acids
ECLS-BC	Early Childhood Longitudinal Study (Birth Cohort)

EFSA	European Food Safety Authority
EPA	Eicosopentaenoic acid
FITS	Feeding Infants and toddlers studies
FAO	Food and Agriculture Organization
FBDG	Food-based dietary guidelines
FFQ	Food frequency questionnaire
FSV	Fat soluble vitamins
GIT	Gastrointestinal tract
HC	Head circumference
HDL	High density lipoprotein
HIV	Human immunodeficiency virus
HFSQ	Household food security questionnaire
ITF	Infant and Toddler forum
ISSFAL	International Society for the Study of Fatty Acids and Lipids
kJ	Kilojoule
LBM	Lean body mass
LDL	Low density lipoprotein
MGRS	Multi-centre Growth Reference Study
MRC	Medical Research Council
MS	Metabolic syndrome
MUAC	Mid-upper arm circumference
MUFA	Mono-unsaturated fatty acids
n	Omega
NCD	Non-communicable disease
NDNS	National Diet and Nutrition Survey
NFCS	National Food Consumption Survey
NFCS-FB1	National Food Consumption Survey Fortification baseline-1

NHANES	National Health and Nutrition Examination Survey
OTC	Over the counter
oz	Ounce
PE	Port Elizabeth
PDCAAS	Protein digestibility-corrected score
PUFA	Poly-unsaturated fatty acids
RAE	Retinol activity equivalent
RDA	Recommended dietary allowance
SA	South Africa
SAFBDG	South African Food Based Dietary Guidelines
SAM	Severe acute malnutrition
SA-NFCS	South African National Food Consumption Survey
SANHANES	South African National Health and Nutrition Examination Survey
SCFA	Short chain fatty acids
SFA	Saturated fatty acids
SSB	Sugar-sweetened beverages
TB	Tuberculosis
TBS	Tablespoon
TC	Total cholesterol
TE	Total energy
T2DM	Type 2 Diabetes Mellitus
TGL	Triglycerides
THUSABANA	The Transition and Health during Urbanization of South Africans; BANA, children
TFA	Trans fatty acids
TSF	Triceps skinfold
TV	Television

UK	United Kingdom
UL	Upper level / Upper limit
U-AMDR	Upper macronutrient distribution range
UNICEF	United Nations International Children's Emergency Fund
USA	United States of America
USDA	United States Department of Agriculture
UFA	Unsaturated fatty acids
WAZ	Weight-for-age z-score
WIC	Women, infant and child
WHO	World Health Organisation

CHAPTER 1: ORIENTATION AND MOTIVATION

1.1 Introduction

The transition from infancy (birth to one year of age) to the first phase of childhood (one to three years of age) is a crucial life stage with regard to nutrition, as the child undergoes significant social, cognitive and emotional growth (Lucas *et al.*, 2012:389), during which food preferences and feeding behaviours are established and which, in turn, affects future eating habits, as well as general long-term health (Cowbrough, 2010: Online; ITF, 2010b:3). Children between the ages of one and three years are referred to as toddlers (The Free Dictionary by Farlex, 2015: Online). During the toddler phase a diet rich in energy and nutrients from a variety of food sources should be provided in order to ensure optimum nutritional status, growth and development (ITF, 2010a:11).

However, research reveals that millions of toddlers across the globe, in both developed and developing countries like South Africa (SA), suffer from malnutrition, which includes both undernutrition, as reflected by underweight, wasting and stunted linear growth, as well as overnutrition, as reflected by overweight / obesity (Fryar *et al.*, 2014: Online; Black *et al.*, 2013:427; Vorster, 2010:2; May & Diets, 2010:11-14; Zere & McIntyre, 2003:7). Malnutrition in toddlers are related to diets of poor nutritional quality and limited variety, often characterised by high intakes of saturated fatty acids, refined carbohydrates and sugar-sweetened beverages, and/or inadequate fruit and vegetable consumption (Fryar *et al.*, 2014: Online; ITF, 2010b:4; Steyn *et al.*, 2006:644).

1.2 The development of eating behaviour during the phases of young child development

Infancy (birth to 12 months) is characterised by rapid physiological development, during which birth weight should double by six months of age, and triple by 12 months of age (Trahms & McKean, 2012:375). Adiposity levels (total percentage of body fat) peak at the age of six months and gradually declines towards the age four to six years (Lucas *et al.*, 2012:389).

Initially, exclusive feeding with breast milk or breast milk substitutes is sufficient to meet the infant's nutritional and physiological needs; breastfeeding being considered the optimal feeding method (Birch *et al.*, 2007:2; Weaver *et al.*, 2008:40). By the age of six months, however, increased nutritional requirements can only be met via the addition of complimentary solid foods. Therefore, introduction of solids initiate the weaning process – the gradual transition from breast milk / breast milk substitutes to a nutritionally balanced and varied diet (Trahms & McKean, 2012:376). Food variety (in term of food groups as well as texture) should be increased gradually over the following six months of weaning, until the age of one year, when the infant should be able to tolerate the normal family diet in smaller, age-appropriate amounts (Weaver *et al.*, 2008:40).

Additionally, the weaning period marks the time during which the infant starts to develop taste preferences and behaviours surrounding food, that will be carried over to later childhood and beyond. Therefore, infants need to be exposed to a variety of food with different flavours and textures. Infants are naturally more accepting of foods with a sweet taste (Birch *et al.*, 2007:2), making the introduction of sweeter foods like fruit relatively easy, compared to foods such as vegetables. Repeated exposure to the latter is essential, however, and recent studies found that offering a combination of vegetables, as opposed to a “one at a time” approach, increased acceptability (ITF, 2010a:8).

Regarding texture, lumpier foods involves more complex chewing techniques that develop during the weaning period, given that the infant is exposed to such textures from the start. If not, they will be likely to refuse these foods later on. Studies showed that delayed introduction of solids (after the age of six months) is associated with feeding difficulties by the age of 15 months, and lower fruit and vegetable intake in later childhood (ITF, 2010b:4; ITF, 2010a:9; Coulthard *et al.*, 2009:75; ITF 2008:5)

The next stage, referred to as the “toddler” stage, when the child progresses from milk feeds to a solid diet, occurs during the second and third years of life. At this stage the child should demonstrate self-feeding abilities and enjoy a variety of family foods, while still being encouraged to try new foods (ITF, 2010a:9-10; Weaver *et al.*, 2008:40). During this phase, food preferences that were developed during infancy, are

established to form the basis for diet and health in later life (ITF, 2010b:3; Cowbrough, 2010: Online).

Toddlers characteristically demonstrate extreme curiosity about their environment, exploring their surroundings (including food) by means of all their senses (smell, touch, sight), while being willing to try new textures and flavours of food. While they are easily distracted and unable to sit still for prolonged periods, they are very aware of other people around them and will observe and even imitate behaviour of caregivers and / or peers, wanting to eat what they are eating (ITF, 2010a:9-10; Weaver *et al.*, 2008:40,43).

During the second year, feeding becomes more challenging, marking the neophobic response to food. The latter refers to the sudden rejection of new foods or familiar foods presented in different consistencies. In most cases, the suspect food will be an item the child does not recognise and thus perceives as “unsafe”, such as a new food or familiar vegetables in a more solid consistency than what the child knew previously (Cowbrough, 2010: Online; ITF, 2010a:10; Weaver *et al.*, 2008:43; Addressi *et al.*, 2005:264). Research indicates that during the second year of life, between eight and 15 exposures to suspect foods are required in order for the toddler to show acceptance (Lucas *et al.*, 2012:388; Carruth *et al.*, 2004:57).

Most children outgrow this phase by the age of five years, gradually accepting unfamiliar foods by means of observation and imitation of parents and peers (ITF, 2010a:10; Cowbrough, 2010: Online).

Nutritional requirements in toddlers are unique in that, relative to their size, they require markedly high amounts of energy and micronutrients (daily energy requirements being three times higher than in adults), in order to ensure optimum nutritional status (ITF, 2010a:11; Weaver *et al.*, 2008:40). However, a toddler’s stomach capacity (200 ml), is only one third that of an adult (Trahms & McKean, 2012:376).

Furthermore, it is essential that toddlers consume a variety of food sources from all the food groups on a daily basis, since their micronutrient requirements are also increased. Optimal daily dietary variety from all five food groups are referred to as

dietary diversity, which is one of the indicators to assess dietary quality among young children (Kennedy *et al.*, 2013:5, Arimond & Ruel: 2004:2579). Toddlers have the ability to self-regulate food intake, which is characterised by food consumption that varies greatly on a daily basis, further complicating the task of caregivers to provide optimal diets for toddlers (ITF, 2010a:11).

Therefore, various national nutrition guidelines for toddler feeding have been established, in order to guide healthcare professionals and caregivers. Toddler feeding guidelines in the United Kingdom (UK) focus on providing toddlers with a variety of food from all five food groups, in age-appropriate portions, on a daily basis (ITF, 2014: Online; ITF, 2010a:11). Energy and nutrient dense meals are emphasised and three age-appropriate portioned meals, with two to three small snacks recommended (Cowbrough, 2010: Online; Weaver *et al.*, 2007:41-42). Furthermore, the Infant and Toddler forum (ITF) compiled general toddler feeding guidelines, called the “Ten Steps for Healthy Toddlers”, providing caregivers and health care workers with a complete overview of the essential components required for optimal nutrition and development in toddlers (ITF, 2016a: Online).

The American Heart Association’s (AHA) “Dietary Recommendations for Healthy Children” emphasise general nutrition guidelines – abundant intake of fruit and vegetables, whole grain starches, reduced intake of animal fat and substitution with plant fats, intake of lean meat, chicken, fish (focus on fatty fish, such as tuna) and reduced-fat dairy, as well as 60 minutes of moderate to vigorous play each day (AHA, 2014: Online).

These guidelines by the AHA, are also supported by the Dietary Guidelines for Americans (2010: Online), developed by the United States Department of Agriculture (USDA) (2015b: Online) for individuals aged two years and older, which recommend that the goal should be to develop healthy eating habits from a young age, ensuring that children consume more nutrient dense foods (such as fruit, vegetables, whole grain starches and low fat / fat free dairy products), while limiting consumption of sodium, saturated fats, added sugars and refined grains. The main goal of these guidelines are to promote an overall healthy lifestyle among young children through the consumption of a nutrient-dense, energy-controlled diet, in addition to regular physical activity.

To support the 2010 Dietary Guidelines for Americans, the USDA compiled the *My Plate* food guide in 2011 (to replace the older *My Pyramid*) as a visual tool to emphasise the principles. The *My Plate* food guide is applicable to all member of the population from the age of two years and emphasises age-appropriate portion sizes in terms of the five basic food groups (fruit and vegetables, grains, proteins, dairy and oil/fat), which are illustrated in the form of a food plate (USDA, 2015a: Online).

In SA, the SA-Food-based Dietary Guidelines (SA-FBDG) for children older than one years and younger than seven years, are used as a general nutritional intake guideline for toddlers. SA-FBDG are similar to that of the AHA, with additional emphasis on regular clinic visits, regular plant protein intake and ample clean water consumption (Bourne, 2007:228).

1.3 Assessment of nutritional status

Nutritional status refers to the balance between adequacy of nutritional intake and nutritional requirements, reflecting the degree to which an individual's nutritional needs are met (Hammond, 2012:129). Paediatric patients require optimal nutritional status in order to maintain normal growth and development (Shaw & McCarthy, 2015:3).

Assessment of nutritional status among toddlers relies on a combination of socio-demographic, physical, biochemical and dietary assessment parameters, since these are all relevant aspects that either impact on, or reflect the nutritional intake of the child (Maqbool *et al.*, 2008:5-6). Obviously, as toddlers are still too young to provide reliable information, much of this information needs to be obtained from the toddler's caregivers.

1.3.1 Socio-demographic status

The socio-demographic background of the child should be considered during a nutritional assessment, as it can significantly impact on nutritional status. Some of the relevant information required for a social history includes information regarding household income, access to food and employment status of caregivers and other household inhabitants, as well as the type of housing, living conditions and access to basic services (Chiocca, 2015:193).

1.3.2 Clinical assessment

Clinical information to be obtained from caregivers includes a full medical history, social history and physical signs of nutritional deficiency. A medical history includes all previous and current illnesses experienced and medication used by the toddler, as well as family history of disease. Physical signs of nutritional deficiency are assessed by means of observation – any abnormal appearance of the oral cavity, hair, skin, eyes, face and skeletal structures can indicate nutritional deficiency and should be evaluated in context of the other findings (Chiocca, 2015:204-205, Shaw & McCarthy, 2015:8; Maqbool *et al.*, 2008:6).

Analysis of biochemical data is only indicated in paediatric patients where an underlying medical condition causing nutritional deficiency is suspected (such as in the case where physical signs are present) and may be performed on blood, stool, urine, skin or hair samples (Shaw & McCarthy, 2015:9-10; Litchford, 2012:191-198; Maqbool *et al.*, 2008:11).

1.3.3 Anthropometric assessment

Anthropometric assessment, also known as growth assessment, includes the following measurements: weight, standing height (used in children aged 24 months and older), recumbent length (used in children from birth to 24 months), mid-upper-arm circumference (MUAC), tricep skinfold (TSF), head circumference (HC), used in children aged two years and younger, and occasionally dual-energy X-ray absorptiometry (DXA) to assess whole body composition and bone mineral density (BMD) (Lucas *et al.*, 2012:390; Maqbool *et al.*, 2008:7).

Routine assessment should always include measurements of weight and height/length, as this provides data on adequacy of general physiological development, as well as long-term nutritional status (Shaw & McCarthy, 2015:4-5; Maqbool *et al.*, 2008:7). MUAC as a single measure is also a useful indicator of lean body mass (LBM) and malnutrition in children between the ages of six and 60 months. The measurements are interpreted in relation to age (MUAC-for-age charts) and/or according to age-specific cut-off values (WHO, 2009:2).

Weight, height/length and MUAC are used in combination with age for the assessment of nutritional status in toddlers. The parameters that need to be periodically interpreted include weight-for-age, weight-for-length/height, length/height-for-age, body mass index (BMI)-for-age (in toddlers two years and older) and MUAC-for-age (Hammond & Litchford, 2012:165-167,169). The World Health Organization (WHO) global growth standards for the interpretation of these parameters are available for boys and girls respectively, from birth to 19 years of age. Growth assessment is interpreted based on z-scores which refers to standard deviations from the 50th percentile. The relevant growth parameters which should be assessed are summarised in Table1-1 (Shaw & McCarthy, 2015: 4-5; WHO, 2015a: Online; Mei & Grummer-Strawn, 2007:441; de Onis *et al.*, 2007:144-148; WHO, 2006: Online).

Table 1-1 Indication for, and interpretation of, WHO growth charts (WHO, 2015a: Online; Shaw & McCarthy, 2015:4-5; de Onis *et al.*, 2007:144-148; WHO, 2006: Online)

Measurement	Indication for use
Weight-for-age	Detection of acute underweight / severe underweight
Length/height-for-age	Detection of chronic malnutrition, impairing linear growth (stunting)
Weight-for-length/height	Detection of acute wasting and overweight / obesity
BMI-for-age	Detection of overweight / obesity among children ≥ 2 years of age
MUAC-for-age	Indication of lean body mass in children 3-59 months of age Detection of wasting and severe wasting among this group
HC-for-age	Supplementary measurement of growth in children 0-3 years. Detection of non-nutritional developmental abnormalities

1.3.4 Dietary intake assessment

Dietary intake information is a vital part of the nutritional assessment in toddlers, as it provides valuable information on eating patterns (quantity and quality of consumption), cultural factors affecting feeding, as well as household food security and availability of food (Maqbool *et al.*, 2008:6).

Dietary assessment technique options for use in toddlers include a detailed prospective food record over three to seven days, a 24-hour recall or a food frequency questionnaire, as discussed in Chapter 2 (Hammond, 2012:137-141). This

information, obtained from the caregivers, is analysed based on country/region specific food databases and evaluated by comparison to current age-specific standards in order to determine the level of nutritional adequacy (Hammond, 2012:138; WHO, 2010:33-43; Maqbool *et al.*, 2008:6).

1.4 Factors affecting dietary intake and nutritional status

Toddlers demonstrate a yearning for independence combined with a sense of fear and anxiety of unfamiliar environments and situations. Various additional factors, such as parental influence, the type of family meals offered, location where most meals are eaten, socio-demographic status, availability of food (reflected by household food security) and dietary variety (diversity), have lasting effects on the development of food preferences, adequacy of nutritional intake and ultimately nutritional status in toddlers (Cowbrough, 2010: Online; Weaver *et al.*, 2008:40; Queensland Health, 2007:2).

1.4.1 Parental and social influence

Parents, especially mothers, as the primary care giver and provider of nutrition in toddlers, have been shown to be the main role models to their children with regards to feeding habits. Recent studies confirm that toddlers tend to consume similar foods as their parents (Anzman *et al.*, 2010:1117; Hart *et al.*, 2009:397; Birch *et al.*, 2007:3, Hoerr *et al.*, 2006:1766).

Furthermore, flavours and textures that the child becomes accustomed to, portion sizes, as well as energy-density of meals and snacks, are all determined by the diet provided by the parents. Toddlers are able to self-regulate energy intake, but they tend to over-consume when provided with bigger portions, increasing the risk of becoming overweight or obese. Toddlers from lower income groups have been found to be at greater risk of being offered excessive portions, due to larger physical size in these communities being associated with good health. Thus infants and toddlers are easily overfed in fear of the child being perceived as malnourished (ITF, 2010a:9; Anzman *et al.*, 2010:1116-1120; Birch *et al.*, 2007:3).

Parenting styles during feeding also play a major role in the development of food preferences, as well as the acceptance of new foods. Three parenting styles are recognised, namely the authoritarian, permissive and authoritative styles. Parents using

the authoritarian parenting style might force food upon the child, such as pressuring them to consume vegetables for fear of punishment, or offering rewards for doing so. In both instances, children tend to develop dislikes in these foods in later life. Similarly, the over-restriction of certain foods, such as sugary snack and drinks, also tend to lead to overconsumption when available (Anzman *et al.*, 2010:1117,1120; ITF, 2010a:10; Birch *et al.*, 2007:3). The permissive parenting style involves parents avoiding conflict during feeding and rather offering only familiar foods; these toddlers present an increased tendency to become “picky eaters” in later childhood and develop nutritional deficiencies. The authoritative style is the preferred approach, and requires that parents use their authority in providing new foods, but display patience. This style entails guiding the child by making suggestions, and by assuring the child that the food is safe by setting an example and consuming the food themselves (ITF, 2010a:10; Birch *et al.*, 2007:3-4).

External media influences affects dietary intake of both parents and toddlers. In a study by Grier *et al.* (2007:221), marketing was found to play a major role in increasing fast food consumption among parents, as well as their toddlers. Horodynski *et al.* (2010:584) found that when more meals are eaten in front of the television (TV), consumption of unhealthy foods among both mothers and their toddlers increased.

1.4.2 Where meals are eaten

Meals eaten away from home, including those offered at day care centres, are often based on unhealthy convenience items. Many mothers have full-time jobs, hence toddlers are often looked after and fed by caregivers, be it at home or at a day care centre. In the absence of parents, toddlers will observe and copy the feeding behaviours of their peers (ITF, 2010a:10) and if unhealthy eating habits are the order of the day, both physical development and food preferences will be adversely affected (Birch *et al.*, 2007:4; Cowbrough, 2010: Online). Ziegler *et al.* (2006:124) found that 50% of toddlers consumed meals away from home and that these meals were characterised by higher energy and high trans-fatty acid content, with higher intakes of fried potato chips and sugar sweetened cool drinks.

1.4.3 Dietary diversity

Dietary diversity refers to the variety of food consumed over a given period of time, by either an individual or a household, in terms of food groups (Kennedy *et al.*, 2013:5; Arimond & Ruel, 2004:2579). Therefore dietary diversity reflects the nutritional quality of the diet (WHO, 2007:7). While adequate dietary diversity is of significant importance for adults and children alike, reflecting the degree to which nutritional requirements are met, maintaining an adequate level of dietary diversity among infants and toddlers is especially crucial, since they require a consistent supply of nutrient dense food sources in order to meet their high nutritional requirements and thus achieve optimal physical and mental growth and development (Steyn *et al.*, 2006:644; Arimond & Ruel, 2004:2579).

Research supports the correlation between increased dietary diversity and improved nutritional adequacy of diets consumed by infants and young children (FANTA, 2006: Online; Steyn *et al.*, 2006:644). A direct relationship between dietary diversity and nutritional status, specifically growth, among infants and toddlers has been confirmed in recent studies. (Marriott *et al.*, 2012:354; Steyn *et al.*, 2006:644; Arimond & Ruel, 2004:2579, 2582). Cross sectional studies by Nti (2011:105) in Ghana, as well as Arimond & Ruel (2004:2579) across eleven diverse countries, found that increased dietary diversity was associated with significantly improved nutritional status of toddlers as reflected by growth parameters. In other words more diverse diets were associated with significantly improved weight-for-age, length-for-age, weight-for-length z-scores, and height-for-age z-scores, and the associations appeared to be independent of socio economic status (Arimond & Ruel; 2004:2579). These findings emphasise the importance of maintaining an adequate level of variety in toddlers' diets.

1.4.4 Household food security

Household food security is defined as the degree to which all members of the household have sufficient access to nutritionally adequate, safe and affordable food, in order to maintain an active and healthy lifestyle (USDA, 2013: Online; Vorster, 2010:2; Blumberg *et al.*, 1999:1231).

Lack of household food security, on the other hand, refers to the limited and fluctuating availability of nutritionally adequate and safe food among members of a household, resulting in regular hunger, nutritionally inadequate dietary intake, increased risk for developing malnutrition and raised anxiety levels regarding the situation (NRC, 2006: Online, Blumberg *et al.*, 1999:1231).

Global statistics on food security in 2012-2014, as reported by the Food and Agriculture Organization (FAO), indicates that 805 million people (one in every nine people) are estimated to be food insecure and chronically undernourished; the majority of these people residing in developing countries (FAO, 2014:8). Furthermore, undernutrition exacerbates diseases such as measles, malaria, pneumonia and diarrhoea (Black *et al.*, 2003:2226) and in combination with suboptimum breast feeding, stunting, wasting and micronutrient deficiencies, including vitamin A and zinc, contributes to an estimated 3.1 million child deaths per year, or 45% of total child mortality worldwide (Black *et al.*, 2013:427; Tran, 2013: Online). Household food insecurity affects even first-world countries like the United States where the Census Bureau data for 2007 indicated that 12.4 million US children are living in households with low to very-low food security level resulting in a detrimental effect on physical and mental development (Children's Healthwatch Policy Action Brief, 2009: Online).

Recent research by Cook *et al.* (2013:52,57) found that even marginal household food security can affect physical development and general health, as well as emotional state of caregivers. Results from the Early Childhood Longitudinal Study, Birth Cohort (ECLS-BC), which was started in 2001, using a nationally representative sample of nine-month year old children born in the US, with diverse social, ethnic / racial backgrounds, concluded that children between the ages of kindergarten and the third grade, living in households with marginal food security, presented with significant weight fluctuations, social impairment and inadequate learning abilities (Jyoti *et al.*, 2005:2831).

1.5 Current nutritional status of toddlers around the world

Global statistics from the 2013 updated version of the Joint Database on Child Malnutrition by United Nations International Children's Emergency Fund (UNICEF), WHO and the World Bank, indicated that in 2012, 99 million under-five year olds were

estimated to be underweight (15%), 162 million stunted (25%), 51 million wasted (8%) and 17 million severely wasted (3%) (Thompson *et al.*, 2013: Online).

1.5.1 The double burden of malnutrition in developing countries

According to the Joint Database on Child Malnutrition 2013 statistics, Asia and Africa (developing countries) had the highest prevalence for underweight, stunting and wasting. Although statistics reflected a decline in prevalence since the year 2000, it was insufficient to meet the Millennium Developmental Goals for 2015 (Thompson *et al.*, 2013: Online). Conversely, these statistics also reflected a rise in the prevalence of overweight among under-five-year-old children since the year 2000 until 2012 – from 32 million to 44 million (5% to 7%). This trend was reflected in all regions, including developing and developed countries, such as Asia and Africa. According to these statistics, SA had the highest prevalence of overweight under-five-year-old children (18%), followed by Asia (12%) (Thompson *et al.*, 2013: Online).

These numbers reflect a global trend of persistent undernutrition occurring alongside progressively increasing rates of overnutrition in members of the same population in populations in low and middle income countries, which is referred to as *the double burden of malnutrition* (Kimani-Murage *et al.*, 2015:1371). This double burden has long term detrimental effects on young children, in that undernutrition (wasting and/or stunting) during early childhood results in poor physical and cognitive development, low immunity and impaired quality of life, while overweight / obesity tracks into adulthood and is associated with increased risk for the development of non-communicable diseases (NCD) (Shrimpton & Rokx, 2012:5). In a recent systemic review by Tzioumus & Adair (2014:234), rapid growing economies, urbanisation and inadequate access to nutritious food, were identified as some of the numerous factors that contributes to the high prevalence of this double burden of malnutrition. These factors drive a significant transition in nutritional intake patterns; characterised by a shift from plant-based diets to energy-dense diets high in saturated fatty acids (SFA), sugar and refined carbohydrates (CHO); which in combination with a lack of physical activity, increase the burden of NCD in affected populations.

1.5.2 Malnutrition in developed countries

In developed countries, like the US, overnutrition features as the major form of malnutrition. The National Health and Nutrition examination Survey (NHANES) of 2011-2012, reported that an estimated 16.9% of toddlers and adolescents (2 – 19 years) were overweight, with 14.9% estimated as overweight and 8.4% as obese (Fryar *et al.*, 2014: Online). Conversely, undernutrition among children younger than five years have been estimated at only 2.1% of this population in the US

Various nutritional intervention programmes have been launched in the USA in an attempt to address these problems, including the Feeding Infants and Toddlers Study (FITS) 2002/2008 and the Special Nutrition Programme for Women Infants and Child (WIC) studies. However, results proved unsatisfactory for both of these programmes. A follow-up survey in 2010 on the FITS 2002 / 2008, showed that while breastfeeding rates had increased and the consumption of sugar-sweetened items had decreased, fruit and vegetable consumption remained low, with 28% of toddlers consuming no form of vegetables, and 16-36% consuming no whole fruit. Furthermore, of the few vegetables consumed, white potato was consumed the most and mainly in the deep fried form (May & Dietz, 2010:11-14; Siega-Riz *et al.*, 2010:38). Similarly, a sample of 4-24 month year old children drawn from the participants of the WIC, reflected excessive energy intakes with a significant number of toddlers having consumed no fruit or vegetables on the day of recall (Ponza *et al.*, 2004:71). Overweight / obesity rates have, however, dropped from 12.1% in the US survey results from 2009-2010, to 8.4% in the 2011-2012 results, indicating some improvement (Fryer *et al.*, 2014: Online).

In the United Kingdom (UK) data from the National Child measurement programme (NCMP), collected in 2013/2014, indicated that 9.5% of children aged four to five years are obese, reflecting a 0.2% increase since the 2012/2013 report (Public Health England, 2015: Online). Results from the Health Survey for England (HSE) of 2012 (the latest edition), which included data for a wider age group range, indicated that 14% of children, aged two to 15 years were classified as obese (HSCIC, 2013: Online). The UK Government's Foresight Programme (2007: Online) predicted that, at the current rate, 25% of all children in the UK will be obese by 2050. Results from the Early Bird 36 Study by Gardner *et al.* (2009:67) suggested that most excess weight is

gained before the age of 5 years, and that weight at the age of five years predicts the weight, as well as metabolic status at the age of nine years (unrelated to birth weight). Adiposity levels (total percentage of body fat) peak at the age of six months and gradually declines towards the age of four to six years (Lucas *et al.*, 2012:389). This is in line with studies that show that a child is supposed to reach a minimum level of body fatness (adiposity level) by age four to six years, after which an adiposity rebound, which is a normal pre-puberty (gender-specific) weight and fat increase, takes place (Lesen & Israel, 2012:464). However, overweight and obese toddlers experience adiposity rebound at an earlier age, which is a risk indicator of overweight / obesity in adulthood (Lucas *et al.*, 2012:389). These results emphasise the effect of poor nutrition during early childhood on weight status.

According to Gregory *et al.* (1995: Online), as referred to by ITF (2010b:4), the National Diet and Nutrition Survey (NDNS) of 1995 already reflected poor nutritional status amongst young children in the UK, finding that more than 50% of toddlers consumed insufficient amounts of foods which are rich in micronutrients (like fruit and vegetables), while 85% consumed excess amounts of added sugar and 50% consumed sugar-sweetened beverages (SSB) on a regular basis. Excessive intake of SSB, specifically, have been linked in a recent systemic review by Malik *et al.* (2006:274), to overweight / obesity among all age groups on an international level. De Boer *et al.* (2013:1) evaluated longitudinal as well as cross-sectional correlations between SSB and weight status among children aged two to five years in a sample of children (n = 10700) selected from the Early Childhood Longitudinal Survey – Birth Cohort (ECLS-B) participants of 2001. The selected participants were a statistically representative sample of the US newly-born population, followed up during the second, fourth and fifth year of life. Results reflected a significant increase in weight gain and subsequent BMI z-scores during the third and fourth year of life among two-year-olds consuming high volumes of SSB. In this study, regular SSB consumption was associated with a higher odds ratio for obesity among five-year-olds, emphasising the extent of the health risk excessive SSB consumption poses to the young population.

Results from a survey conducted by the ITF in the UK reflected that parental knowledge plays a major role in the nutritional status of toddlers. They found that 77%

of parents felt ill-prepared to feed their toddler, while only 16% could accurately indicate adequate portion sizes for toddlers (ITF, 2014: Online). In the US, a recent study by Cluss *et al.* (2013:218-219) on parents of obese children from urban academic hospital paediatric clinics, indicated that the majority of parents were able to correctly identify food groups, but scored lower in classifying nutritious value of food. The lowest scores for nutritional knowledge were among the subgroups of mothers with the lowest income and/or education levels, and among black mothers.

On the other hand, results from the NDNS, conducted from February 2008 to June 2009, using a sample of 1 – 4 year old children from the general population from the UK, reflected significant improvement of dietary intake among toddlers living in the UK. Energy intake remained stable; protein, fruit and vegetable intake increased; fat intake comprised primarily of reduced fat spreads; and there was decreased intake in saturated fatty acids. Sugar consumption from sugar-sweetened products and SSB, also decreased significantly since the previous survey in 1992 to 2001. Successful public health campaigns were proposed as the main attributing factor (ITF, 2010b:5).

1.6 Current nutritional status of toddlers in South Africa

Studies over the last two decades confirmed the existence of the double burden of malnutrition among young children in SA.

1.6.1 Undernutrition among SA toddlers

Results from an observational study conducted by the Centre of Poverty Employment and Growth from 2008 - 2009, representing children under the age of five years from all nine SA provinces, identified undernutrition as a major issue (Altman *et al.*, 2009:13). Stunting was identified as the main form of undernutrition in this survey, with the highest rates evident among young children living in the Northern Province and the Eastern Cape Province (Zere & McIntyre, 2003:7).

More recent results from the 2012 South African National Health and Nutrition Examination Survey (SANHANES-1) (Shisana *et al.*, 2013:207), indicated that among children aged from birth to 14 years, 15.4% were stunted and 3.8% severely stunted, whereas 2.9% were wasted, 0.8% severely wasted, 5.8% underweight and 1.1% severely underweight. The highest prevalence of stunting was among children

between birth and three years (26.9% boys and 25.9% girls). Based on the results of SANHANES-1, it was concluded that girls between the ages of two and 14 years, living in the Eastern Cape Province, ranked third among the provinces with regards to the number of stunted young girls (15.6%) (Shisana *et al.*, 2013:207).

1.6.2 Overweight / obesity among SA toddlers

On the other hand, the 1999 South African National Food Consumption Survey (SA NFCS), a cross-sectional survey representing children between the ages of one and nine years selected using data from the 1996 Census for each of the nine SA provinces, showed an obesity rate of 6% among one to nine year olds (Vorster, 2010:2). Just over a decade later, results from SANHANES-1 (Shisana *et al.*, 2013:201) indicated that the prevalence of overweight / obesity among children aged two to 14 years was 23.6% and 16.2%, among girls and boys, respectively (being significantly higher among girls compared to boys). In a provincial/regional study in Mpumalanga, Kimani-Murage *et al.* (2010:158) reported that 25% of toddlers aged 1-4 years in the province were stunted and that a significant number of adolescent girls were overweight/obese, with prevalence of central obesity, predisposing them to metabolic disease and NCD's later in life.

1.6.3 The relationship between stunting and overweight / obesity in SA children

Several SA studies found that stunting in young children may be a significant indicator of overweight / obesity in later life. In the North-West province of SA, the Transition and Health during Urbanisation of SA; BANA/children (THUSABANA) study, representing children between the ages of 10 and 15 years, found a significant positive association between stunting in girls, and the development of obesity in later life (Vorster *et al.*, 2011:434). Similarly a cohort study by Pettifor (2006:98) reported a stunting rate of 48% of three year olds living in the central village areas of the Limpopo.

1.6.4 The role of diet in the double burden of malnutrition among SA children

In the study by Pettifor (2006:98), 84% of the cohort presented with rapid weight gain by the age of three years, resulting in a combination of stunting and overweight occurring in 19% of the sample. A major impacting factor identified in this study was the poor nutritional quality of diets consumed by toddlers. Their diets proved to be high in refined starches and low in heme-protein, fat and most micronutrients, resulting in

poor linear growth and greater fat deposition (Mamabolo *et al.*, 2005:501). Heme-protein intake may serve as a marker for meat consumption, which in a recent study was identified as a buffering agent against stunting (Krebs *et al.*, 2011:185).

These findings reflect the current “nutrition transition” observed in SA, by which populations are undergoing a phase of transition from the rural traditional diet (high in unrefined starch, legumes, fruit and vegetables) to a modern westernised diet, characterised by higher intakes of energy-dense meals consisting of refined starches; added sugars; SSB; total fat (specifically saturated fatty acids); excessive addition of fat, oils and sugar during food preparation; as well as minimal fruit and vegetable consumption (Vorster *et al.*, 2011:430). Nutrition transition among children in SA was already evident in the 1999 SA NFCS which found that children between the ages of one and nine years consumed diets high in refined starch (eg. maize meal and pure sugar) and saturated fat (whole milk), but consume a fruit and vegetables in insignificant amounts (Faber & Wenhold, 2007:396; Steyn *et al.*, 2006:644).

Dietary intake of poor nutritional quality also contributes to micronutrient deficiencies among young children, which are associated with poor cognitive, psychological and immunological development and contributes to about 70% of mortality among children younger than five years in developing countries (Faber & Wenhold, 2007:396; SCN, 2003: Online). The 1999 SA NFCS reported high prevalence of micronutrient deficiencies, including vitamin A and iron, among one to nine year old SA children. Results from the recent SANHANES-1 (Shisana *et al.*, 2013:214), confirmed that micronutrient deficiencies were still prevalent among SA children under the age of five years – with the national prevalence of vitamin A deficiency in this age group at 49.3% in males and 39.0% in females, and the highest prevalence of iron deficiency anaemia in the 24–35 months age group (15.2%).

Nutrition transition therefore contributes to the progressively growing double burden of disease in SA, which is characterised by over- and under nutrition occurring simultaneously among members of the same community or even household, in the presence of both infectious diseases, such as HIV and TB, as well as NCDs, including obesity, Type 2 Diabetes (T2DM), hypertension, and cardiovascular disease (CVD). This is illustrated in the increased prevalence of obesity among previously stunted children (Vorster, 2010:2). Regardless of the cause, current evidence suggests that

any form of early rapid weight gain (e.g. catch-up growth) during infancy (birth to one year) predispose children to obesity and thus the development of NCD's in later life (Ong & Loos, 2006:904-908).

1.6.5 Dietary diversity among SA toddlers

Dietary diversity, as a proxy indicator of micronutrient status, was found to be low among SA children and to be significantly associated with poor growth and thus poor nutritional status (Steyn *et al.*, 2006:645,647). A systematic review by Labadarios *et al.* (2011:891), reported that rural households are more affected with only eight or less different food items consumed per day, compared to a variety of 16 items by urban households.

1.6.6 Household food security in SA

SA is considered food secure at a national level, e.g. the country is able to produce, import, retain and sustain sufficient food to support the population as a whole. However, at household level, SANHANES-1 (Shisana *et al.*, 2013:145) found that 54% of South African households were food insecure. Household food insecurity is considered one of the confounding factors of nutrition transition. SA statistics for inequity reflects high unemployment and poverty rates, with significant correlation between declined earnings and increasing food prices (Altman *et al.*, 2009:14-15). The lack of food security in SA has been proven to play a distinct role in the cause of dietary inadequacy and the prevalence of stunting among children ages one to nine years (Faber & Wenhold, 2007:396).

The systematic review by Labadarios *et al.* (2011:891) also reported that food security among the poor in SA had not improved from 1999 to 2008. Researchers used the Community Childhood Hunger Identification Project (CCHIP) index (Food Research and Action Centre, 1991: Online) to measure food security and child hunger. This internationally validated tool consists of eight questions, aimed at determining whether adults and / or children of the household are affected by either real food shortages and altered intake, or perceived inadequate food availability, due to financial constraints. A food security score of zero affirmative answers indicated that the household was adequately food secure, while five or more reflected household food shortage and

insecurity. Since the last four questions are aimed at identifying hunger among children only, a score of five or more would directly affect the children of a household.

Results reflected a consistent trend of mothers from low socio economic communities being faced with the choice of either feeding their children diets with poor nutritional quality, or sacrificing their own nutritional status in order to feed their children (Labadarios *et al.*, 2011:891).

Recently, the CCHIP index was used in the SANHANES-1 (Shisana *et al.*, 2013:143-144), indicating that although SA is considered food secure on a national level (based on *per capita* food consumption data), only 45.6% of households in SA were food secure, whereas 28.3% and 26% were at risk of experiencing hunger, or actively experiencing hunger, respectively. Of those experiencing hunger, the majority lived in urban informal (32.4%) and rural informal (37%) communities.

Regarding the food security on a provincial level, the Western Cape had the lowest rate of hunger (16.4%) and the Eastern Cape Province and Limpopo were the only two provinces with a hunger rate above 30%. Despite attempts to improve poverty rates by increasing availability of social grants to the poor, the National Food Consumption Survey - Fortification Baseline-based (NFCS-FB-1) survey of 2005 reported that 55% of households earned between R1 and a R1000 per month, while unemployment rates were as high as 93% in the Limpopo Province. The Eastern Cape Province ranked third from the top with 91% unemployment, and also rated among the provinces with the largest number of food insecure families (Bhutta *et al.*, 2008:417). Similarly SANHANES-1 (Shisana *et al.*, 2013:68-69) reported a national unemployment rate of 32.5%, with no source of income reported among 65.7% and 41.9% of urban and rural households, respectively. In the Eastern Cape Province an unemployment rate of 42.6% was reported which is a marginal improvement over the 2005 NFCS-FB findings. The province, however, still ranked third with the highest rates of unemployment in SA, Limpopo and the Eastern Cape Province were still the only two provinces with hunger rates of more than 30% (Shisana *et al.*, 2013:145).

1.6.7 Risks associated with nutrition transition in SA

The SANHANES-1 (Shisana *et al.*, 2013:79-91) also confirmed the growing burden of NCD's in SA, finding that of participants 15 years and older, 10.4% were pre-

hypertensive (blood pressure between 120 – 138 / 80 -89 mmHg), 10.2% had hypertension (blood pressure \geq 140/90 mmHg), 23.9% had high levels ($>$ 5 mmol/L) of total cholesterol; 28.8% had high levels ($>$ 3 mmol/L) of low density lipoprotein (LDL) cholesterol; and 47.9% had significantly reduced levels ($<$ 1.2 mmol/L) of high density lipoprotein (HDL) cholesterol. This emphasises the importance of minimising the risk factors that predispose to NCDs, including childhood stunting and childhood overweight / obesity as discussed above.

1.7 Problem statement

From the literature it is clear that the quality of nutrition in young children, specifically in those from birth to three years, is a major nutrition priority, since this group is at greatest risk for stunting, followed by rapid early weight gain and predisposition to development of NCD's in later life (Ong & Loos, 2006:904-908).

Most recent data indicate that optimum nutrition during the first 1000 days of life, which corresponds with the duration of pregnancy up to the age of two years, are of crucial importance with regards to optimal physical and neurological development, as well as future health and risk for NCD's (Eriksson, 2011:7). Studies show that the age period between one and three years (toddler phase), represents a unique window for establishing food preferences and eating habits. As toddlers have increased nutritional requirements, optimum nutrition is vital (Cowbrough, 2010: Online; ITF, 2010b:3). Nutritional status in this period has been shown to predict general health and weight status in later life (ITF, 2010a:9; Anzman *et al.*, 2010: 1116-1117; Birch *et al.*, 2007:3).

The increased prevalence of overweight / obesity, as well as stunting among toddlers in SA and worldwide, in the presence of low quality diets with limited dietary diversity and food variety, therefor warrants serious interventions.

In SA, the lack of proper intervention strategies and surveillance programs to address poverty and food insecurity remains an unresolved issue – a large percentage of toddlers are consuming diets lacking dietary diversity and nutritional quality, resulting in undesirable rates of stunting and eventually overweight / obesity in later childhood (Vorster *et al.*, 2011:434; Steyn, *et al.*, 2006:644).

The Eastern Cape Province has been identified as amongst the areas in SA with the highest rates of unemployment, poverty, household food insecurity and stunting (Bhutta *et al.*, 2008:417). Yet, no studies could be located in the literature that specifically focused on the nutritional status of toddlers in the Eastern Cape Province, despite the significant reasons for concern in this area (Altman *et al.*, 2009:14; Zere & McIntyre, 2003:7).

Nelson Mandela Bay in the Eastern Cape Province, is a major sea port on the south eastern coast of Africa and a major centre for automotive manufacturing in SA (Statistics SA, 2011: Online). With a population of approximately 1.5 million, Nelson Mandela Bay ranks as the fifth largest city population and second largest city in terms of area in SA (Nelson Mandela Bay Municipality, 2015: Online). According Statistics South Africa (2011: Online), the Nelson Mandela Bay population consists largely of younger people (44%), of which 10% are toddlers, emphasising the importance of adequate nutritional status among this group with regards to raising healthy and productive adults. Socio-economic status statistics indicate that most of the population reside in formal dwellings (97.7%), have access to electricity for cooking (85.9%), lighting (90.5%) and heating (54.5%), clean water supply (96.6%), access to refrigeration (78.2%), flush toilet facilities (87.4%), as well as access to family planning (3 – 4 members per house on average). A large portion of households are however, led and maintained by females (41%). Although the majority (37.9%) of the female population are 44 years of age and younger and therefore of working age; a household supported by a single person's income increases the risk of food insecurity (Menale *et al.*, 2013:154).

The unemployment rate is 37%, and is specifically higher amongst the youth (47.7%). Additionally, wealth indices vary significantly - the majority of citizens earn a monthly income of between R19, 601 and R153,800 (41%) per month; 17% earn up to R2,457,601 per month; and 16% are without a source of monthly income (Statistics SA, 2011: Online).

The purpose of this study was to evaluate the nutritional status – i.e. integrated information from physical examinations, anthropometric measurements, assessment of the usual dietary intake and evaluation of dietary diversity, socio-demographic information; and evaluation of the household food security - of toddlers attending day

care centres in Newton Park, which is one of the largest residential and main industrial suburbs of Nelson Mandela Bay. Some toddlers would thus be residing in Newton Park. However, others would be attending day care centres in Newton Park due to their caregivers being employed in Newton Park, while possibly residing in lower income group suburbs.

Findings of this mini-dissertation could provide useful baseline data regarding the nutritional status of toddlers from various areas of Nelson Mandela Bay. It may serve as a pilot study for a larger and more extensive study representing toddlers from the whole Nelson Mandela Bay aimed at identifying the specific factors that impair nutritional status of toddlers in this area. This information, if obtained, may assist health care workers to identify nutrition-related problems in the area and to design and implement applicable nutritional intervention programmes aimed at educating caregivers, and/or providing nutritional aid for vulnerable toddlers.

1.8 Aim and objectives

This study had the following aim and objectives:

1.8.1 Aim

The aim of this study was to evaluate the nutritional status of toddlers attending day care centres in Newton Park, a main residential and industrial suburb in Nelson Mandela Bay.

1.8.2 Objectives

In order to achieve this aim, the following was assessed for toddlers who met the inclusion criteria:

- i. Socio-demographic information (age, race and language of the toddler, caregiver information, geographical area of residence and family income status);
- ii. Clinical information (symptoms of bilateral pitting oedema);
- iii. Anthropometric measurements (weight-for-age; length/height-for-age; length/height-for weight, BMI, MUAC-for-age and HC).
- iv. Dietary information:

- Dietary intake (energy, macronutrient and fibre intake, as well as daily number of servings consumed from each food group);
- Dietary diversity; and
- Food security.

1.9 Layout of the mini-dissertation

This mini-dissertation is structured as follows:

Chapter 1 – Introduction, an overview on current nutritional status of toddlers around the world and in SA and motivation for the study are discussed, including the background, problem statement, aim, objectives and the layout of the dissertation.

Chapter 2 - The literature review includes a detailed discussion on nutritional assessment and nutritional requirements in toddlers.

Chapter 3 - Methodology followed in this study is described, including ethical considerations, study design, study population and sample selection, measurements – variables, operational definitions, techniques, study procedures, as well as selection and standardisation of techniques to ensure validity and reliability, the pilot study, statistical analysis, as well as limitations of the research and steps taken to overcome these, are discussed.

Chapter 4 - Results of the study are discussed and summarised, as well as problems encountered throughout the course of the study.

Chapter 5 - Results of the study are interpreted and discussed in the context of to the latest relative literature. Current obtained results are compared with previous studies conducted in different settings.

Chapter 6 - Conclusions are drawn from the results of this study, and recommendations for improvements, further research, as well as recommendations for the implementation of strategies to ensure optimal nutritional status and prevent future disease of lifestyle among toddlers living in Newton Park, Nelson Mandela Bay, are made.

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CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Optimal nutritional status, which refers to the balance between nutritional adequacy and nutritional requirements, or in other words, the degree to which an individual's nutritional needs are met (Hammond, 2012:129), is an essential prerequisite for normal growth, cognitive development and ultimately desired future health in toddlers. Therefore, toddlers should undergo thorough nutritional assessment on a regular basis, during which a wide range of social, clinical and physical parameters are examined (Shaw & McCarthy, 2015:3-4; Chiocca 2015:193).

In this chapter, evidence-based guidelines on conducting a nutritional assessment in toddlers based on the integration of socio-demographic information, clinical information (medical history and physical signs of malnutrition), anthropometric measurements, dietary assessment (dietary intake, dietary diversity and household food security), physiological development, as well as relevant biochemical results and tests (Shaw & McCarthy, 2015:4; Kleinman & Greer, 2014:609; Maqbool *et al.*, 2008:5-6), will be discussed.

2.2 Assessing nutritional status in toddlers

Nutritional status refers to the balance between nutritional adequacy and nutritional requirements, reflecting the degree to which an individual's nutritional needs are met (Hammond, 2012:129). Paediatric patients, specifically, require optimal nutritional status in order to maintain normal growth and cognitive development, as well as reach optimum future health. Therefore, it is important to conduct regular, thorough nutritional assessments in young children (Shaw & McCarthy, 2015:3-4; Chiocca, 2015:193).

Assessment of nutritional status requires a holistic approach which includes a wide range of physical, clinical and social parameters (Queensland Health, 2007: Online). Assessment parameters required to perform an accurate evaluation of a young child's nutritional status comprise of an assessment of socio-demographic information, a clinical assessment (medical history and examination of physical signs), anthropometric assessment, dietary intake assessment, assessment of dietary

diversity, household food security, as well as assessment of relevant biochemical results and tests (Shaw & McCarthy, 2015:4; Kleinman & Greer, 2014:609; Maqbool *et al.*, 2008:5-6).

In the case of toddlers, much of the information required for nutritional assessment need to be obtained from parents or primary caregivers (Chiocca, 2015:193). Applying appropriate interviewing techniques during nutritional assessment of toddlers is thus essential, since sufficient information will only be obtained once a relationship of trust is established between the healthcare provider and caregiver. Interviews should be initiated with an appropriate introduction, including an explanation of the procedures within a private setting and minimal distractions. Interview technique and language style should be individualised, using an interpreter where appropriate (Chiocca, 2015:193).

Focus should be on open-ended questions, in order to establish rapport and avoid multiple questions at a time. Toddlers should be involved as far as possible. Non-verbal questions, such as tone of voice, posture, gestures and level of eye contact can provide information on inter-relationships, compliance and the emotional health of the child and / or caregiver(s) (Pearson Education, 2006:964).

2.3 Socio demographic information

Detailed information on the toddler's socioeconomic background need to be obtained from the primary caregiver, including information on living conditions, available resources for food preparation, the caregiver's knowledge of adequate toddler nutrition, relationship between the caregiver and toddler, as well as the cultural background and possible religious or cultural food restrictions that may apply (Shaw & McCarthy, 2015:7; Chiocca, 2015:194 Hammond, 2012:137; Maqbool *et al.*, 2008:5). Many of these factors, including family composition, employment status, as well as total household income should be considered, in turn, influence household food security (which is discussed in detail under dietary information). A general description of the housing environment should be obtained and evaluated in terms of safety and adequacy, including the availability of a clean, safe water supply, electricity, as well as cooking/food storage facilities (Hammond, 2012:137; Pearson Education, 2006:965-966).

Psychosocial aspects, which need to be assessed, include identification of any emotional stressors and recent changes at home, atmosphere during family meals, meal-related routines of the toddler and child care arrangement (Hammond, 2012:137; Pearson Education, 2006:965-966).

2.4 Clinical assessment

Clinical assessment involves the evaluation of a child's social and medical history, as well as assessment of physical signs and symptoms related to nutritional intake (Shaw & McCarthy, 2015:7-9; WHO, 2015a: Online).

2.4.1 Medical history

Data collected for the medical history includes prenatal and birth records, medication use by the child, as well as records of all previous and current medical conditions of the child as well as the caregiver, and any family history of illness with a potential impact on nutritional status of the child (Shaw & McCarthy, 2015:7; Chiocca 2015: 193; Hammond, 2012:137; Maqbool *et al.*, 2008:5).

Prenatal information required includes an overview of the mother's nutritional status during pregnancy. Maternal age, general prenatal care, dietary intake information and adequacy of weight gain during pregnancy, should be noted (Pearson Education, 2006:965). Any medical conditions, nutritional deficiencies, hospitalisation history, and medications used by the mother should be noted, as it could potentially impact on the toddler's health.

To fully evaluate the nutritional status of a toddler, information regarding gestational age, birth weight, developmental score (Apgar score) at birth, special medical procedures required at birth (need for incubation, ventilation or resuscitation presence of any genetic or metabolic abnormalities, as well as relevant postnatal information such as length of hospital stay and any feeding or physiological difficulties experienced by the infant that affected feeding (such as respiratory issues, rashes, jaundice and readmissions to hospital), should be assessed. Immunisation status of the child should also be noted (Chiocca, 2015:193; Pearson Education, 2006:965-966).

Current and past medical conditions experienced by the child should be noted, in terms of date of onset, duration, medication used and severity of impact on nutritional

status. All records on medical procedures and diagnosis should be reviewed. Some relevant medical conditions include cardiac, endocrine (eg diabetes mellitus), respiratory, allergic, metabolic and neurological abnormalities (Chiocca, 2015:193; Hammond, 2012:137; Pearson Education, 2006:966).

Family history of disease should also be recorded, as it could be hereditary. Medical conditions experienced by family members within three generations of the child; parents, siblings, cousins, aunts / uncles and grandparents are considered relevant, as listed in Table 2-1.

Table 2-1 Relevant familial and hereditary medical conditions (Pearson Education, 2006:966)

Familial / hereditary disease	Characteristics of disease
Infectious disease	Tuberculosis, HIV, hepatitis and varicella
Heart disease	Heart defects, myocardial infarctions, hypertension and hyperlipidemia
Allergies	Eczema, hay fever or asthma
Eye / ear disorders	Glaucoma, cataracts, vision loss and hearing loss
Hematologic disorders	Sickle cell anemia, thalassemia and leukemia
Lung disorders	Cystic fibrosis (CF)
Cancer	Type and early age of onset
Endocrine disorders	Diabetes mellitus, hypothyroidism and hyperthyroidism
Mental disorders	Mental retardation, epilepsy, Huntington chorea and psychiatric disorders
Musculoskeletal disorders	Arthritis and muscular dystrophy
Gastrointestinal disorders	Ulcers, colitis and kidney disease
Problematic pregnancies	Repeated miscarriages and stillbirths
Learning disabilities	Attention deficit disorder and Down syndrome

All medications (OTC, prescription and alternative) used by the toddler should also be noted and evaluated for possible drug-nutrient interactions, since resulting altered metabolism of medications can have significant clinical and nutritional consequences (Shaw & McCarthy, 2015:7; Maqbool *et al.*, 2008:5). Table 2-2 lists drug-nutrient reactions commonly encountered in young children.

Table 2-2 Common drug-nutrient interactions observed in young children (Maqbool *et al.*, 2008:5)

Drug	Possible drug-nutrient interaction
Amphotericin B	Hypokalemia, hypomagnesemia
Antiacids	Vitamin D and iron deficiency
Cholestyramine	Vitamin A, D, E and K malabsorption
Cyclosporine	Elevated triglycerides, hypokalemia, hypomagnesemia
H ₂ blockers	Iron deficiency
Methotrexate	Folate deficiency
Phenytoin	Folate deficiency
Corticosteroids	Hyperglycemia, hypophosphatemia
Sucralfate	Hypophosphatemia
Sulfasalazine	Folate deficiency
Trimethoprim	Folate deficiency
6-Mercaptopurine	Purine metabolism (DNA synthesis / repair)

2.4.2 Clinical assessment: physical signs and symptoms of malnutrition

Assessment of physical signs relevant to nutritional status includes an evaluation of various body systems for signs of nutritional deficiency. Physical signs and symptoms associated with inadequate nutritional intake includes abnormal colour and texture changes of the hair, skin, eyes, lips, tongue, teeth, gums, nails, face, skeletal structures and muscle mass. Furthermore, changes of subcutaneous tissue appearance, such as the presence of bilateral pitting oedema, are indicative of advanced nutritional deficiency and forms part of the diagnostic criteria of severe acute malnutrition (Shaw & McCarthy, 2015:8-10; WHO, 2015a: Online; Kleinman & Greer, 2014:610-611).

Presence of one or more of these physical signs serve as an indication of nutritional deficiency, which should be analysed in combination with biochemical indices and anthropometric results (Chiocca, 2015:203-205). Table 2-3 lists the various physical signs to assess for nutritional deficiencies (Shaw & McCarthy, 2015:8-9, Chiocca, 2015: 204-205; Maqbool *et al.*, 2008:6).

Table 2-3 Physical signs and symptoms associated with nutritional inadequacies (Shaw & McCarthy, 2015:8-9, Chiocca, 2015:204-205; Kleinman & Greer, 2014:610-611; Maqbool *et al.*, 2008:6).

Assessment	Clinical sign	Possible nutrient(s) deficiencies	Possible nutrient excesses
Subcutaneous tissue	Oedema Poor skin turgor	Protein and Thiamine Dehydration	None
Skin	Xerosis and scaling Follicular hyperkeratosis Ecchymosis, peteciae, purpura Desquamation in sun exposed areas Yellow pigmentation; nil sclerae involvement Generalized dermatitis Pallor, anaemia Poor wound healing	EFA, vitamin A, Zinc Vitamin A and C Vitamin C and K Niacin Zinc, EFA Iron, Folate, Vitamin B12 Protein, Vitamin C, Zinc	Carotene
Skin (face)	Seborrheic dermatitis in nasolabial folds Moon-face, diffuse depigmentation	Zinc, Vitamin B2 Protein	
Hair	Lack of shine, thin, sparse Easy to pluck out Colour changes, altered texture “corkscrew” hair	Protein, zinc, EFA, Biotin Protein Protein and energy, Zinc Copper (Menke’s disease)	Vitamin A
Eyes	Conjunctival pallor Bitot’s spots, Xerosis, Night blindness Corneal vascularization	Iron, Vitamin B12, Folate Vitamin A B Vitamins	
Lips	Angular stomatitis, Cheilosis	Pyrodoxine, Niacin, Riboflavin	
Tongue	Glossitis (scarlet inflamed tongue) Atrophic lingual papilla (smooth tongue) Hypogeusia / Dysguesia (taste alterations)	Pyrodoxine, Niacin, Riboflavin, Vitamin B12, Folate Iron, Niacin, Vitamin B2, Folate, Vitamin B12 Zinc	
Gums	Bleeding, spongy and swollen	Vitamin C	
Teeth	Mottling enamel Caries	Fluorosis (Excess fluoride) Excess sugar	
Face	Thyroid enlargement	Iodine	
Nails	Spoon shaped (Koilonychia)	Iron, zinc, copper	
Muscoskeletal	Decreased muscle mass / wasting Tender calves, thighs Costochondral junction enlargement “beading” on ribs (rachitic rosary), bowed legs, bone pain	Protein and Energy Vitamin B1 Vitamin D, calcium	
Neurological	Mental confusion, disorientation Peripheral neuropathy Tetany Headache	Niacin, Vitamin B12, Vitamin B6, Vitamin B1, Niacin, Vitamin B12, Vitamin B6 Calcium and Magnesium	Vitamin B6 Vitamin A
Gastrointestinal	Drowsiness, lethargic and vomiting Cardiomegaly and heart failure Hepatomegaly and distention Abdominal distention and flatus	Vitamin B1, Phosphorus Protein and energy Lactose intolerance	Vitamin A and D

2.5 Anthropometric assessment

Anthropometric assessment of toddlers is also known as growth assessment. Growth assessment is conducted through the measurement of certain physical parameters (such as weight and height) and interpreting these parameters according to age (Lucas *et al.*, 2012:390; Maqbool *et al.*, 2008:7). Anthropometric measurements that are useful for nutritional assessment of toddlers include weight, standing height (used in children aged 24 months and older), recumbent length (used in children from birth to 24 months), MUAC, TSF, HC (used in children aged three years and younger), as well as DXA and BMD (Kleinman & Greer, 2014:616; Lucas *et al.*, 2012:390; Maqbool *et al.*, 2008:7).

MUAC and TSF (combined) are specifically useful in clinical settings where factors such as oedema and significant loss of LBM are present (Shaw & McCarthy, 2015:6-7, Maqbool *et al.*, 2008:7). TSF measurements are often not well tolerated by young children and is therefore not used as a standard measure in nutritional assessment (Shaw & McCarthy, 2015:5-6). However, MUAC, as a single measure, is still a useful indicator of LBM and malnutrition in children between the ages of six to 60 months, since rapid circumference increase takes place during this phase. MUAC measurements are interpreted in relation to age (MUAC-for-age charts), as well as according to age-specific cut-off values – a value below 125 mm indicates moderate malnutrition, while a measurement below 115 mm is indicative of severe acute malnutrition (SAM) (Mwangome *et al.*, 2012:887-888; WHO, 2009:2).

The first three years of life is marked by rapid brain development and thus a steady increase in HC. HC is measured over the frontal occipital area and should be conducted routinely according to the schedule outlined in Table 2-4. HC measurements reflect long term level of nutritional status. However, short term changes in nutritional status are more accurately identified through weight and height parameters, since brain growth are preserved during periods of nutritional stress or deprivation (Maqbool *et al.*, 2008:7).

Measurement of weight and height/length, are included as routine assessment techniques, providing data on adequacy of general physiological development, as well as long-term nutritional status (Shaw & McCarthy, 2015:4-5; Maqbool *et al.*, 2008:7).

These measurements should be conducted according to a predetermined schedule; preferably at least three-monthly from six to 24 months and annually for the duration of the toddler phase until six years of age (as outlined in Table 2-4 (Shaw & McCarthy; 2015:5; Online; Maqbool *et al.*, 2008:6).

During the first year of life (referred to as infancy), infants are expected to double their birth weight by the age of four months, triple their birth weight by the end of the first year and present with an increase in length of 24 – 25 cm by the end of the first year of life (Shaw & McCarthy, 2015:11; Trahms & McKean, 2012:376).

Furthermore, weight should quadruple by the end of the second year of life. Weight and height should increase by about 2.5 kg and 12 cm, respectively during the second year of life; and then continue to increase at a rate of 2kg and 10 cm per year, respectively, until the next growth spurt at puberty, which occurs between the ages of nine and twelve years (Shaw & McCarthy, 2015:11; Lucas *et al.*, 2012:389). Adiposity levels (total percentage of body fat) peak at the age of four to six months and gradually declines to a minimum by age four to six years, after which an *adiposity rebound* takes place – a normal pre-puberty (gender-specific) weight increase (Lucas *et al.*, 2012:389; Lysen & Israel, 2012:464). However, overweight and obese toddlers might experience adiposity rebound at an earlier age, which is a risk indicator of overweight / obesity and chronic disease of lifestyle in adulthood (Lucas *et al.*, 2012:389).

Table 2-4 Suggested schedule for growth assessments (AAP, 2014: 568-570

Age (years)	Weight (kg)	Height (cm)	Head circumference (cm)
12 months	YES (3-monthly)	YES (3-monthly)	YES (3-monthly)
15 months	YES (3-monthly)	YES (3-monthly)	YES (3-monthly)
18 months	YES (3-monthly)	YES (3-monthly)	YES (3-monthly)
24 months	YES (3-monthly)	YES (3-monthly)	YES (3-monthly)
2 – 6 years	YES (annually)	YES (annually)	Not applicable
3 – 6 years	Annually	Annually	Not applicable

Accurate and concise measuring techniques are crucial, as discussed under measuring techniques in chapter 3 (Lee & Nieman, 2003:171–172). Weight, height/length and MUAC are used in combination to assess nutritional status in toddlers. Parameters include weight-for-age, weight-for-length/height, length/height-

for-age, BMI-for-age in toddlers two years and older and MUAC-for-age (Kleinman & Greer, 2015:612; Hammond & Litchford, 2012:165-167,169).

The WHO released new global growth standards, based on z-scores (which refers to standard deviations from the 50th percentile), instead of percentiles, in 2006 – the project included six large cohort studies, conducted among economically and ethnically diverse countries, aiming to develop a single international growth standard that represents the best description of physiological growth in all children, as well as establish breastfed infant as the normative for growth and development (WHO, 2015a: Online; Mei & Grummer-Strawn, 2007:441). Currently, growth charts are available for age birth to 19 years (WHO, 2015a: Online).

Table 2-5 provides a summary of the various growth measurements, indication for use and interpretation (WHO, 2015a: Online; de Onis *et al.*, 2007:144-148).

Weight-for-age charts are used to describe a toddler's weight relative to his/her current age. This is used to identify acute moderate to severe malnutrition, which is indicated by significant weight loss due to recent reduction in nutritional intake / illness. Weight-for-age charts, however, neither account for toddlers with short stature (stunted), nor for those who are taller and leaner than the norm; nor does it accurately reflect overweight / obesity (WHO, 2015a: Online).

Table 2-5 Indication for and interpretation of WHO growth charts (de Onis *et al.*, 2007:144-148; WHO, 2015a: Online)

Measurement	Interpretation and indication for use
Weight-for-age	Detection of acute underweight / severe underweight
Length/height-for-age	Detection of chronic malnutrition (stunting)
Weight-for-length/height	Detection of acute wasting and overweight / obesity
BMI-for-age	Detection of overweight/obesity among children ≥ 2 years of age
MUAC-for-age	Indication of lean body mass in children 3-59 months of age Detection of wasting and severe wasting among this group
HC	Supplementary measurement of growth in children 0-3 years. Detection of non-nutritional developmental abnormalities

Length/height-for-weight charts describe length/height in terms of weight, independent of age. The former is used to detect acute and severe *wasting* (acute undernutrition) among toddlers below the age of two years, although chronic long-term malnutrition may also present as wasting in severe cases. BMI-for-age charts, similar to length/height-for-age charts, are used in those children older than two years. However, BMI-for-age charts can identify overweight / obesity among toddlers with greater accuracy than length/height-for-age charts (Shaw & McCarthy, 2015:7).

Length/height-for-age charts, conversely, focus on long-term chronic malnutrition, identifying toddlers with failure to grow adequately in stature (stunting) (WHO, 2015a: Online). Height age, the age at which the child's current height plots at the 50th percentile / z-score of 0 SD, should be determined in toddlers who are either severely stunted (z-score smaller than -3SD) or significantly taller than the norm for age. Height age measurements will therefore enable the healthcare professionals to either investigate for possible causes of abnormal height, or provide the relevant nutritional care in severely stunted toddlers (Shaw & McCarthy, 2015:7-8).

2.6 Dietary assessment

Dietary assessment includes information regarding dietary intake and dietary diversity, and is influenced by household food security status (Chiocca, 2015:194-195).

2.6.1 Assessment of dietary intake

Dietary intake information, collected in the form of a diet history, is a vital component of the nutritional assessment in toddlers, as it provides valuable, in-depth information on the toddler's usual dietary patterns, as well as various factors impacting on nutritional intake. Nutritional intake can be affected by cultural background, social circumstances, as well as additional gastrointestinal tract (GIT) symptoms and disease states (Hammond, 2012:139; Maqbool *et al.*, 2008:6).

Dietary information to be recorded includes detail on meal frequency, quantity, quality, typical meal times and food preferences / aversions. Throughout this assessment the previously acquired information regarding the knowledge of the caregiver of age-appropriate nutrition and nutritional requirements for toddlers as well as their attitude towards feeding should be taken into account. The presence of GIT / physiological

disturbances, such as food allergies / intolerances, chronic vomiting, diarrhoea constipation, loss of appetite and swallowing difficulties should be recorded. Usual bowel habits and stool frequency / consistency should also be noted and used to assess for the presence of any GIT motility abnormalities (Hammond, 2012:139). Normal bowel movement frequency in toddlers range from approximately 1 to 2 stools per day by the age of three years, and stools should be soft and easy to pass (Decher & Krenitsky, 2012:612).

The Bristol Stool Scale by Lewis & Heaton (1997:921), is the standard tool used in classifying bowel habits as designating normal consistency, constipation or diarrhoea, and this tool can be used as a visual aid during the questioning session with caregivers.

Table 2-6 Age-appropriate feeding skills of toddlers (Chiocca, 2015:194-195; Trahms & McKean, 2012:385)

Age	Feeding skills
12 – 18 months	<ul style="list-style-type: none"> Tolerates table foods and straining of food no longer required Rotary chewing movement developed and able to tolerate a variety of food consistencies – mashed, chopped, cook and raw. Plays with food and throws it when full Able to hold a cup, but requires assistance with drinking process Able to hold a spoon, but not fully able to use it Eat food with fingers via the pincer grasp (forefinger and thumb), but tend to mess often Aware of the behaviour from others and try to imitate
18 – 24 months	<ul style="list-style-type: none"> Appetite decreases Easily distracted from eating Ability to hold a cup in one hand and ingest a sufficient amount of fluid with minimal spillage Developed ulnar deviation of wrist allows ability to use a spoon for feeding Food preferences develop and neophasic response to food starts – prefers familiar foods Developed molars and ability of tongue to clear food from lips Self-feed with less spillage Express satiety verbally
24 – 36 months	<ul style="list-style-type: none"> Tolerates most foods and established food preferences Mastered use of age-appropriate utensils and feed themselves Express strong sense of autonomy Express constant curiosity and enjoys helping with meal preparation

Additionally, the toddler's feeding abilities and tolerance of various food consistencies should be considered and assessed according to age-appropriate standards (Chiocca, 2015:194-195) Table 2-6 stipulate the various age-appropriate feeding skills of toddlers (Chiocca, 2015:194-195; Trahms & McKean, 2012:385).

Information on food preparation techniques, location of most meals consumed by the toddler and the social circumstances surrounding meals, such as whether the toddler eats with the family around a dinner table, or in front of the TV in isolation, are important aspects of the diet history. Social and cultural factors, as discussed in section 2.3, impacting on nutritional intake include availability of appropriate cooking facilities, food availability (household food security) and cultural food restrictions and preferences. Level of physical activity should also be assessed for all toddlers aged 2 years and older. Recommendations include physical activity of at least 1 hour each day and limiting the time that the toddler watches TV to less than 2 hours per day (Lucas *et al.*, 2012:394-396; Hammond, 2012:139).

2.6.2 Techniques to record dietary intake of toddlers

Dietary intake can be assessed by means of either prospective or retrospective food records. Prospective methods are conducted by means of recording data on current diet. Weighed food record kept by the patient or caregiver for a specified number of days is classified as a prospective food record. Retrospective food records, on the other hand, relies on the patient or caregiver to recall recent dietary intake, such as in the 24-hour recall questionnaire, or past dietary intake over a longer period of time (months or years), such as the food frequency questionnaire (FFQ) (Hammond, 2012:137; Collins *et al.*, 2010:1105; Maqbool *et al.*, 2008:6).

2.6.3 Quantitative food record or diary

Food records, also referred to as food dairies, are prospective recording methods stretching over a duration of usually approximately 3 – 7 days (including week / weekend days). Patients or caregivers are required to keep a written record of all food and drinks consumed over the course of each day, indicating portion sizes, cooking methods and times. Additionally, patients are encouraged to record meals as it is eaten, to minimize error of recall. Food records can be quantified by either weighed or estimated recording methods. Individual dietary intake should be analysed at the end of the specified period via the use of a nutritional database and compared to Dietary reference intake (DRI) for age and gender. National Food guides, such as the Choose My Plate food guide from the USDA (USDA, 2015a: Online) and the FBDG of SA (Vorster *et al.*, 2013:9) can also be used. Food records provide both quantitative and qualitative data and can be used as a method to estimate usual dietary intake in

toddlers. Usual dietary intake of macronutrients require a period of 3 – 10 days, whereas intake of micronutrients may require up to 50 days (Hammond, 2012:138; Collins *et al.*, 2010:1105; Maqbool *et al.*, 2008:6).

i Advantages

Dietary intake data collected via written food records tend to be more concise than retrospective records, since less emphasis is placed on memory to recall dietary intake, with subsequent less food omission. Relatively short periods (3 – 7 days) are required to provide a general estimate of individual intake. Additionally, inclusion of meal times, methods of preparation and portion sizes provides more accurate data on actual daily food intake, as well as detail on recipes and type of products purchased. Furthermore, including weekend days allows the dietician / healthcare provider to identify major changes in meal patterns and nutritional quality. Optimum accuracy through the use of food records in toddlers can be obtained by educating caregivers on portion sizes, brand names, nutritional labels and relevant detail required on food preparation (Chiocca, 2015:199; Hammond, 2012:138,141; Collins *et al.*, 2010:1105).

ii Disadvantages

Food records can be labour intensive for caregivers, regarding weighing food and recording all detail required, as well as influenced by literacy level and ability to estimate portion sizes or operate a scale. Furthermore, actual food intake could be influenced by the process of recording all meals. Electronic analysis of nutritional data is time consuming and requires updated software and expertise. Additionally, reliability of this method decreases after seven days, deeming it unsuitable for assessment of usual micronutrient intake (Chiocca, 2015:199; Hammond, 2012:141; Collins *et al.*, 2010:1105).

2.6.4 24-Hour recall questionnaire

24-hour recall questionnaires are retrospective food records, conducted by a trained interviewer via a structured interview (face-to-face or telephonically). Participant are requested to recall all food and drink consumed over a specified time period - common time frames used include 24 hours or three days. Nutritional data are analysed

electronically post interview, as with food records (Chiocca, 2015:199; Hammond, 2012:140; Collins *et al.*, 2010:1105).

i Advantages

Interview procedures are non-invasive and does not alter usual food intake patterns of participants, thus low respondent burden. Furthermore, there is no literacy requirements, since the interviewer adapts the questions to the required intelligence level (Shaw & McCarthy, 2015:9,11; Hammond, 2012:140; Collins *et al.*, 2010:1105).

ii Disadvantages

Accuracy of dietary recall depends on the respondent's memory and requires a trained interviewer, making it an expensive and time-consuming method of collecting dietary intake information. Furthermore, usual dietary intake can only be estimated when using an extended recall period, which further decreases accuracy. Challenges related to updated software regarding nutritional analysis are similar to that of written food records (Hammond, 2012:140; Collins *et al.*, 2010:1105).

2.6.5 Food frequency questionnaire

FFQs are retrospective dietary intake records over an extended duration of time – a pre-determined number of weeks, months or years. Foods are combined into groups, according to nutrient content, and participants are requested to report their usual intake of each food from these lists. Frequency, in terms of the specific time frame, as well as quantity are requested for each food. Participants are requested to report usual food consumption from each food group, in terms of frequency within the specified time period. FFQs can be used for research as either self-administered questionnaires (large trials), or in the form of an interview (small trials), since it is designed to reflect usual food intake. FFQs can be administered to children older than nine years and to caregivers of younger children (Hammond, 2012:138-140; Collins *et al.*, 2010:1105-1106; Maqbool *et al.* 2008:6).

i Advantages

FFQs reflects long-term dietary intake of specific food groups, which might have been identified within 24-hour recall questionnaires or quantitative food records. Additionally, detailed FFQs can be used to identify micronutrient intake, in order to

determine adequacy. Furthermore, FFQs require a low respondent burden, is inexpensive to use and a practical research tool in large trials (Chiocca, 2015:200; Collins *et al.*, 2010:1106).

ii **Disadvantages**

FFQs lacks the ability to collect sufficient detail regarding cooking method and portion size, affecting accuracy in terms of food quantification. Data obtained from a FFQ tends to overestimate dietary intake, as appose to Quantitative food records and 24-hour recall questionnaires and is not an optimal method of quantifying individual intake. Additionally, participants are required to recall food patterns and estimate portion sizes / frequency to an extent, affecting reliability in terms of accuracy. Analysis by means of an updated nutritional data base is required (Hammond, 2012:140; Collins *et al.*, 2010:1106).

2.6.6 Additional information needed for dietary assessment of toddlers

Information is also required regarding age-appropriate feeding behaviour. Between birth and six months of age, exclusive feeding with breast milk or breast milk substitutes is sufficient in meeting the infant's nutritional and physiological needs; breastfeeding being considered the optimal feeding method (Weaver *et al.*, 2008:40; Birch *et al.*, 2007:2). After six months, however, increased nutritional requirements can only be met via the addition of complimentary solid foods. Therefore, introduction of solids initiate the weaning process – the gradual transition from breast milk / breast milk substitutes to a nutritionally balanced and varied diet (Trahms & McKean, 2012:376-379). Food variety (in term of food groups as well as texture) should be increased gradually over the following six months of weaning, until the age of one year, when the infant should be able to tolerate the normal family diet in smaller age-appropriate amounts (Weaver *et al.*, 2008:40).

Additionally, the weaning period marks the time during which the infant starts to develop taste preferences and behaviours surrounding food that will be carried over to later childhood and beyond. Therefor infants need to be exposed to a variety of foods with different flavours and textures. Infants are naturally more accepting of foods with a sweet taste (Birch *et al.*, 2007:2), making the introduction of sweeter foods like fruit, relatively easy compared to foods such as vegetables. Repeated exposure to the

latter is essential however, and recent studies found that offering a combination of vegetables, as opposed to the “one at a time” approach, increased acceptability (ITF, 2010a:8).

Regarding texture, lumpier foods involves more complex chewing techniques that develop during the weaning period, given that the infant is exposed to such textures from the start. If not, they will be likely to refuse these foods later on. Studies showed that delayed introduction of solids (after the age of six months) was associated with feeding difficulties by 15 months and lower fruit and vegetable intake in later childhood (ITF, 2010b:4; ITF, 2010a:9; Coulthard *et al.*, 2009:75; ITF, 2008:5).

Once the child reaches the toddler phase, dietary intake should progress from predominantly milk feeds to a solid diet. At this stage the child should demonstrate self-feeding abilities and enjoy a variety of family foods, while still being encouraged to try new foods (ITF, 2010a:9-10; Weaver *et al.*, 2008:40). Food preferences developed during infancy becomes established, forming the basis for diet and health in later life (ITF, 2010b:3; Cowbrough, 2010: Online).

Toddlers characteristically demonstrate extreme curiosity in their environment, exploring their surroundings (including food) by means of all their senses (smell, touch, sight), while willing to try new textures and flavours in food (ITF, 2010a:9-10; Weaver *et al.*, 2008:40,43). They are easily distracted and unable to sit still for prolonged periods. However, they are very aware of other people around them. Toddlers will observe and even imitate behaviour of caregivers and / or peers, wanting to eat what they are eating.

During the second year, feeding becomes more challenging, marking the neophobic response to food. The latter refers to the sudden rejection of new foods or familiar foods presented in different consistencies. In most cases, the suspect food will be an item they do not recognize and thus dismiss as “unsafe”, such as a new food or familiar vegetables in a solid consistency (Cowbrough, 2010: Online; ITF, 2010a:10; Weaver *et al.*, 2008:43; Addessi *et al.*, 2005:264). Research indicates that between eight and 15 exposures to suspect foods are required in order for the toddler to show acceptance during the second year of life.

Most children outgrow this phase by the age of five years though, gradually accepting unfamiliar foods by means of observation and imitation of parents and peers (ITF, 2010a:10; Cowbrough, 2010: Online).

Toddlers are unique in that, relative to their size, they require markedly high amounts of energy and micronutrients, (daily energy requirements being three times higher than in adults), in order to ensure optimum nutritional status (ITF, 2010a:11; Weaver *et al.*, 2008:40). However, a toddler's stomach capacity is only one third (200ml) that of an adult (Trahms & McKean, 2012:376).

Therefore, in order to meet the toddler's increased requirements for energy and nutrients, three age-appropriate portioned meals, as well as two to three small snacks should be offered daily. Meals should be energy and nutrient dense and compiled to include a daily variety of nutritious food from all the food groups (Weaver *et al.*, 2008:41). Optimal dietary diversity is therefore essential and one of the indicators to assess dietary quality among young. Additionally, toddlers have the ability to self-regulate food intake, characterized by food consumption that varies greatly on a daily basis (WHO, 2007:7; Arimond & Ruel: 2004:2579).

A general overview of feeding patterns among toddlers can usually be assessed with sufficient adequacy by using 24-hour recall questionnaires, providing that caregivers are also questioned on factors such as age-appropriate meal textures, utensils used, the child's ability to feed him or herself, as well as the social factors regarding meal times – setting of family meals, presence of force-feeding practices and chronic conflict surrounding meal times etc. (Shaw & McCarthy, 2015:9). Table 2-7 lists typical questions addressing these issues (Chiocca, 2015:197-200).

Table 2-7 Supplementary dietary assessment questions in toddlers (Chiocca, 2015:197-200)

Supplementary dietary assessment questions in toddlers
How do you prepare food for your toddler?
Do you have any concerns about your toddler's eating?
What do you do when your toddler refuses a certain food?
Describe food preparation methods when cooking for your toddler, as well as how you serve food (consistency, presentation, and temperature).
Describe cooking equipment / utensils you use for preparing and feeding your toddler?
Describe your toddler's eating patterns and routine.
Does your toddler eat meals with the whole family or separately?
Does your toddler drink from a bottle or a cup?
How much juice does your toddler consume in a day?
Describe typical snacks you offer your toddler.

2.6.7 Interpretation and analysis of dietary intake information

Dietary intake data should be analysed for nutritional adequacy –nutritional analysis computer software may be used to calculate energy and nutrient intakes from a food composition database, and to compare current nutritional intake levels to the relevant DRI values for toddlers (Chiocca, 2015:200).

2.6.8 Nutritional reference values

Nutritional reference values, known as the DRI, are used as baseline for analysis of current nutritional intake and adequacy thereof (Chiocca, 2015:200).

DRI, developed by the Food and Nutrition Board of the Institute of Medicine, is a collective term describing a set of reference values for each nutrient, which are used to determine the nutritional adequacy of diets consumed by healthy individuals. Reference values included within the DRI's are the estimated average requirements (EAR), recommended dietary allowance (RDA), adequate intake (AI), upper limit (UL), as well as the acceptable macronutrient distribution range (AMDR) (IOM, 2006:3,6,8).

EAR values describes the average daily nutrient intake estimated to meet the nutritional need of 50% of healthy individuals within a life stage or a gender group. However, the EAR is primarily used as a reference point for assessing the adequacy of estimated nutritional intake among groups, but serve as the basis for calculating the

RDA. RDA values describes the average daily dietary nutrient intake level sufficient to meet the nutrient requirements of the majority (97 to 98 percent) of healthy individuals in a particular life stage and gender group. Therefore, the RDA exceeds the requirements of most individuals within a population and can thus be used as a reliable tool for assessing dietary adequacy among individuals - usual nutritional intake at a level equal to the RDA on a regular basis, should have a low probability of inadequacy (IOM, 2006:8-10).

AI values are used when neither EAR nor RDA can be determined for a specific nutrient. AI values are used for assessing nutritional intake among groups and describes the recommended average / presumably adequate daily intake level based on observed or experimentally determined estimations of nutritional intake (IOM, 2006:9). UL values describes the highest average daily nutrient intake level that is likely to pose no risk of adverse health effects to the majority of individuals within the general population. Probability of adverse effects increase as intake levels increase above the set UL value (IOM, 2006:11).

The AMDR describe the intake range of an energy source (CHO, protein and fat) that is sufficient in providing individuals with adequate essential nutrients, yet associated with a reduced risk of chronic disease. AMDR ranges include an upper and lower boundary and are expressed as a percentage of total energy (TE). Intake levels outside of this range increase the risk of developing chronic disease, as well as nutritional deficiencies (IOM, 2006:11).

2.6.9 Nutritional requirements and recommendations

Nutritional requirements are affected by various external factors (level of physical activity, weather conditions) and internal factors (hormonal, metabolic, genetics). However, ultimately any inadequate or excess energy consumption will result in body weight changes and ultimately an undesired change in nutritional status (Ireton-Jones, 2012:20). In young children, additional nutrient intake is required to meet needs of energy expenditure, as well as that of energy deposition for optimal growth and development (IOM, 2006:88). Furthermore, higher amounts of micronutrients are required for growth and development during childhood, with greater risk of deficiency

when requirements are not met, emphasising the importance of an optimal diet in toddlers (Lucas *et al.*, 2012:391).

i Macronutrient requirements

Macronutrients are energy-yielding nutrients - CHO, protein and fat, required for optimal physiological functioning (Miller-Keane, 2003: Online). Food sources containing macronutrients yield energy through physiological oxidation (metabolism), ensuring maintenance of body temperature, circulation, pulmonary and neurological function (IOM, 2006:83,85). The following section includes age-specific nutrient recommendations for energy, CHO, protein and fatty acids.

a. Energy

The Estimated Energy Requirements (EER) is defined as the average dietary energy intake required for maintenance of energy balance in healthy adults, in terms of specific age, gender and level of physical activity. In children, however, the EER should be sufficient to support deposition of tissue and adequate growth. EER can be calculated for four levels of physical activity, of which the active level is recommended for optimum maintenance of health. In young children, additional energy intake is required to meet needs of energy expenditure, as well as that of energy deposition for optimal growth and development (IOM, 2006:88).

Chronic energy excess, or deficit, impacts negatively on nutritional status, specifically in young children. Excessive energy intake leads to unwanted weight gain, while inadequate energy intake leads to failure to thrive and ultimately malnutrition (wasting and stunting). Additional consequences include decreased cognitive function, delayed bone age and increased susceptibility to infectious disease (IOM, 2006:91-92).

The EER in toddlers provides average energy requirements for healthy children of normal weight in this life stage. The DRI for EER in toddlers aged 1 – 2 years is 4393 Kilojoule (kJ) and 4166 kJ for males and females, respectively. However, individualized estimations of the EER in toddlers aged 13 – 35 months can be calculated, using the following equation: $EER (kcal) = (89 \times \text{weight [kg]} - 100) + 20$ (IOM, 2005:5; IOM, 2006:82-83).

b. Carbohydrates

Carbohydrates (CHO) are macronutrients that serve as the primary source of fuel, maintaining physiological processes within the human body. CHO are categorized into three main groups – simple sugars (monosaccharides and disaccharides), oligosaccharides and polysaccharides (Gallagher, 2012:33; IOM, 2006:103-104).

Monosaccharides are single glucose units, including glucose (dextrose), fructose and galactose. Monosaccharides form the foundation of complex other carbohydrate sources - disaccharides, oligosaccharides and polysaccharides (Gallagher, 2012:33-34).

Disaccharides contain double glucose bonds and include sucrose (table sugar), lactose (sugar in milk) and maltose, all of which occurs naturally in food. Oligosaccharides are low-molecular-weight polymers with multiple glucose bonds (2 – 20), consisting of raffinose / stachyose (found in legumes), fructans and fructo-oligosaccharides (e.g. wheat, barley, rye onions). These CHO enhance sweetness of low-calorie foods and aid as prebiotics (Escott-Stump, 2015:946).

Oligosaccharides act as prebiotics through partial enzymatic hydrolysis in the small intestine, followed by fermentation in the colon, yielding short chain fatty acids (SCFA), such as acetic, propionic and butyric acid. Of these SCFA, Butyrate serve as the main nutritional source for the colonic mucosa, specifically *Lactobacillus bifidus*, whereas acetic and propionic acid are absorbed, yielding a small portion of energy to the host (EFSA, 2013:20).

Sugar alcohols (polyols), such as sorbitol and mannitol, are poorly digested alcohol forms of monosaccharides, which occurs naturally (in trace amounts) in some fruit and vegetables, but are mostly synthetically produced from glucose and used as bulking agents and sugar substitutes. Polyols are therefore classified as an “added sugar” (Vorster *et al.*, 2013:9).

Added sugars are defined as monosaccharides / disaccharides added to foods during the preparation or processing phase. These sugars do not occur naturally, such as lactose in milk and fructose in fruit, but are manufactured and added in larger amounts,

such as cakes, pies, SSB, candies and high-fructose corn syrup (Vorster, 2013:30; Gallagher, 2012:38; IOM, 2006:104).

Polysaccharides (> 10 glucose units) are stored in plant cell walls and classified as starch (digestible) or dietary fibre (indigestible). Starches consist of amylopectine, amylose and modified starch, whereas dietary fibre consists of intact plant cell components which resists enzymatic digestion by human GIT (e.g. cellulose, hemicelluloses, β -glucan and plant gums) (Vorster, 2013:29; Gallagher, 2012:36-37).

Dietary fibre can be classified as *soluble*, *insoluble fibre* and functional fibre. *Soluble fibres* (gums from oats, legumes, guar and barley and pectins in apples, strawberries, carrots and citrus) form gels that slow gastric emptying, glucose absorption and lowers serum cholesterol through lipid and bile acids bond formation, as well as through fermentation substrates. *In-soluble fibres* (cellulose and hemicellulose from whole wheat, bran and vegetables, as well as lignin from fruits, edible seeds and mature vegetables) also slow gastric transit, but undergoes less colonic fermentation than soluble derivatives, increasing faecal water volume and preventing constipation. *Functional fibre* refers to indigestible CHO that has been extracted from plants in order to isolate the fibre component for therapeutic purposes (Escott-Stump, 2015:946; Gallagher, 2012:36-38; Anderson *et al.*, 2009:188-205; SACN, 2008: Online; IOM, 2006:111-112,121).

CHO, primarily in the form of lactose from breast milk, is the first macronutrient infants are exposed to, since breast milk contains the highest lactose content of all dairy products – 7g per 100g. During the weaning process, toddlers should be exposed to a variety of CHO, starting with soft cooked fruit and vegetables. Breast milk also contain a generous portion of oligosaccharides, favouring colonization of non-pathogenic microbiota (specifically *Lactobacillus bifidus*) and hence protecting Infants and toddlers from infections and constipation (Trahms & McKean, 2012:380).

Therefore, oligosaccharide-enriched starter and follow-on infant formula has been studied, regarding possible benefits on gastrointestinal function, GIT, RT infections and dermatological disturbances (e.g. eczema). However, nil consensus has been reached regarding official fortification recommendation (EFSA, 2013:20).

Life stage specific DRI's (in terms of RDA or AI) for total CHO requirements were developed based on the minimum glucose level required for utilization by the brain for optimal physiological functioning (IOM, 2006:103). AMDR for CHO intake in toddlers are similar for all life stage groups at 45 – 65% of total daily energy intake (IOM, 2006:107). Furthermore, the RDA for total CHO requirements and AI for total fibre intake are 130 grams / day and 19 grams / day, respectively, as illustrated Table 2-8 (IOM, 2006:102,107,110).

Table 2-8 Dietary reference intake for carbohydrates in toddlers (IOM, 2006:102,107,110)

Age group	Carbohydrates (g/d)	Total fiber (g/d)
Toddlers (1 – 3 years)	130*	19

* RDA, # AI

General recommendations for CHO intake during the toddler phase include placing emphasis on fibre intake, hence offering more whole grain starches, fruit and vegetables, with less refined CHO and SSB / foods (Escott-Stump, 2015:29; AHA, 2014: Online; Webster-Gandy *et al.*, 2012:272).

Additionally, a general recommendation was set for restriction of added sugars to \leq 25% of total daily energy intake, in order to reduce risk of chronic disease among all life stage groups (IOM, 2006:103).

c. Protein

Proteins are macronutrients consisting of nitrogen and Amino acids (AA), which are linked by means of peptide bonds to form a sequence. AA function as precursors for various molecules, such as nucleic acids, hormones and vitamins, whereas AA sequences are genetically predetermined, affecting the function of proteins. Proteins are the main structural constituent of human cells, functioning as enzymes, membranes, transport carriers, hormones and immunoproteins. Therefore, an adequate protein supply is essential for optimal physiological functioning of the host (Gallagher, 2012:48; IOM, 2006:145-146).

AA can be classified as essential, conditionally essential and non-essential. Non-essential AA are physiologically produced through the process of transamination and thus readily available to exert biological function in the human body. Essential amino

acids (EAA), however, as in the case of Essential Fatty Acids (EFA), cannot be synthesized by the human body and needs to be consumed through the diet, whereas conditionally EAA only becomes essential during pathophysiological conditions, such as catabolic illness (Escott-Stump, 2015:949-951; Gallagher, 2012:51; IOM, 2006:146). Table 2-9 lists and classifies all the AA (Gallagher, 2012:51; IOM, 2006:147).

Table 2-9 Physiological classification of AA (Escott-Stump, 2015:949–951; IOM, 2006:147; WHO, 1985:65)

Essential AA	Conditionally essential AA	Non-essential AA
Histidine Isoleucine Leucine Lysine Methionine Phenylalanine Threonine Tryptophan Valine	Arginine, citrulline, ornithine Cysteine Glutamine Glycine Proline Serine Taurine Tyrosine	Alanine Aspartic acid Asparagine Glutamic acid Carnitine Creatine Glutathione Theanine

Protein quality of dietary sources is the determining factor in maintaining a positive nitrogen balance. Protein quality is determined by the EAA composition, as well as the digestibility of the dietary source and hence bioavailability of the AA content. All nine EAA are required (in physiologically adequate amounts) for optimal protein synthesis, utilization and thus optimal bodily repair and growth, since even a marginal deficiency of a single EAA impairs aforementioned processes (Gallagher, 2012:51-53; IOM, 2006:146).

Therefore, the quality of dietary protein sources should be analysed. The WHO/FAO/USDA recommends protein digestibility-corrected amino acid score (PDCAAS) as the preferred method to analyse protein quality, used to calculate the AA score, corrected for digestibility. A score equal to or larger than one represents a protein of high quality (Gallagher, 2012:52-53).

Animal protein sources are naturally higher in quality than plant sources, but protein quality can be improved by means of combination – a dietary protein source lacking one or more EAA, can be “complemented” by a another food source containing that

limiting EAA in abundance, forming a complete protein. Examples include combining seeds and legumes, as well as dairy and grains (Gallagher, 2012:53).

Protein requirements in adults are aimed at maintaining nitrogen equilibrium, whereas infants and toddlers require sufficient dietary protein to maintain a positive nitrogen balance, in addition to ensuring protein deposition for adequate growth (IOM, 2006:150).

Therefore, protein recommendations in infants and toddlers are based on the sum of protein needed for maintenance of a positive nitrogen balance, as well as for growth, adjusted for efficiency of dietary protein utilization (EFSA, 2013:14-15). The IOM (2006:145) recommends an AMDR for protein in toddlers of 5 - 20% of TE, while Table 2-10 and Table 2-11 illustrate the EAR and RDA for total protein and EAA requirements in toddlers, respectively (Gallagher, 2012:51; WHO, 1985:65).

Findings from a recent prospective feeding study indicates that higher protein content of infant formula milk, as apposed to that of breast milk, might result in higher growth rate and improved insulin secretion (Axelsson, 2006:121). However, current available studies indicates only slight enhanced weight-for-length scores in those fed formulas with higher protein content (Grote *et al.*, 2010:117-118), lower BMI and risk for obesity at age six in those fed with a lower protein infant formula (Thorisdottir *et al.*, 2013:145), as well as a positive association between higher protein intake during infancy and enhanced growth with a higher BMI in childhood (Hörnell *et al.*, 2013:57).

Therefore, the European Food Safety Association (EFSA) (2013:15-16) concludes that further research is required to determine whether moderate alterations in growth parameters observed in young children, as a result of higher protein consumption during infancy, persists in later childhood, posing a risk for obesity and chronic disease in adulthood.

Table 2-10 Dietary reference intake for protein in toddlers (IOM, 2006:144)

Age group	Protein: EAR (g/kg/d)	Protein: RDA (g/kg/d) / (g/d)
Toddlers (1 – 3 years)	0.87	1.05 (13)

Table 2-11 Recommended intake for EAA in toddlers (Gallagher, 2012:51, IOM, 2006:460).

Essential Amino Acid	RDA: 1 – 3 years (mg/kg/d)
Histidine	21
Isoleucine	28
Leucine	63
Lycine	58
Methionine + cysteine	28
Phenylalanine + tyrosine	54
Threonine	32
Tryptophan	8
Valine	37

d. Fat

Dietary fat (lipids) are the most energy dense macronutrient and thus the primary component of stored energy. Therefore only small amounts of dietary lipids are required to maintain normal physiological function. Furthermore, lipids aid in the absorption and transport of fat soluble vitamins (FSV) (vitamin A, D, E and K) and phytochemicals (carotenoids and lycopene), insulation of internal structures and digestion – inhibits gastric secretions, slows gastric emptying and stimulates pancreatic flow (Escott-Stump, 2015:943; Gallagher, 2012:40; IOM, 2006:123,126).

Lipids can be classified into three main groups – simple lipids (compound fatty acids in the form of triglycerides (TGL); neutral fats), compound lipids (phospholipids, glycolipids and lipoproteins) and miscellaneous lipids, such as sterols, FSV and trans fatty acids (TFA), of which dietary lipid sources consists mainly of compound fatty acids, in the form of TGL (Escott-Stump, 2015:948; Gallagher, 2012:40-41).

TGL consists of a three-carbon glycerol compound. Each carbon is numbered according to the stereospecific numbering (sn) system, binding and esterifying a fatty acid at the sn-1, sn-2 and sn-3 position (Innis, 2011:275).

Dietary lipids are classified based on the saturation of the carbon chain, into SFA, TFA, poly-unsaturated fatty acids (PUFA), mono-unsaturated fatty acids (MUFA), the number of carbon units, as well as the position of the double bonds (saturation). SFA have no double bonds and a longer chain length. PUFA are characterised by one or more double bonds and MUFA have only a single double bond in the chain (IOM, 2006:125; Gallagher, 2012:41). Table 2-12 categorises the fatty acids, and lists some of the major components and dietary sources (Escott-Stump, 2015:948; Gallagher, 2012:41; IOM, 2006:126,134).

No RDA or AI for total fat intake have been established in members of the population aged one years and older, due to a lack of evidence regarding a defined limit for adequate consumption levels. However, an AMDR for total fat intake in toddlers has been set at 30 - 40% of TE by the Institute of Medicine (IOM) (2006:123), while the FAO/WHO (2008:4) recommends a slightly lower range of 25 – 35% of TE in children from the age of two years.

SFA are non-essential, hence synthesised by the human body with a role in structural and metabolic processes. High SFA intake, specifically lauric and palmitic acid, has been associated with an increased risk for coronary heart disease (CHD), through an increased serum LDL concentration, as well as an increased total cholesterol (TC) / HDL ratio among all age groups (IOM, 2006:123-124; FAO/WHO, 2008:3).

In contrast, breast milk, which provides 100% of daily energy needs in infants and up to half of TE in toddlers \leq 24 months, consists of 50% fat, of which 20 – 25% is SFA (mainly palmitic acid), 30% MUFA, 13% omega-6 (n-6) PUFA and 1% (omega-3) n-3 PUFA, hence similar in composition to that of full cream cow's milk (thus high in SFA) (Innis, 2011:276; FAO/WHO, 2008:4).

SFA in breast milk are attached to the sn-2 carbon domain (middle domain), whereas SFA in high fat mammalian products, such as full cream cow's milk, are evenly distributed between sn-1 and sn-2. Therefore, the unique lipid structure of breast milk

enables superior absorption, utilization and energy metabolism, without metabolic stress and risk of chronic disease observed from consumption of a diet high in SFA (Innis, 2011:276).

Table 2-12 Classification of dietary lipids (Escott-Stump, 2015:948; Gallagher, 2012:41; IOM, 2006:126,134).

Fatty acid class	Fatty acid component	Food sources
Saturated fatty acids	Caprylic acid Caproic acid Lauric acid Myristic acid Palmitic acid Stearic acid	Butter fat, coconut oil, palm kernel oil, cocoa butter, all animal fat.
Poly-unsaturated fatty acids		
Omega 3 family	Alpha-linolenic acid (ALA)	Vegetable oils (Soybean, canola, rapeseed), flaxseed, soy beans, pumpkin seed and walnut.
	Eicosapentaenoic acid (EPA) Docosahexaenoic acid (DHA)	Cold water fish (oily fish): Tuna, salmon, mackerel, herring, sardines, herring, fish oil capsules.
Omega 6 family	linoleic acid (LA)	Safflower, sunflower, corn, soybean, peanut oil.
	Arachidonic acid (AA)	Nil sufficient dietary source
Mono-unsaturated fatty acids	Oleic acid	Plant sources: Olive oil, canola oil, peanut oil, sunflower oil, sesame oil, avocado, olives, nuts (macadamia, pecan, almonds).
Omega 9 family		Animal sources: Animal fat (mainly meat fat)
Miscellaneous lipids:		
Sterols	Cholesterol	Animal organ meat (e.g. heart, kidney, liver), egg yolk, all animal meat products (meat, poultry, fish, dairy).
Trans fatty acids	Hydrogenated vegetable oil	Brick margarines, commercial baked products (e.g. cakes, pastries and biscuits)

The FAO/WHO (2008:6) has concluded that there is currently convincing evidence indicating the beneficial effect of replacing SFA with PUFA, and to a lesser extent MUFA, on serum low density lipoprotein (LDL) cholesterol levels (significant decrease) and TC / HDL cholesterol ratio (significant improvement with increased HDL cholesterol concentrations). Although no long term studies have been conducted on the relationship between the various fatty acids and chronic disease prevention among children, it is assumed that findings in adults will also apply to children – improved chronic disease risk profile with decreased SFA and increased PUFA intake (FAO/WHO, 2008:4).

Therefore, an upper-AMDR (U-AMDR) for SFA of 8% TE has been established by the FAO/WHO (2008:4) for children from the age of 24 months and older, with an additional recommendation to further decrease intake among those with strong family history of Dyslipidaemia. Similarly, the updated guidelines from the AAP (Stephen & Frank, 2008:202) recommends that reduced fat dairy products be used from the age of 12 months in those at risk of obesity / family history of obesity and chronic disease (Stephen & Frank, 2008:202).

The majority of TFA are produced during the industrial process of partial hydrogenation of vegetable oils, whereas a trace amount of TFA are naturally occurring in food products (such as dairy and meat) as a result of bacterial PUFA metabolism (Smuts & Wolmarans, 2013:94).

Research continues to prove the adverse cardiovascular effects of TFA consumption – increased serum LDL cholesterol levels, lipoprotein a and apolipoprotein-B concentrations, as well as decreased serum HDL cholesterol levels, all contributing to an increased risk of CHD and possibly Metabolic Syndrome (MS) and T2DM as well (Smuts & Womarans, 2013:94; FAO/WHO, 2008:9).

Therefore, SA has recently published the updated “Regulations related to trans-fat in foodstuff” (Act number 54 of 1972 in the SA Government Gazette), which has been implemented since August 2011. New legislation states that TFA content are to be limited to no more than 2g per 100g in any oil / fat product intended for human consumption. Furthermore, a claim of “TFA free” is only warranted for products

containing a TFA content of less than 0.01g per 100g of the consumable end products (SA DOH, 2011: Online).

Cholesterol, similar to fatty acids, serve as an integral component of cell membranes and play a significant role in the synthesis of steroid hormones and bile acids. Food sources rich in cholesterol includes all animal meat and dairy products, as listed in Table 2-12. However, since cholesterol can be synthesised by the human body, it is considered as non-essential and harmful when consumed in large amounts – dietary intake of cholesterol is associated with increased serum LDL cholesterol levels and an increased risk of developing CHD. Therefore, it is recommended that dietary cholesterol intake be limited to a daily intake of less than 300 mg/day among all life stage groups of the population (Smuts & Wolmarans, 2013:96; IOM, 2006:143).

Breastmilk has a high cholesterol content (100 – 200 mg/L), as apposed to minimal levels in formula milk, yet has been associated with lower serum total cholesterol levels in adolescence and adulthood, compared to formula-fed infants and toddlers (Trahms & McKean, 2012:380). Research suggests an increased stimulation and synthesis of enzymes required in cholesterol metabolism during infancy, hence increased cholesterol processing sufficiency in later life, as a possible mechanism (Owen *et al.*, 2008:305).

MUFAs are non-essential fatty acids and can be obtained from a variety of plant and animal sources. Epidemiological data indicates that the general population obtains approximately 50% of their daily MUFA intake from animal products. Furthermore, current research does not reflect any independent health benefit exerted by increased MUFA intake, hence nil RDA / AI or UL could be established for any of the life stage groups (IOM, 2006:124).

However, the FAO/WHO (2008:7) has found convincing evidence that replacing SFA (palmitic and lauric acid) with MUFA results in a decreased serum LDL cholesterol, as well as an improved TC / HDL cholesterol ratio, as mentioned previously, with an increased serum HDL cholesterol concentration observed from replacing CHO with MUFA.

Therefore, the FAO/WHO (2008:3-4) suggests an AMDR of approximately 15 – 25% of TE for all life stage groups, recommending that MUFA should comprise of the remaining daily fat allowance (% of TE), after contributions from all the other fatty acids (SFA, PUFA, TFA) have been subtracted. The SA-FBDG suggests a slightly lower MUFA intake of approximately 10% of TE for all life stage groups (Smuts & Wolmarans, 2013:96).

PUFAs are EFA. Humans lack the biological enzymes required for the synthesis of EFA and therefore relies on dietary sources to meet requirements and prevent EFA deficiency (Calder, 2012:592; IOM, 2006:124). Some of the symptoms associated with EFA deficiency includes dermatological disturbances (dry/flaky skin, follicular keratosis, atopic tendencies), attention deficit tendencies, decreased cognitive abilities and insomnia (FAB, 2003: Online).

PUFAs consist of n-6 and n-3 PUFAs. n-6 PUFAs exert pro-inflammatory effects through conversion of dietary alpha Linoleic acid (ALA) and arachidonic acid to pro-inflammatory eicosanoids (e.g. leukotrienes and prostaglandins), playing a role in gene regulation of fatty acid synthesis, cell signalling and epithelial cell function. n-6 PUFA are generally consumed in adequate (often excessive) amounts by the majority of the population, hence deficiency is rare among healthy individuals. n-3 PUFAs, however, exert various anti-inflammatory effects through conversion of dietary LA to the its two active eicosanoids; eicosapentaenoic acid (EPA) and docosapentaenoic acid (DHA) and is associated with a range of health benefits, as discussed below (IOM, 2006:129-130).

DHA and EPA plays a significant role in the human body, exerting a wide range of physiological functions via four general regulation mechanisms: alteration of cellular hormonal and metabolite concentrations, mediation of inflammation pathways (lipid oxidation and oxidative stress), direct cellular mediation via activation of anti-inflammatory transcription factors and alteration of cell membrane phospholipids (Calder, 2012:594).

Physiological functions include a role in regulation of vascular function (such as controlled BP and platelet function), cardiac function (such as lowered plasma TGL levels and normalized heart rate), metabolism (improved insulin sensitivity, fatty acid

metabolism, bone turnover and suppressed tumour cell growth), immunity, decreased inflammation, the aging process and the Central nervous system (CNS) (large component of the brain and retina; visual signalling) (AHA, 2014: Online; Calder, 2012:594).

Therefore, research has linked consumption of DHA and EPA to the prevention of chronic disease of lifestyle, such as CVD and T2DM (Serhan *et al.*, 2008:349; IOM, 2006:135).

DHA, specifically, is highly concentrated in the human brain and retina, hence significantly associated with cognitive and visual development in the foetus and young child up to the age of 24 months (Cetin & Koletzko, 2008:297; Krauss-Etschmann *et al.*, 2007:1392).

Physiological levels of EPA and DHA in the foetus correlates with maternal consumption of n-3 PUFA, emphasizing the need for adequate n-3 PUFA intake during pregnancy (Dunstan *et al.*, 2008:45). Recent research by Judge *et al.* (2007:1572) concluded that offspring from mothers who were supplemented with DHA during pregnancy reflected greater problem solving skills by the age of nine months. Furthermore, supplementation with both DHA and EPA during the last 16 months of pregnancy resulted in toddlers displaying greater hand-eye coordination skills by the age of 30 months, as compared to the control group (Dunstan *et al.*, 2008:45).

Recommendations by the FAO/WHO (2008:4) suggest U-AMDR for total PUFA intake of < 15% and 11% TE in children between the ages of 12 and 24 months and \geq 24 months, respectively, consisting of an U-AMDR of 10% and 3% of TE n-6 PUFA and n-3 PUFA, respectively, hence in line with the IOM (2006:74,122-123) recommendations. Additionally, the IOM (2006:122) specifies that 10% of the AMDR for ALA should comprise of preformed EPA/DHA sources, in order to account for poor conversion rate of ALA, the latter being applicable to all life stage groups.

The SA-FBDG provides general fatty acid recommendations for all life stage groups, suggesting a lower total PUFA intake of six to less than 10 % of TE, with a higher suggested daily intake of ALA than that of the IOM (2006:122); 1.4 – 2.7 (Smuts & Wolmarans, 2013:96).

However, biological conversion of ALA to EPA/DHA is of minimal efficiency. Therefore, it is recommended that members of all life stage groups to include preformed DHA/EPA sources (oily fish) in their diet on a regular basis (Neff *et al.*, 2011:207).

Furthermore, research suggests that a high n-6 PUFA to n-3 PUFA ratio can further inhibit the conversion of ALA to DHA, whereas a low n-6 PUFA to n-3 PUFA ratio can inhibit desaturation of LA to Arachidonic acid. Additionally, ratios below 5:1 increase risk of impaired growth in infants.

Therefore, currently available research recommends that infant formulas contain ratios between 5:1 – 10:1 and 6:1 – 16:1 (IOM, 2006:138).

The AHA (2015: Online) recommends that oily fish sources should be chosen according to the recommendation that each 85g portion contains ≥ 500 mg EPA/DHA. Pregnant women and young children should however avoid fish with a high mercury content, such as mackerel, sword fish and shark, opting for a variety of alternative oily fish (e.g. catfish, sardines, tuna and salmon) and shellfish sources (AHA, 2015: Online; Johnston *et al.*, 2012:827).

The SA-FBDG supports abovementioned guidelines and further urges early introduction of oily fish varieties in toddlers, in order to ensure long term adequate n-3 PUFA intake (Smuts & Wolmarans, 2013:96).

Various institutions have specified nutritional recommendations for EPA/DHA intake during pregnancy and the Infancy / toddler phase exists. The International Society for the Study of Fatty Acids and Lipids (ISSFAL) (2004: Online) recommends a daily intake of 500mg/day EPA and DHA for the general adult population, with an additional specification of 200 mg / day DHA during pregnancy and lactation, which is in line with the recommendations by the FAO (2010: Online) and that of the AAP, by Johnston *et al.* (2012:827), which is 200 – 300 mg/day EPA and DHA and 200 – 300 mg /day DHA during pregnancy and lactation, respectively.

The FAO/WHO (2008:4) suggests the following AI levels in toddlers: 10 – 12 mg/kg/day of DHA and 100 – 150mg/day EPA + DHA in those aged 12 – 24 months and two to four years, respectively. In SA, the latest SA-FBDG suggests that all members of the population consume a daily amount of 250 – 500 mg EPA/DHA from

performed sources and that oily fish be introduced early on in the weaning phase of toddlers, in order to ensure long term adequate intake of high quality n-3 PUFA sources (Smuts & Wolmarans, 2013:96). Table 2-13 provides an overview of the dietary intake recommendations for PUFA among toddler and pregnant members of the population (Smuts & Wolmarans, 2013:96; FAO/WHO, 2008:3-4; IOM,

Table 2-13 Dietary recommendations for PUFA in toddlers and pregnant women (Smuts & Wolmarans, 2013:96; FAO/WHO, 2008:3-4; IOM, 2006:74,122-123).

Age group	AMDR: PUFA (% X TE)	n-6 PUFA (LA) (g/d)	AMDR: LA (% x TE)	n-3 PUFA (ALA) (g/d)	AMDR: ALA (% x TE)	PUFA Ratio: n-6: n-3
Toddlers (1 – 3 years)	11 - < 15% 6 - < 10%	7	5 – 10%	0.7 1.4 – 2.7	0.6 – 1.2%	5 : 1 Range: 5:1 – 10:1 5:1 – 15:1 6:1 – 16:1
Pregnancy (all ages)	6 - 11% 6 - < 10%	13	5 – 10%	1.4 1.4 – 2.7	0.6 – 1.2%	5:1 – 10:1

2006:74,122-123).

e. Fluid requirements

Water is a vital component of the human body, involved in all physiological functions and accounts for approximately 70% of total body weight. Water is required for cellular homeostasis, maintaining vascular volume and the medium for nutrient transport and waste excretion. Fluid input and output are controlled through homeostatic mechanisms and total daily dietary fluid requirements are based on the water content of all beverages, as well as food (EFSA, 2013:21-22; IOM, 2006:158).

The IOM (2006:157) recommends an AI value of 1.3 L fluid per day in total, with 0.9 L from beverages, including water, whereas the EFSA (2013:22) recommends a range of 1.1 – 1.3 L per day in children aged 24 – 36 months (IOM, 2006:157).

ii **Micronutrient requirements**

Micronutrients, consisting of vitamins and minerals, are organic substances required for optimal physiological function. Vitamins are organic compounds found in food and cannot be biologically synthesised in sufficient amounts by the human body. Vitamins can consist of multiple isomers and active analogues, known as *vitamers*, and exert one or more of the following metabolic functions – membrane stabilization, electron transfer, serve as hormones and coenzymes. Vitamins can be classified as fat-soluble (vitamin A, D, E, K) or water-soluble (B-vitamins, vitamin C, biotin) (Gallagher, 2012:56-57;64-65).

Minerals, however, are micronutrients similar to vitamins, but required in even smaller quantities (constitutes only 4 – 5% of human body weight), yet still essential for normal physiological functioning. Classification of minerals include macrominerals (calcium, phosphorus, sodium, potassium, chloride) and microminerals (iron, magnesium, sulphur, zinc, copper, manganese, fluoride, molybdenum, cobalt, selenium, iodine, chromium and boron). Bioavailability of mineral components in food vary and is affected by interactions of minerals with one another, as well as with additional organic compounds, which can lead to nutritional deficiencies (Gallagher, 2012:91-92,95-96). Therefore, all micronutrients are essential substances required for optimal growth and development in young children and should therefore be ingested through consumption of a diet with adequate dietary diversity (Gallagher, 2012:56,91).

Table 2-14 lists the DRI's for all micronutrients in toddlers (IOM, 2006:530-535).

Table 2-14 DRI (RDA and AI) for vitamins and minerals in toddlers (IOM, 2010: Online; IOM, 2006:530-535)

Vitamin A (ug RAE/d)	Vitamin C (mg/d)	Vitamin D (ug/d)	Vitamin E (mg/d)	Vitamin K (ug/d) DRI (RDA and AI) for	Thiamine (mg/d)	Riboflavin (mg/d)	Niacin (mg/d)	Vitamin B6 (mg/d)	Folate (ug/d)	Vitamin B12 (ug/d)	Pantothenic acid (mg/d)	Biotin (ug/d)	Choline (mg/d)	
300	15	15	6	30*	0.5	0.5	6	0.5	150	0.9	2*	8*	200*	
Calcium (mg/d)	Chromium (ug/d)	Copper (ug/d)	Fluoride (mg/d)	Iodine (ug/d)	Iron (mg/d)	Magnesium (mg/d)	Manganese (mg/d)	Molybdenum (ug/d)	Phosphorus (mg/d)	Selenium (ug/d)	Zinc (mg/d)	Potassium (g/d)	Sodium (g/d)	Chloride (g/d)
700	11*	340	0.7*	90	7	80	1.2*	17	460	20	3	3*	1*	1.5*

*AI values

*1 ug of cholecalciferol is equal to 40 IU Vitamin D

RAE – Retinol Activity Equivalent

Meeting nutritional requirements in the presence of food jags (neophobic phase) during the second year of the toddler phase can prove challenging, hence the risk for micronutrient deficiencies increases. Toddlers require a diet with adequate dietary diversity, in order to meet stipulated requirements for each of the micronutrients, as listed in Table 2-14 (Escott-Stump, 2015:29).

Essential micronutrients to focus on during the toddler phase include iron, calcium, vitamin A, vitamin D and zinc, since young children tend to consume insufficient amounts of these nutrients (Craig, 2010:613; Baker *et al.*, 2007:14).

However, the AAP does not support the use of routine micronutrient supplementation in young children, with the exception of Fluoride, since evidence suggests that fluoride supplementation can prevent dental caries in children consuming non-fluoridated water (Kleinman, 2009).

a *Zinc*

Zinc plays an essential role in physiological growth and development, exerting structural, catalytic and regulatory functions within the human body. Zinc acts as a catalyst for a large number of enzymes and RNA polymerases, as well as a structural component of proteins, including those implicated in gene expression. Furthermore, zinc also plays an important role in immunity, wound healing and macronutrient metabolism (Gallagher, 2012:112-113; IOM, 2006:403-404).

Food sources rich in zinc can be classified according to bioavailability. Food sources with a high bioavailability include all animal flesh foods, such as red meat and fish. Whole grains and fortified cereal grains have a lower bioavailability due to the high phytate content of whole grains, as well as the large zinc losses (~ 80%) during the milling process of grains (IOM, 2006:405). Calcium supplements (specifically phosphate containing varieties) and iron supplements decrease zinc absorption, while food rich in calcium and iron has not been shown to affect zinc absorption (Gallagher, 2012:111; IOM, 2006:408-409).

Zinc content of breastmilk is significantly more bioavailable than that of cow's milk and infant formulas, providing infants with sufficient zinc intake during the first six months (Trahms & McKean, 2012:380; IOM, 2006:404).

Zinc deficiency presents with symptoms such as growth retardation (decreased growth velocity), alopecia, diarrhoea, decreased reproduction development, eye and skin lesions and anorexia (EFSA, 2013:28-29; IOM, 2006:410). Therefore, nutritional requirements for zinc in toddlers were set at 3 mg per day, accounting for daily zinc losses and additional amounts required for growth and development (IOM, 2006:403-404).

b *Iron*

Iron is an essential trace element (mineral), acting as a component of numerous enzymes, cytochromes, myoglobin, haemoglobin, as well as an essential mineral in transporting of oxygen and electrolytes. Haemoglobin contains the largest component of iron (60%). Haemoglobin forms part of circulating erythrocytes, which transport oxygen throughout the body, in order to maintain metabolism. Remaining iron

components are utilized (15%) or stored in myoglobin of myocytes (25%). Former iron components are known as functional iron, whereas iron stored in ferritin, hemosiderin and transferrin are referred to as storage iron (Gallagher, 2012:105,109; IOM, 2006:328-329).

Iron sources can be classified as either heme or non-heme iron. Heme iron is found in animal flesh products, such as poultry, fish and red meat, and is considered of high biological value, hence well absorbed. Non-heme iron from plant sources, such as legumes and vegetables, has a low bioavailability, hence poor absorption. Additionally, absorption of non-heme iron is affected by numerous dietary factors – ascorbic acid (vitamin C) and animal meat products enhance absorption, whereas phytate, polyphenols and calcium all inhibit and decrease absorption of non-heme iron from food (Gallagher, 2012:106,108; IOM, 2006:334-335).

Food sources rich in heme iron includes all animal flesh products, with beef liver (5.6 mg per 90g), lean beef meat (2.5mg per 90g) and canned tuna (2.5mg per 90g) ranking among the richest heme iron sources. Non-heme iron sources with a high iron content includes fortified oats (~14mg per 1 cup), cooked soy beans (4.4g per ½ cup), cooked chick peas (2.4mg per ½ cup) and cooked spinach (3.2 mg per ½ cup) (Gallagher, 2012:108; Baker & Greer, 2010:1045-1046).

Iron deficiency, a condition marked by insufficient available iron stores for maintenance of normal physiological function, occur due to either iron malabsorption, or a long term negative iron balance. Advanced iron deficiency results in iron deficiency anaemia, a condition marked by severe iron deficiency and a decreased haemoglobin concentration (< 6.8 mmol/L) (Baker & Greer, 2010:1040).

Iron content of breast milk is relatively low (0.3 mg/L), yet more bioavailable (approximately 50% of content absorbed), as apposed to that of infant formulas, cow's milk and complementary solid foods. Furthermore, infants have the ability to regulate iron absorption rate according to individual requirements, hence decreasing the risk of an iron deficiency up until the age of six months (EFSA, 2013:27; Trahms & McKean, 2012:380).

However, the risk for iron deficiency anaemia after the second half of the first year, up to the age of two years of life is relatively high, since meeting increased iron requirements during this time requires iron fortified infant formulas and adequate heme iron sources as part of complementary solid foods. Factors such as prematurity at birth, maternal chronic disease during pregnancy, lack of iron-fortified infant formulas after six months, excessive cow's milk consumption, introduction of cow's milk before the age of 24 months and complementary solid foods low in iron all contribute to risk of deficiency. Consequences and symptoms of iron deficiency anaemia includes impaired growth, impaired immunity, chronic fatigue, behavioural problems, impaired concentration and cognitive / psychomotor development delays (Chiocca, 2015:205; Baker & Greer, 2010: 1040).

Iron requirements in toddler's accounts for basal iron losses, increased concentration of iron in tissue and storage compartments, increased requirements for growth and expansion of blood volume. Taking into account fluctuation of bioavailability, nutritional recommendations was developed based on a general bioavailability of 18% for all member of the population aged one year and older. Therefore, an RDA of 7 mg per day is recommended in toddlers (IOM, 2006:329,334)

In addition to the recommendations by the AAP (2014:568-570) on iron status screening, as will be covered in section 2.7, the AAP stipulates nutritional prevention strategies as well – exclusive breast feeding with an added supplemental iron source by the age of four to six months is recommended. Alternatively, infant formula, as the infant feed of choice or in addition to breast milk, should be iron-fortified during the first year of life. Cow's milk should be introduced after 12 months and complementary foods introduced during weaning should include sources rich in iron (e.g. iron-fortified cereals and animal proteins). Lastly, cow's milk intake after 12 months should not exceed 24 ounce (~680 g), since large volumes might displace iron-rich food sources from the diet, as well as decrease iron absorption (Baker & Greer, 2010:1044-1046). Furthermore, iron from food sources with a high phytate content, such as beans and lentils (IOM, 2006:335), are poorly absorbed, emphasising the need for consumption of high bioavailable iron-rich feeds.

c **Vitamin A**

Vitamin A is one of the fat-soluble vitamins and plays a significant role in vision, as well as immunity, gene expression, growth and dermatological health (Escott-Stump, 2015:962).

Vitamin A deficiency leads to xerophthalmia, the primary clinical sign, which presents as night blindness during the initial stages and later as conjunctival xerosis, Bitot's spots and corneal ulceration, hence irreversible loss of vision. Xerophthalmia affects an estimated annual three to 10 million children among those living in developing countries (IOM, 2006:171,179; EFSA, 2013:35-36), with the prevalence in SA, 43.6% according to SANHANES-1 (Shisana *et al.*, 2013:213).

Vitamin A consists of numerous retinol compounds – retinol (pre-formed vitamin A), retinal, retinyl esters, as well as provitamin A carotenoids (dietary precursors of retinol) (IOM, 2006:171).

Pre-formed vitamin A naturally occurs in animal products, whereas provitamin A carotenoids can be consumed through oils, yellow / orange fruit (such as cantaloupe) and yellow / green vegetables (such as carrots, squash, butternut, peas and spinach), after which it is converted to Pre-formed vitamin A (IOM, 2006:171; Escott-Stump, 2015:962). Breast milk contains 60 mg pre-formed Vitamin A per 100 ml (INC, nd: Online), whereas organ meat typically contains 1049 – 9126 RAE per 3 oz). Less bioavailable plant sources, such as cooked carrots and butternut, contains approximately 671 and 953 RAE per ½ cup, respectively (Escott-Stump, 2015:962).

Therefore, the RDA for vitamin A in toddlers is 300 ug retinol activity equivalent (RAE) per day, as indicated in Table 2.14; hence a variety of vitamin A rich sources should be offered (IOM, 2006:170)

Vitamin A requirements are expressed as RAE's, accounting for the fact that beta-carotene plant sources are less bioavailable and should be consumed in larger quantities to meet requirements (IOM, 2006:171; Gallagher, 2012:60-61).

Bioavailability and absorption of vitamin A is enhanced though adequate intake of dietary fat, and the cooking process of food sources containing beta-carotene (e.g. carrots) (IOM, 2006:177).

d **Calcium and vitamin D**

Calcium is a mineral required for structural maintenance of all skeletal structures and teeth, hence 99% of physiological stores are bound within bones and teeth (IOM, 2006:287; EFSA, 2013:22-23). Additional functions of calcium includes a role in muscle contraction, heart rhythm, blood coagulation and blood pressure regulation (Escott-Stump, 2015:952).

Inadequate dietary consumption of calcium leads to increased bone resorption (hence poor bone mineral density), in order to maintain normal serum calcium levels and normal cellular / tissue function (Escott-Stump, 2015:952, EFSA, 2013:23; Gallagher, 2012:97-98). Dairy products are the primary dietary source of calcium – plain low fat yoghurt (415 mg per 227 gram), cheddar cheese (307 mg per 43 gram), low fat milk (285 mg per cup) and buttermilk (284 mg per cup), whereas mature breast milk contains only 35 mg per 100 ml (Escott-Stump, 2015:953; INC, nd:online). Additional calcium-rich food sources include plant foods, like broccoli (900 – 1000 mg per ½ cup, cooked) and spinach (291 mg per cup, cooked), sardines (368 mg per cup), as well as fortifies foods, like fortified cereals and bread (200 mg per slice) (Escott-Stump, 2015:953; Gallagher, 2012:98).

Vitamin D (*calciferol*), as a fat-soluble vitamin, plays a major role in bone health and can be obtained from the diet (from fortified products), as well as synthesised within the skin through sun exposure to ultraviolet B rays. Vitamin D also exert hormonal functions, of which exact mechanism is unknown at current (EFSA, 2013:36; IOM, 2006:225).

The primary function of vitamin D is the maintenance of normal intracellular and extracellular Calcium and Phosphorous levels, gene expression, promoting the deposition of these nutrients within bone structures, as well as playing a role in prevention of Cancer, CVD, T2DM and infectious diseases (Escott-Stump, 2015:963; EFSA, 2013:36-37; Lucas *et al.*, 2012:393).

Vitamin D deficiency presents primarily as inadequate bone mineralization, leading to rickets in young children and other bone deformities (Escott-Stump, 2015:964; EFSA, 2013:36).

Nutritional requirements of vitamin D in toddlers is 15ug cholecalciferol (600 IU), which can be met through adequate sun exposure (approximately 10 – 20 minutes per day) and consumption of vitamin D rich food sources (IOM, 2010: Online).

Food sources naturally rich in vitamin D includes sardines (250 IU per 57 gram), tuna (200 IU per 85 gram) and egg yolk (20 IU per egg yolk), whereas food sources fortified with Vitamin D includes Soy milk (119 IU per cup), low fat fresh milk (100 IU per cup), orange juice (100 IU per cup) and margarine (60 IU per TBS) (Escott-Stump, 2015:963–964; Gallagher, 2012:69).

iii Portion recommendation

General recommendations on portion sizes for toddlers is to provide one tablespoon (TBS) of a food for each year in age, offering more according to the child's appetite (Lucas *et al.*, 2012:398).

An estimated one third to half and half to two thirds of an adult-sized portion can be served by the age of one year, three years and six years, respectively (Trahms & McKean, 2012:387).

Parents should ensure that meals are served in regular intervals - three main meals and three snacks, focussing on adequate variety (dietary diversity), including all five food groups (ITF, 2016b: Online; Webster-Gandy *et al.*, 2012:272; Online; Weaver *et al.*, 2007:42)

Current proposed healthy eating guidelines and portion sizes for children aged one to four years in the UK (Thomas & Bishop, 2007:292-300; Scottish executive, 2006:5-27; Crawley, 2006:69-71), were recently compared to reported portion sizes from two large nutritional surveys focussing on this age group, namely the Avon Longitudinal Study for Parents and Children (ALSPAC) (Emmet *et al.*, 2002:55), and the National Diet and Nutrition Survey (NDNS) (Gregory *et al.*, 1995: Online), in order to determine the practicality and nutritional adequacy of these guidelines. Based on this comparison, practical portion size ranges for this age group, were established (More & Emmett, 2014:135), that are adequately flexible to meet the nutritional requirements, considering appetite common fluctuations (More & Emmett, 2014:135; Wrieden *et al.*, 2008:1344; Cowin & Emmet, 2007:254;). Food portion reference ranges were

generated and standardised for a total of 164 foods, which were grouped under the five main food groups (**Appendix H**). Table 2-15 provides a summary of commonly consumed foods, adapted from the original 164-item exchange list, which currently serves as the most recently published nutrition guideline for this age group (More & Emmett, 2014:138-146).

Table 2-15 Evidenced-based food portion reference ranges in children aged 1 – 4 years (More & Emmett, 2014:138-146).

1	Breads, rice, potatoes , pasta & other starchy foods	
	Food item	Portion range
	Bread / bread roll	½ - 1 slices and 1/4 - 3/4 rolls
	Cream / wholewheat cracker, rice cakes	1 - 3 crackers, rice cakes
	Potato baked, mashed	1/4 - 1/2 whole, 1 – 4 TBS mashed
	Potato chips	4 - 8 chips
	Couscous	2 - 4 heaped TBS
	Noodles	1/2 - 1 small C
	Pasta, rice (boiled)	2 - 5 TBS
	Dry breakfast cereal	3 - 6 heaped TBS
	Porridge made with water	5 - 8 TBS
	Sugar-coated cereal	3 - 6 TBS
	Wheat Bix	1/2 - 1 1/2 biscuits
	Hotcross bun	1/4 - 1/2 bun
	Scone	1/2 - 1 scone
2a	Fruit	
	Food item	Portion range
	Apple, orange, mango	1/4 - 1/2 medium fruit OR piece
	Avocado	1/2 - 2 TBS
	Banana, pear, pineapple	1/4 - 1 medium fruit OR fruit piece
	Berries and grapes	3 - 10 small berries
	Dried fruit	1 - 4 pieces OR 1/2 - 2 TBS
	Fruit salad	1/2 - 1 small bowl
	Stewed / tinned / pureed fruit	2 - 4 TBS
2b	Vegetables	
	Food item	Portion range
	Beetroot, broccoli, cauliflower	1/2 - 2TBS
	Cabbage, carrots	1 - 3 TBS
	Celery, cucumber, pepper	2 - 8 small slices / sticks
	Cherry tomato, tomato	1 - 4 cherry, 1/2 - 1 tomato
	Squash, spinach, green beans, onions, peas, mixed vegetables, sweetcorn	1/2 - 2 TBS
	Mushrooms	1 - 4 button mushrooms
	Homemade veg soup	1/2 - 1 bowl (60 - 125ml)
3	Milk, cheese and yoghurt	
	Food item	Portion range
	Cow's milk, flavoured milk	100 - 120ml
	Formula milks	100 - 120ml
	Hard cheeses	15 - 25g OR 2 - 4 TBS grated

Soft cheese (cottage / ricotta)	1/2 - 1 TBS
Processed cheese	1 slice, 1 small cube, thickly spread on bread (15 - 21g)
White cheese sauce	1 - 4 TBS
Yoghurt	125ml (1 small tub)
Custard	5 - 7 TBS
Milk pudding	4 - 6 TBS
4	Meat, fish, eggs, nuts and pulses
Food item	Portion range
Bacon	1/4 - 1 rasher
Beef patty	1/4 - 1 small
Chicken	1/2 - 2 slices OR 1/2 - 1 drumstick OR 2 - 4 nuggets
Meatballs	1 - 3 balls (1 TBS size)
Minced meat	2 - 5 TBS
Pork	1/2 - 2 slices
Sausage	1/4 - 1 medium
Fish fingers	1 - 2 fingers
Fish cakes	1/2 - 1 cake
Fresh fish	1/4 - 1 fillet OR 1 - 4 TBS
Tinned fish	1/2 - 1 1/2 TBS
Eggs	1/2 - 1 boiled OR 2 - 4 TBS
Nuts	1 - 2 TBS ground
Peanut butter	1/2 - 1 TBS
Dried/cooked beans / lentils	2 - 4 TBS

5a	Fats and oils	
	Food item	Portion range
	Butter / margarine	1 tsp
	Extra oil used for cooking	1 tsp
	Mayonnaise, creamed sauce, salad dressing (oil-based)	1 - 2 tsp
5b	Puddings and snacks	
	Food item	Portion range
	Any type of cake	2 - 4 TBS OR 1/4 - 1/2 slice
	Chocolate mouse	1 - 3 TBS
	Sweet tart / pie	1/2 - 1 small tart or slice
	Ice cream	2 - 3 heaped TBS
	Jelly	2 - 4 TBS
	Pancake	1/2 - 1 small
	Doughnut	1/4 - 3/4 of a 60g piece
	Biscuit coated or with filling	1/2 - 1 biscuit
	Plain biscuit	1 - 2 small biscuits
	Muffin	1/8 - 1/4 of a 125g muffin
5c	Sauces and sweet / savoury spreads	
	Food item	Portion range
	Jam / syrup / honey	1 tsp
	Gravy, tomato sauce	1 - 2TBS
	Marmite	Thinly spread (1g)
5d	Confectionary, savoury snacks and sweet drinks	
	Food item	Portion range
	Added sugar (granules)	1/2 - 1 tsp
	Chocolate bar	2 - 4 blocks (12 - 24g)
	Dried snack bar	1/2 - 1 bar (15g)
	Popcorn (sweet/savoury)	1/2 - 1 cup (4 - 8g)
	Boiled sweets, gums	1 - 2 sweets, 2 - 4 gums
	Crispy chips	4 - 6 chips
	Salty biscuit	1 - 3 small biscuits
	Fruit juice (diluted)	1 C (100 - 120ml)
	Undiluted squash / fizzy drinks	1 C (100 - 120ml)
	Drinking chocolate (powder)	1 - 2 tsp

iv Food-based dietary guidelines and food guides

Food-based dietary guidelines (FBDG) and food guides are scientifically-based national dietary recommendations aimed at promoting healthy lifestyle within an entire population. FBDG convey essential nutritional messages in terms of basic language and symbols, considering local culture, customs and dietary patterns. Locally available foods are used in order to illustrate recommended portion sizes, food groups and dietary patterns for optimum nutritional status and health. Additionally, FBDG forms a platform for public nutrition, health and agricultural policies, as well as nutrition education programmes (FAO, 2015a: Online).

More than 100 countries have established national FBDG, often accompanied with visual food guides, in the form of a food plate or a pyramid. Food guides provide a visual illustration of food groups, specifying portion recommendations (FAO, 2015b: Online).

Various food guides exist, such as the “Eat Well Plate” developed for the UK (NHS, 2015: Online), the “My Plate” developed by the USDA (2015a: Online), the “Rainbow Food Guide” developed for Canada (Health Canada, 2011: Online), the newly revised “Healthy Living Pyramid: developed for Australia (Nutrition Australia, 2015: Online), as well as the recently updated SA-FBDG (Vorster *et al.*, 2013: Online).

In the UK, the ITF website is dedicated to improving the nutritional status of infants and toddlers through ongoing education of both parents and healthcare workers. Nutritional guidelines are focussed on consuming a variety of foods from all five food groups, in age-appropriate portions, on a daily basis, as illustrated in Table 2-15 (ITF, 2014: Online; ITF, 2010a:11). Energy and nutrient dense meals are emphasised and three age-appropriate portioned meals, with two to three small snacks are recommended (Cowbrough, 2010: Online; Weaver *et al.*, 2008:41–42). Basic user-friendly educational material on toddler feeding guidelines, such as the “Ten steps for healthy toddlers”, provide caregivers and health care workers with a complete overview of the essential components required for optimal nutrition and development in toddlers, as illustrated in Table 2-16 (ITF, 2016a: Online).

In SA, the SA-FBDG for children older than one year and younger than seven years, are used as a general nutritional intake guideline for toddlers. SA-FBDG are similar to that of the ITF, with additional emphasis on regular clinic visits, regular plant protein intake and ample clean water consumption (Bourne, 2007:228). Additionally, the proposed updated SA-FBDG for children between the ages of 12 months and 24 months place more emphasis on gradual introduction of complementary solid feeds, a variety of fruit and vegetables, as well as limitation of sugar and SSB. Current and the proposed updated FBDG for young children is listed in Table 2-17 (Vorster *et al.*, 2013:9; Bourne, 2007:228).

Table 2-16 Ten steps for healthy toddlers by the ITF (ITF, 2016a: Online)

Family meals should be relaxed and happy occasions
Parents should decide which nutritious foods to offer, but toddlers should decide how much to eat
Foods from all 5 food groups should be offered to toddlers on a daily basis
A daily routine of three main meals and two to three small snacks should be established
Drinks should be offered as six to eight cups of liquid; water preferably
Suitable Vitamins A and Vitamin D supplements should be provided each day.
toddlers should not be force-fed and taste preferences should be respected
Reward for toddlers should entail attention and not special food and treats
Fried food and all snacks high in saturated fat, salt, refined carbohydrates and sugar should be limited, whereas sugar-sweetened beverages (fizzy drinks and undiluted fruit squashes) and food with a choking hazard (nuts) should be completely avoided
Allow for at least three hours of sleep during the day and 12 hours of sleep at night

Table 2-17 South African Food-based Dietary Guidelines for children aged > 1 year and < 7 years (Vorster *et al.*, 2013:9; Bourne, 2007:228).

Food-based Dietary Guidelines for children aged > 1 and < 7 years of age	Proposed new guidelines for toddlers 12 – 36 months (2013)
Feed children five small meals a day Encourage children to enjoy a variety of foods	Feed your child five small meals during the day. Continue to breastfeed to two years and beyond. Gradually increase the amount of food, number of feedings and variety as your child gets older.
Offer children clean, safe water regularly	Hands should be washed with soap and clean water before preparing or eating food.
Take children to the clinic every 3 months	
Encourage children to be active every day	Encourage your child to be active.
Make starchy foods the basis of a child's main meals	Make starchy foods part of most meals.
Children need plenty of vegetables and fruits every day.	Give your child dark-green leafy vegetables and orange coloured vegetables and fruit every day.
Children can eat chicken, fish, meat, eggs, beans, soya or peanut butter every day	Give your child meat, chicken, fish or egg every day, or as often as possible.
Children need to drink milk every day	Give your child milk, <i>maas</i> or yoghurt every day.
Chicken, fish, milk, meat or eggs could be eaten daily	
If children have sweet treats or drinks, offer small amounts with meals	Avoid giving tea, coffee and sugary drinks and high-sugar, high-fat salty snacks to your child.

2.6.10 Dietary diversity

Additional tools in evaluating the adequacy of macro and micronutrient content, include dietary diversity scoring (Kennedy *et al.*, 2013:5). Dietary diversity refers to the variety of food consumed over a given period of time, by either an individual or a household, in terms of food groups. Adequate dietary diversity is of significant importance for adults and children alike, as it reflects by proxy, the adequacy of nutritional intake and the degree to which nutritional requirements are met (Kennedy *et al.*, 2013:5; Arimond & Ruel, 2004:2579). Maintaining an adequate level of dietary diversity is especially crucial for infants and toddlers, since they require a consistent supply of nutrient dense food sources in order to meet their high nutritional needs and to achieve optimal physical and mental growth and development (Steyn *et al.*, 2006:644; Arimond & Ruel, 2004:2579). The WHO (2007:3,7) has therefore included *minimum dietary diversity* in the eight core indicators for assessing infant and young child feeding practices. Dietary diversity also reflects the level of economical access a particular household has to a variety of food, which is related to current socio economic status and food security (Hatloy *et al.*, 2000:57).

Research supports correlation between higher dietary diversity scores and improved nutritional adequacy of diets consumed by infants and young children, as well as growth parameters of young children emphasising the importance of maintaining an adequate level of variety in toddlers' diets (Marriott *et al.*, 2012:354; Steyn *et al.*, 2006:644; FANTA, 2006: Online; Arimond & Ruel, 2004:2579,2582).

Dietary diversity scores are commonly based on twelve food groups, focusing predominantly on meals prepared and consumed at home over a 24 hour reference period (Kennedy *et al.*, 2013:5). Dietary diversity scoring systems can, however, be adapted according to study population needs, as recommended by Kennedy & Nantel (2006: Online), as was done by Kennedy *et al.* (2007:473) in a study where scoring was based on 10 food groups among Filipino children of 24 to 71 months of age.

Kennedy *et al.* (2013:24) recently proposed the use of an updated score based on nine food groups, which has been validated on an international level for women of reproductive age (Arimond *et al.*, 2010:2059-2068). Recent studies by Nti (2011:105), Steyn *et al.* (2006:644) and Daniels *et al.* (2007:2) successfully applied this nine food

group measure of dietary diversity among children aged from one to eight years. Additionally, a significant correlation was observed between dietary diversity assessed in this way, and micronutrient adequacy as well as growth parameters.

The WHO assesses dietary diversity based on seven food groups, calculating the proportion (percentage) of children aged six to 23 months who consume at least four of the seven food groups on a daily basis, which is the cut-off value for minimum adequate dietary diversity according to this tool (WHO, 2007:3,7). Three recent publications using this tool, found a strong correlation between dietary diversity with micronutrient adequacy and growth parameters among infants and toddlers (Khanal *et al.*, 2013:131; Marriott *et al.*, 2012:354; Arimond & Ruel, 2004:2579).

2.6.11 Household and child food security

Household food security is defined as the degree to which all members of the household have sufficient access to nutritionally adequate, safe and affordable food, in order to maintain an active healthy lifestyle (USDA, 2013: Online; Vorster, 2010:2; Blumberg *et al.*, 1999:1231).

Household food insecurity, on the other hand, refers to the limited and fluctuating availability of nutritionally adequate and safe food among members of a household, resulting in regular hunger, nutritionally inadequate dietary intake, an increased risk for malnutrition and raised anxiety levels regarding the situation (NRC, 2006: Online; Blumberg *et al.*, 1999:1231).

Several tools have been developed to assess food security at household level. Examples of tools specifically measuring food security at the level of the children in the households include the 8-question Children's Food Security Scale which is a sub-section of the USDA 18-question Household Food Security Questionnaire (Bickel *et al.*, 2000:Online), as well as the CCHIP index (Food Research and Action Centre, 1991: Online).

The 18-question Household Food Security Questionnaire (HFSQ) interprets the level of household food security in terms of four levels – high, marginal, low and very low food security. High food security is associated with constant adequate access to food without anxiety; marginal food security is associated with insufficient access to food at

times, but insignificant reduction in quantity, quality and variety of nutrition; low food security is associated with reduced quality and variety of food, but normal quantity and eating patterns; and very low food security is associated with insufficient financial resources on household level and limited food access, as well as periods of insufficient food quantity and disrupted meal patterns, leading to hunger. However, when using the 8-question Children's Food Security Scale, the level of food security is interpreted in terms of only three levels – high or marginal food security, low food security and very low food security (Nord & Hopwood, 2007:535).

2.7 Physiological development and milestones related to nutrition

Dietary intake may also be influenced by developmental phase and age-appropriate physiological developmental milestones, and age-appropriate feeding skills therefore also need to be assessed (Lucas *et al.*, 2012:390; Maqbool *et al.*, 2008:7).

Infancy (birth to 12 months) is characterised by rapid physiological development, during which birth weight should double and triple by six months and the end of the first 12 months, respectively (Trahms & McKean, 2012:375). The next phase is classified as the preschool phase (12 months to five years), characterised by a significant decreased rate of growth (between 12 and 18 months), in preparation for the next growth spurt during puberty. Extensive neurological development takes place throughout the preschool phase, marked by rapid brain development and establishment of fundamental cognitive skills (e.g. working memory, language skills, inhibitory control) (Escott-Stump, 2015:28; Rosales *et al.* 2009:190). Table 2-18 lists of appropriate age-specific developmental milestones during the toddler phase (Chiocca, 2015:34-35, CDC, 2014a: Online).

Table 2-18 Developmental milestones in toddlers (Chiocca, 2015:34-35; CDC, 2014a: online).

Age	Motor skills	Cognitive	Language	Social
12 months	<p>GROSS MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Able to sit up without assistance • Begin to stand alone • Walks while holding on to furniture. • Begin to walk short distances independently with wide-based gait <p>FINE MOTOR SKILLS</p> <ul style="list-style-type: none"> • Fine pincer grasp, self-feeding and ability to use a cup. • Attempts building two-block towers. • Throw ball overhand. • Able to turn several pages at a time. 	<ul style="list-style-type: none"> • Able to use utensils more efficiently • Short attention span and egocentric thinking • Able to follow one-step commands • Explore via shaking, banging, poking or throwing objects. • Able to place and remove objects from a container. • Search for objects where it was last seen • Show interest in cause and effect games • Able to name general objects and associate names with correlating pictures • Copy gestures 	<ul style="list-style-type: none"> • Responds to simple spoken requests • Uses simple gestures, like shaking of the head or waving. • Utter first meaningful words (2 – 10 words), like “mama”, “dada” and “uh-oh!” • Ability to learn a new word each week. • Imitates vocalizations. 	<ul style="list-style-type: none"> • Develops rituals and yearns for more autonomy. • Express more emotion and may have temper tantrums. • Tends to be shy and nervous with strangers; cries when parents leave. • Favor certain things and people • Hands you a book when he wants to hear a story • Seek attention through repetition of sounds or actions • Puts out arm or leg to help with dressing • Enjoys social games, such as “peek-a-boo”
15 Months	<p>GROSS MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Able to walk well (independently), crawl up stairs and may even run <p>FINE MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Able to build a two-cubed tower, scribble vigorously and self-feed with skill. 	<ul style="list-style-type: none"> • Egocentric, refuse to share toys. • Express increasing interest in pictures 	<ul style="list-style-type: none"> • Can say 3 – 10 words • Understands simple commands • Use finger pointing and grunting for requests 	<ul style="list-style-type: none"> • Separation anxiety peaks between 15-18 months • Imitates during play, parents doing housework and likes to play with balls • Enjoys listening to short stories
18 months	<p>GROSS MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Ability to walk slightly faster and steadier and slowly walk up stairs with assistance. • May run and start to play with a ball outside. 	<ul style="list-style-type: none"> • Ability to follow one-step verbal commands – e.g. child will sit when asked to do so. • Recognize the purpose and function of everyday objects – e.g. telephone, brush and spoon. 	<ul style="list-style-type: none"> • Can utter 20 or more words, consisting of two-word phrases. • 25% intelligibility, understanding requests, following simple directions. • Knows up to 50 words. 	<ul style="list-style-type: none"> • Likes to hand things to others, inviting them to play. • Increasing frequency of temper tantrums and still weary of strangers. • Tend to have security objects,

	<ul style="list-style-type: none"> • Drag toys along while walking <p>FINE MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Can build a tower of three to four cubes • Can assist with undressing • Mastered skill of drinking from a cup and using a spoon. • 	<ul style="list-style-type: none"> • Can identify a few basic body parts • Can distinguish between people • Shows interest in a doll or stuffed animal by pretending to feed • Enjoy scribbling alone 	<ul style="list-style-type: none"> • Says no and shakes head. • Points to show someone what he wants 	<p>such as a “blanky”</p> <ul style="list-style-type: none"> • Explore alone, but remain close to parents / caregivers. • Tend to cling to caregivers when confronted with an unfamiliar situation. • Still enjoys playing pretend, such as feeding a doll • Enjoys listening to short stories with abundant pictures.
<p>24 months</p>	<p>GROSS MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Walks with significantly steadier gait. • Able to walk up stairs unassisted. • Able to climb onto platforms, such as furniture, without assistance. • Stand on toes. • Starts to run, jump and kick a ball outside, independently. <p>FINE MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Ability to get dress in simple outfits, independently. • Ability to draw or copy straight lines and circles. 	<ul style="list-style-type: none"> • Still egocentric • Start developing a sense of time. • Start following twos-step commands, such as “pick up your shoes and put it back in the cupboard • Ability to find well-hidden objects, even when hidden under two or three covers. • Begins to categorize shapes and colours. • Able to name six body parts. 	<ul style="list-style-type: none"> • Vocabulary of approximately 300 words, using two-to-three word phrases. • Ability to point and name objects and complete simple sentences from familiar books. • Remember names of familiar people and body parts • Can distinguish between first and last names and start applying it. 	<ul style="list-style-type: none"> • Increased ritualistic behaviour and autonomy. • Enjoys rhyming and singing. • Imitates adults and older children. • Enjoys the company of peers and may identify a friend by name. • Starts to shows defiant behaviour. • Starts to include peers in games, such as chasing games.

30 Months	<p>GROSS MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Ability to jump with both feet. • Can briefly balance on one foot • May be able to ride a tricycle. <p>FINE MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Can build a tower of eight cubes. • Can hold a crayon with fingers instead of fist. • Can imitate horizontal lines and draw / copy a cross. 	<ul style="list-style-type: none"> • Ability to follow two-step verbal commands. • Acknowledge own sex. • State first and last names. • Increased curiosity and tends to question everything 	<ul style="list-style-type: none"> • Ability to use two-word sentences, containing adjectives, adverbs and pronouns (often out of context though). • Can name most colours. 	<ul style="list-style-type: none"> • More willing to be separated from parents. • May ne toilet-trained.
3 Years	<p>GROSS MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Climb stairs, alternating feet. • Able to ride a tricycle. • Able to balance on one leg for a few seconds. • Jump and hop skilfully. <p>FINE MOTOR SKILLS:</p> <ul style="list-style-type: none"> • Able to self-feed skilfully and pour fluid from a jug into a cup. • Starts to use scissors. • Ability to dress without assistance – able to handle clothing buttons. • Able to copy a circle. • Able to build a bridge of blocks. • Able to screw and unscrew lids from jars and turn door handles. • Able to wash own hands. 	<ul style="list-style-type: none"> • Start to progress from autonomy to initiative. • Strives for independency and asks progressively more questions. • Still egocentric, but able to share toys. • Enjoys games with rules and imagination. • Develop irrational fears, such as fear of the dark and monsters. • Can operate toys with buttons, levers, and moving parts. • Plays make-believe with dolls, animals, and people. • Able to complete puzzles with 3 or 4 pieces. 	<ul style="list-style-type: none"> • Vocabulary of approximately 900 words and uses three- to four-word sentences. • 75% intelligibility; uses plurals, pronouns, proverbs and adjectives in context, talks constantly and may stutter. • Follows instructions with multiple steps. 	<ul style="list-style-type: none"> • Still tend to imitate adults and peers. • Shows increased affection for friends. • Understands the concept of taking turns in games. • Separates easily from parents. • Change in routine may be upsetting. • Self-care skills developed – can get dressed and toilet trained.

2.8 Biochemical assessment

Biochemical analysis is required as part of the nutritional assessment in paediatric patients where an underlying medical condition causing nutritional deficiency is suspected. Analysis of serum nutrient levels, nutrient-dependent metabolites or functional impairment of any nutrient-dependent metabolic processes are performed (Shaw & McCarthy, 2015:9).

Blood samples are most often used (whole blood, serum, plasma and blood cells), as well as stool samples and occasionally urine, skin and hair samples. Intake levels of protein and energy among toddlers can be evaluated for adequacy using serum albumin and pre-albumin, the former also providing a long-term reflection of protein stores, in the absence of metabolic stress (Shaw & McCarthy, 2015:10; Litchford, 2012:191-198).

Additionally, the AAP (2014:569) recommends that all toddlers be screened for iron deficiency anaemia at the age of 12 months. toddlers identified to be at high risk of developing iron deficiency anaemia, such as those who was not breastfed during infancy and consumed infant formula without added iron, high consumption of cow's milk and introduction before the age of 12 months, who suffered chronic infections, significant blood loss and / or inflammatory disorders, should receive a follow up screening at 15 and 30 months (Chiocca, 2015:205).

Table 2-19 lists the appropriate biochemical tests and interpretations thereof to assess the status of various nutrients (Shaw & McCarthy, 2015:10, Kleinman & Greer, 2015:634-635; Maqbool *et al.*, 2008:11)

Table 2-19 Assessment of biochemistry in toddlers (Shaw & McCarthy, 2015:11; Kleinman & Greer, 2014:634-635)

Nutrient	Test	Normal values in Children	Interpretation
Protein	Total plasma albumin	55-89g/L	Low levels - long term protein depletion. Low levels – acute protein depletion or an infection.
	Caeruloplasmin RBP	0.18-0.46 g/L 2.6 – 7.6 g/L	
Vitamin B1	Erythrocyte transketolase	1 – 1.5	High activity coefficient (>1.15) – Vitamin B1 activity coefficient deficiency
Vitamin B12	Plasma B12 value	263 – 1336 pmol/L	Low levels – deficiency
Vitamin B2	Erythrocyte glutathione reductase activity coefficient	1 – 1.3	High activity coefficient (>1.3) indicates deficiency.
Vitamin C	Plasma ascorbate level	8.8 – 124 umol/L	Low levels indicate deficiency.
Vitamin A	Plasma retinol level	0.54 - 1.56 umol/L	Low levels indicate deficiency (<0.3umol/L)
Vitamin D	Plasma 25-hydroxy cholecalciferol level	30 – 110 umol/L	Low levels indicate deficiency.
Vitamin E	Plasma tocopherol level	Alpha-tocopherol: 10.9 – 28.1 umol/L	Low levels indicate deficiency.
Copper	Plasma level	70 – 140 umol/L	Low levels indicate deficiency.
Selenium	Plasma level Glutathione peroxidase activity	0.76 – 1.07 umol/L > 1.77 umol/L	Low levels indicate deficiency.
Zinc	Plasma level	10 – 18 umol/L	Low levels indicate deficiency.
Folic acid	Plasma level Red cell level	7 – 48 nmol/L 429 – 1749 nmol/L	Low levels indicate deficiency
Haemoglobin	Whole blood	104 – 140 g/L	Levels < 110 g/L indicate Fe deficiency
RCW	Whole blood	< 16%	High values indicate Fe deficiency
MCV	Whole blood	70 – 86 Fl	Small volume (microcytosis) indicates Fe deficiency
Mean cell haemoglobin	Whole blood	22.7 – 29.6 pg	Low values indicates Fe deficiency
Ferritin	Plasma levels	5 – 70 ug/L	Low levels indicate depletion of Fe stores or an infection.

2.9 Conclusion

Paediatric patients, specifically, require optimal nutritional status in order to maintain normal growth and cognitive development, as well as reach optimum future health. Therefore, it important to conduct regular, thorough nutritional assessments in young

children (Shaw & McCarthy, 2015:3-4; Chiocca, 2015:193). Assessment of nutritional status requires a holistic approach (Queensland Health, 2007: Online), with emphasis on accurate evaluation of all relevant parameters, including socio-demographic information; clinical assessment (medical history and examination of physical signs); anthropometric assessment; assessment of dietary intake, which includes parameters such as dietary diversity, household and child food security; as well as assessment of relevant biochemical results and tests (Shaw & McCarthy, 2015:4; Kleinman & Greer, 2014:609; Maqbool *et al.*, 2008:5-6).

CHAPTER 3: METHODOLOGY

Nutritional status is defined as the balance between nutritional adequacy and nutritional requirements, reflecting the degree to which a toddler's nutritional needs are met. (Hammond, 2012:129). This study aimed to evaluate the nutritional status based on socio-demographic information, nutritional related clinical signs, anthropometric measurements, and usual dietary intake, dietary diversity and household food security of toddlers (referring to a child between the age of 12 and 36 months) attending day care centres in Newton Park, a main industrial suburb in Nelson Mandela Bay.

In this chapter the methodology followed in order to meet the aim and objectives stipulated in Chapter 1, are described in terms of ethical approval, study design, study population and sample selection, variables, techniques, validity, reliability and procedures. The pilot study, statistical analysis, ethical considerations and challenges/limitations experienced during the execution of this study, are also described. All data was collected by the researcher, a registered dietician (SA RD) who was trained at the University of the Free State (UFS) and has been working as a clinical dietician in Nelson Mandela Bay for five years, with experience in all medical nutritional therapy domains, including paediatrics.

3.1 Ethical approval and permission

Approval for conduction this research project was obtained from the Ethics Committee of the Faculty of Health Sciences of the University of the Free State (UFS) (ECUFS NR 14/2015). Permission to perform this study at selected day care centres were not required from the Department of Education, since institutions teaching children younger than six years of age are managed privately and are not required to be registered with any organisation. Upon enquiry from selected day care centres, the researcher was not made aware of registration with any additional departments. Permission was therefore obtained from the principal of each institution (**Appendix E**).

3.2 Study design

A descriptive quantitative study was conducted.

3.3 Study population

The study population was a diverse group (in terms of socio demographics) of toddlers, attending day care centres in Newton Park. Socio demographic status vary greatly among citizens of Nelson Mandela Bay (as discussed in the problem statement, Chapter 1) and an optimal statistical representable study population would have included a sample including day care centres from all suburbs, differentiating between the higher, middle, as well as lower income groups. However, for the purpose of this mini dissertation, Newton Park was selected as the most representable suburb on the basis of its central location, large number of established day care centres and industrial nature. Furthermore, it was to be expected that due to the large number of businesses and work opportunities, caregivers from other suburbs and diverse income groups might enrol their toddlers in Newton Park day care centres during their working hours in this area.

3.3.1 Sample selection, inclusion and exclusion criteria

A convenience sample was drawn from the total population of toddlers attending day care centres in Newton Park. Twelve day care centres were initially identified through a search of electronic data bases (*the initial group*), and seven additional institutions were identified through a physical surveillance of the suburb (*the additional group*). All 19 day care centres were approached and invited to participate in this study. Only six institutions, namely *Playtime Academy*, *Peter Rabbit*, *Mowbray*, *Jungle Book*, *Exclusive Kids Day Care* and *Awesome Kidz*, gave permission for the study and were eventually included, providing a total sample size of 55 toddlers targeted through their caregivers / secondary caregivers. The selection of the convenience sample is summarised in Table 3-1.

All male and female children aged 12 months to 36 months, attending any one of the selected day care centres in Newton Park, Nelson Mandela Bay, were included, on condition that at least one caregiver / secondary caregiver of each participant gave written informed consent and was willing to participate in a structured interview with the researcher.

Children who did not meet the age criteria were excluded from the study. Additionally, toddlers with caregivers who were either unwilling to provide informed consent and / or unwilling to agree to an interview, were excluded from the study.

Data collection (including anthropometric measurements and interviews) was performed from 20 April to 27 May 2015.

Table 3-1 Process of selecting the convenience sample

Name of day care centre	Recruitment group	Participation status	Number of participants
Awesome Kidz Day Care (School B)	Additional group	Participated	11
Blue Buddies Educare	Additional group	Declined	
Bright and Beautiful Educare	Additional group	Declined	
Exclusive Kids Day Care (School A)	Additional group	Participated	10
Incredible Kids Day Care	Initial group	Declined	
Jungle Book (School D)	Initial group	Participated	8
Little Champion Day care centre	Initial group	Declined	
Little Rascals Baby Care	Initial group	Declined	
Miss Muffet Day Care	Additional group	Declined	
Montessori	Initial group	School closed down	
Mowbray (School E)	Additional group	Participated	8
New Generation Learning Centre	Initial group	Declined	
Newton Park Crèche and Educare	Initial group	Declined	
Peter Rabbit (School F)	Initial group	Participated	8
Playtime Academy (School C)	Additional group	Participated	10
Smiley Kids	Initial group	Declined	
The Shepard's Garden Play School	Initial group	Declined	
Tick Tock Educare	Initial group	Declined	
Universal Kids Aftercare	Initial group	Declined	

3.4 Measurements

Measurements refer to the variables and operational definitions, as well as the measurement techniques applied in this study.

3.4.1 Variables and operational definitions

For the purpose of this study, the following variables were measured: socio-demographic information, nutrition-related clinical signs and symptoms, anthropometry, dietary intake, dietary diversity and household food security.

3.4.1.1 Socio-demographic information

Socio-demographic information referred to the age, gender, and ethnicity of the participants (toddlers), age of the caregiver and relationship to the participating toddler, as well as living conditions (location / type of dwelling, number of household occupants), household income and person responsible for food preparation.

3.4.1.2 Physical examination of bilateral pitting oedema

The WHO (2015b: Online) defines SAM by a weight-for-length/height < -3 SD and / or the presence of bilateral pitting oedema and a MUAC < 115 mm, for children six to 60 months. Therefore, for the purpose of this study, the only clinical sign assessed was bilateral pitting oedema, since it is considered a reliable indicator of nutritional status in this group.

3.4.1.2 Anthropometry

Anthropometric variables referred to current length (recumbent length and standing height), weight, BMI, MUAC and HC, which was expressed and recorded in terms of weight-for-age, length/height-for-age weight-for-length/height, BMI-for-age, MUAC-for-age and HC-for-age (Hammond & Litchford, 2012:165).

i Weight-for-age

Weight-for-age growth measurements by the WHO referred to a child's weight relative to current age and was used to identify acute moderate to severe malnutrition. Measurements were expressed and analysed in terms of the WHO (2015a: Online) growth standards, as illustrated in Table 3-2 – SD scores < -2 SD and < -3 SD was

interpreted as moderately underweight and severe underweight, respectively, whereas SD scores > 2 SD and > 3 SD was interpreted as moderately and severely overweight, respectively.

ii Length/height-for-age

Length / height-for-age growth measurements by the WHO Length / height-for-age charts, referred to a child's height / length relative to current age and was used to identify chronic moderate to severe malnutrition (z score < -2 SD and < -3 SD, respectively), hence failure to attain adequate growth in stature (stunting). Measurements were expressed and analysed by means of the WHO (2015a: Online) growth standards, as illustrated in Table 3-2.

iii Weight-for-length/height

Weight-for-length/height measurements by the WHO referred to the length / height in terms of weight, independent of age and was used to detect acute and severe wasting, as well as overweight / obesity among toddlers. Measurements were expressed and analysed in terms of the WHO (2015a: Online) growth standards, as illustrated in Table 3-2.

iv BMI-for-age

BMI-for-age measurements by the WHO refers to the length / height-for-age in children above the age of two years and was used to identify overweight / obesity among study participants (Shaw & McCarthy, 2015:7). Measurements were expressed and analysed in terms of the WHO (2015a: Online) growth standards, as illustrated in Table 3-2. All measurements were interpreted in terms of the WHO z-score SD cut-off values and analysed according to the current WHO growth standards (WHO, 2015a: Online), as indicated in Table 3-2 and Table 3-3.

Table 3-2 Interpretation of z-scores for each growth chart (WHO, 2015a: Online).

z-score	Weight-for-age	Height/length-for-age	Weight-for-length/height	BMI-for-age (> 2 years)
> +3 SD	Obese (severely overweight)	Very tall	**Obese (severely overweight)	Obese
>+2SD	Moderately overweight	Moderately tall	**Moderately Overweight	Overweight
> +1SD	Mildly overweight / at risk for overweight	Mildly tall	Mildly overweight / at risk for overweight	Mildly overweight
-1SD to +1 SD	Normal weight	Normal growth	Normal weight	Normal BMI
<-1SD	Mildly underweight	Mildly stunted	Mildly wasted	Mildly wasted
<-2SD	Underweight (acute)	Stunted	Wasted	Wasted
<-3 SD	Severely underweight (acute)	Severely stunted	Severely wasted	Severely wasted

**weight-for-length / height is less sensitive for overweight / obese measurements than BMI-for-age charts

v Mid-upper arm circumference-for-age

MUAC referred to an anthropometric measurement reflecting muscle mass in children younger than five years (Shaw & McCarthy, 2015:5-6). MUAC was expressed as MUAC-for-age measurements and analysed in terms of the WHO growth standards, as illustrated in Table 3-3 (WHO, 2015a: Online).

Table 3-3 Interpretation of z-scores for MUAC-for-age growth chart in children aged 3 – 59 month (WHO, 2015a: Online).

z-score	Length cut-off value (mm)	MUAC-for-age
-1 SD to +1 SD	125	Normal weight
- 2 SD to - 3 SD	115 – 125	Underweight (acute)
< -3 SD	< 115	Severely underweight (acute)

vi Head circumference-for-age

HC referred to a standard measurement for growth assessment in children aged zero to 36 months (Hammond & Litchford, 2012:169). Inadequate HC readings was indicative of possible non-nutritional abnormalities of the head / brain growth, but not of nutritional status (Lee & Nieman, 2003:172; Shaw & McCarthy, 2015:5). HC was expressed as HC-for-age measurements and interpreted according to the WHO

growth standards, as either normal (-1SD to +1SD) or larger (>+2SD) / smaller (<-2SD) than normal (WHO, 2015a: Online).

3.4.1.3 Dietary assessment

For the purpose of this study, dietary intake was assessed over a 24-hour period and interpreted in terms of nutritional adequacy (energy, macronutrients; including CHO, protein and fat; and fibre intake); daily number of servings consumed from each of the five basic food groups (grains and starches, fruit and vegetables, meat and meat alternatives, dairy, and added oils and sugars); and dietary diversity as a proxy for micronutrient intakes. Food security status of the participants (toddlers) was also assessed.

i Energy, macronutrient and fibre intakes

Dietary intake was recorded based on recall by the caregivers of all foods and beverages consumed by the participants (toddlers) in the 24 hours prior to the interview. The SA Medical Research Council (MRC) Food Finder III dietary analysis software program (SAFOODS, 2015: Online) was used to calculate the total energy (in kJ), macronutrients (CHO, protein and fat in grams), as well as fibre (in grams) content of the 24-hour-recall. Nutritional adequacy was evaluated by comparison of the results to age-specific DRI reference ranges for energy, macronutrients and fibre, as indicated in Table 3-4, including the % AMDR for CHO, protein and fat intake, as listed in Table 3-5.

Energy, macronutrient and fibre consumption between 67% and 100% of the DRI / % AMDR was considered adequate, and an intake of less than 67%, or more than 100% of the recommended DRI, was considered inadequate and excessive, respectively (Smuts & Wolmarans, 2013:96; FAO/WHO, 2008:3-4; IOM, 2006:74,88,102, 107,119,122-123,144).

Table 3-4 Dietary Reference Intakes (DRIs): recommended daily intakes for energy and macronutrients in toddlers (1 – 3 years) (Smuts & Wolmarans, 2013:96; FAO/WHO, 2008:3-4; IOM, 2006:74,88,102,107,119,122-123,144).

Macronutrients (per day)	RDA / AI
Energy (kJ) (EER)	4393♂ 4166♀
Total CHO* (g)	130
Added sugars	Undetermined (to be limited)
Protein (g)	13
Total Fat (g)	Undetermined (to be within % AMDR)
Fibre (g)	*19

*AI

Percentage AMDR (% AMDR) served as an additional assessment of nutritional adequacy in terms of daily macronutrient distribution. Each macronutrient was expressed as a proportion (percentage) of TE (% TE) and compared it to age-specific AMDR reference ranges (DRI) for children aged one to three years, are listed in Table 3-5.

Table 3-5 Acceptable macronutrient distribution ranges (AMDR) for 1 – 3 year olds (IOM, 2006: 11,107,123,145).

Macronutrients	Percentage of total daily energy intakes (% TE)		
	Low (%)	Adequate (%)	High (%)
CHO	<45 – 65 %	45 – 65 %	>45 – 65 %
Protein	<5 – 20 %	5 – 20 %	>5 – 20 %
Fat	<30 – 40 %	30 – 40 %	>30 – 40 %

i. Servings consumed from each of the five main food groups

Data from 24-hour recall questionnaires were also used to calculate the total number of servings consumed from each of the five basic food groups, in order to compare intake with age-appropriate serving recommendations.

For the purpose of this study, the most recently published evidenced-based nutritional intake guideline for children aged one to four years, which is the standardised portion

(serving) reference range recommendations proposed for this age group in the UK (More & Emmett (2014:138-146), was used to calculate the total number of servings consumed from each food group from 24-hour recall data. This guideline expresses portion sizes as reference ranges to allow for intake flexibility (More & Emmett, 2014:137) since appetite among this age group varies greatly (Wrieden *et al.*, 2008:1344; Cowin & Emmet, 2007:254). For the practical purposes of this study, the lower half of the portion ranges were used for younger toddlers (1 – 2 years), and the upper half for those above two years. A detailed list of all 164 food items including recommended portion reference ranges with weights in grams (Appendix H), were used to convert dietary intake of all participants to the number of servings consumed per food group.

Foods were also summarised in the five main food groups, namely (1) bread, rice, potatoes, pasta and other starchy foods; (2) fruit and vegetables; (3) milk, yoghurt and cheese; (4) meat, fish, eggs, nuts and pulses and (5) food and drinks high in fat and sugar. Group two was split into fruit (2a) and vegetables (2b), and group five included fat spreads and oils (5a), puddings, cakes and biscuits (5b), sauces and sweet/savoury spreads (5c) and confectionary, savoury snacks and sweet drinks (5d). Age-appropriate serving recommendations for each of the five food groups, as stipulated by More & Emmett (2014:138-146) (Table 3-6), were used to assess adequacy of daily intake, in terms of food servings. Consumption above or below the recommended number of servings for any of the food groups were considered high or

insufficient, respectively, whereas compliance with recommendations were considered adequate to meet age-related nutritional requirements.

ii Dietary diversity

Table 3-6 Daily serving recommendations for children aged 1 – 4 years of age (More & Emmett, 2014:138-146).

Food groups	Recommended daily servings		
	Insufficient	Adequate	High
1. Grains (bread, rice, potatoes, pasta, other starchy foods)	< 5	5	> 5
2a. Fruit	< 3	3	> 3
2b. Vegetables	< 3	3	> 3
3. Protein (meat, fish, eggs, nuts and pulses)	< 2	2	> 2
4. Milk, yoghurt and cheese	< 3	3	> 3
5a. Fats and oils	< 2	2	> 2
5b. Pudding and snacks	None	≤1	>1
5c. Sauces and sweet/savoury spreads	None	≤1	> 1
5d. Confectionary savoury snacks and sweet drinks	None	≤1/7	1/7

Dietary diversity refers to the variety of food consumed by toddlers during the day and night prior to the interview, in terms of food groups, and reflects the adequacy of nutritional intake, particularly in relation to micronutrient intakes (Kennedy *et al.*, 2013:5; Airimond & Ruel, 2004:2579).

Dietary intake data over the 24-hours prior to the interviews, were recorded in nine food groups (Kennedy *et al.*, 2013:24) (Appendix C1b), which were then subsequently combined into the seven food groups depicted in Table 3-7 (Appendices C2). One point was allocated for each of the food groups represented in the 24h-recall of each participant (toddler). The subsequent dietary diversity score was interpreted according to the minimum dietary diversity cut-off values described by the WHO (2010:35-36), as illustrated in Table 3-8.

Note that as research indicate that fats, oils and sweets (sugar-sweetened items) are irrelevant in their contribution to the micronutrient density of young children's diets, all individual dietary diversity scoring systems exclude these food groups (Kennedy *et al.*, 2013:25; WHO, 2010:36).

Table 3-7 Adaptation of the nine food groups to seven food groups for dietary diversity scoring according to the WHO (2010:35)

Nr	Food group analysis system	Food group combinations from the nine-group questionnaire
1	Grains, roots and tubers	1
2	Legumes and nuts	8
3	Dairy products (milk , yoghurt and cheese)	9
4	Flesh foods (meat, fish and liver / organ meat)	5 and 6
5	Eggs	7
6	Vitamin-A rich fruits and vegetables	3
7	Other fruits and vegetables	2 and 4

Table 3-8 Interpretation of the dietary diversity score based on the seven food groups (WHO, 2010:35)

Dietary diversity score (number of the seven food groups represented in the 24h-recall)	Interpretation
≥4	Adequate
≤3	Inadequate

3.4.2 Child food security

Household food security is defined as the degree to which all members of the household have sufficient access to nutritionally adequate, safe and affordable food, in order to maintain an active healthy lifestyle (USDA, 2013: Online; Vorster, 2010:2; Blumberg *et al.*, 1999:1231). The 8 question Children's Food Security Scale (Table 3-9), which is a sub-section of the standard USDA 18-item Household Food Security Questionnaire (HFSQ) (Bickel *et al.*, 2000: Online), was used to assess food security among the participants in this study.

Although this 8 item-questionnaire (Table 3-9) was proven to have excellent internal validity for the use in children of all age groups, research indicated that food security tended to be overestimated for severe hunger among children younger than five years and underestimated for severe hunger among children older than five years, when using the original scoring system of this component from the USDA HFSQ. In 2007, Nord & Hopwood (2007:534) adapted the scoring system to be more reliable for use in toddlers. Thus, in this study food security were scored and interpreted (Table 3-9 and Table 3-10) as recommended by Nord & Hopwood (2007:535).

Table 3-9 The 8 question Children's Food Security Scale (Nord & Hopwood, 2007:535)

Q1. "We relied on few kinds of low-cost food to feed the children because we were running out of money to buy food"

Was that often, sometimes, or never true for your household in the last 12 months? (Often or sometimes are coded as affirmative.)

Q2. "We couldn't feed our children a balanced meal, because we couldn't afford that."

Was that often, sometimes, or never true for your household in the last 12 months? (Often or sometimes are coded as affirmative.)

Q3. "The children were not eating enough because we just couldn't afford enough food."

Was that often, sometimes, or never true for your household in the last 12 months? (Often or sometimes are coded as affirmative.)

Q4. In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food?

Yes / No ("Yes" is coded as affirmative.)

Q5. In the last 12 months, were the children ever hungry but you just couldn't afford more food?

Yes / No ("Yes" is coded as affirmative.)

Q6. In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food?

Yes / No ("Yes" is coded as affirmative.)

Q7. (Asked if response to Q6 is affirmative): How often did this happen-almost every month, some months but not every month, or in only 1 or 2 months? (Almost every month or some months, but not every month are coded as affirmative.)

Q8. In the last 12 months, did any of the children not eat for whole day because there wasn't enough money for food? Yes / No ("Yes" is coded as affirmative.)

Table 3-10 Degree of food security among participants based on the Children's Food Security Scale (Nord & Hopwood, 2007:535).

Level of food security	Score
High or marginal food security	0 – 1
Low food security	2 – 4
Very low food security	5 – 8

3.4.3 Measuring techniques

Data on socio-demographic factors, dietary diversity, and household food security was obtained by means of questionnaires administered during semi-structured one-on-one interviews between the researcher and caregivers (Appendices A, C & D). Physical examination of clinical signs and Anthropometric data was obtained through direct assessment and measurements of participants and recorded on Excel data sheets (Appendix B)

3.4.3.1 Data collection via questionnaires

Information regarding socio-demographics, dietary intakes and food security of participants were assessed by means of questionnaires which were completed by the researcher (a registered dietician) during semi-structured, one-on-one interviews with caregivers / secondary caregivers (Appendices A, C & D). Interviews were conducted in either English or Afrikaans, according to the preference of each participant's caregiver / secondary caregiver, and the questionnaires were completed in English by the researcher. All caregivers / secondary caregivers spoke either English or Afrikaans, and no language barrier was encountered during any of the interviews. The researcher applied appropriate verbal and non-verbal cues during the interviews, while remaining objective and unbiased.

i Socio-demographic information

The socio-demographic questionnaire is attached as Appendix A.

ii Dietary intake

Dietary intake data for analysis of energy, macronutrient and fibre intakes, as well as analyses of the daily number of servings from each food group, and dietary diversity

analysis, was collected with a **24-hour recall questionnaire** (Appendix C^{1a}). During the completion of the 24-hour-recall questionnaire, caregivers / secondary caregivers were asked to recall all the food and drinks (meals and snacks) that the toddler consumed during the previous 24 hours; including meals and snacks consumed away from home and during the evening, if applicable, which was recorded in the space provided on the questionnaire. The interviewer recorded mixed dishes in terms of the individual ingredients and probed for additional meals and snacks not mentioned. In the case of a missing food group, the researcher probed for possible consumption from these food groups to ensure reliability. Mixed dishes were categorised according to the main ingredient, probing for information on additional ingredients present in significant amounts.

iii Food security

The 8-item Children's Food Security Questionnaire is attached as Appendix D (Nord & Hopwood, 2007:535).

3.4.4 Physical examination of bilateral pitting oedema

Participants were assessed for oedema by applying normal thumb pressure to both of the feet for the duration of three seconds. Presence of a persistent shallow indent was indicative of bilateral pitting oedema, which was classified according to the following severity grades, illustrated in Table 3-11 (WHO, 2015b: Online; Open Learn Works, 2014: Online).

Table 3-11 Classification of nutritional oedema (WHO, 2015b: Online; Open Learn Works, 2014: Online).

Site of oedema	Classification of severity
Oedema of both feet or ankles	Mild
Oedema in both feet, lower legs, hands and lower arms	Moderate
Generalized oedema of both feet, legs, arms and face	Severe

3.4.5 Anthropometric measurements

Current weight, length, MUAC and HC was measured by the researcher, a registered dietician, according to standardised techniques. Additionally, all measurements were

repeated three times and used to calculate an average, ensuring reliability of results. Data was recorded on an Excel data sheet (Appendix B).

3.4.5.1 Recumbent length and standing height

In participants ≤ 24 months, recumbent length was measured, whereas standing height was measured in those ≥ 24 months and who was able to stand. In those exactly 24 months of age, standing height was chosen, taking into account the proven variance of 0.7cm between recumbent length and standing height, the latter producing a smaller reading (Hammond & Litchford, 2012:165; Mei & Grummer-Strawn, 2007:442; Lee & Nieman, 2003:171).

i Recumbent length

Recumbent length measurements were recorded by the researcher and a trained assistant. Participants, wearing minimal clothing, was held in the supine position, the head secured in the head in the Frankfort plane by the assistant, ensuring that the crown touches the headboard, with the rest of the body aligned to the centre of the backboard and buttocks / shoulders touching the backboard, whereas the researcher held the child's legs straight and slid the foot board towards the sole of the upright bare feet. Measurements were recorder to the nearest 0.1 cm from the foot board (Hammond & Litchford, 2012:166). All measurement were recorded by the same person (researcher), repeated three times and an average value calculated, in order to assure reliability and decrease measurement error (Maqbool *et al.*, 2008:7; Lee & Nieman, 2003:171).

ii Standing height

Standing height measurements were recorded using a stadiometer. Participants wore minimal clothing and no shoes, and were required to stand up straight, heels together, hands relaxed by their sides, with their head in the Frankfort horizontal plane. The researcher ensured that each child's heels, buttocks, shoulders and the back of the head was against the vertical surface of the measuring scale. The child was requested to inhale deeply pre-measurement and hold their breath while the headboard was lowered onto the top of their head. Measurements were recorded by the researcher, to the nearest 0.1 cm, at eye level. All measurements were repeated three times,

calculating an average value, ensuring reliability and decreased measurement error (Maqbool *et al.*, 2008:7; Gibson, 2005:247; Lee & Nieman, 2003:172).

iii Weight

Weight was measured by the researcher, using an electronic “Seca” scale, which was securely placed on a flat, hard surface and set on zero before each measurement. Participants were required to wear minimal clothing and empty their bladder pre-measurements. The researcher ensured that each participant stood in the middle of the scale, with their weight evenly distributed and without touching anything (Hammond & Litchford, 2012:166; Gibson, 2005:370; Lee & Nieman, 2003:173).

Scales were calibrated after each site visit, using known weights, and zeroed before each reading. Three consecutive readings was recorded to the nearest 0.1 kg for each of the participants, using the average value (Maqbool *et al.*, 2008:7; Gibson, 2005: 247-252).

iv Mid-upper arm circumference

MUAC was measured with a non-stretchable measuring tape. All clothing around the right arm was removed and the toddler was required to stand erect, with arms relaxed at his / her side and with palms facing towards the thigh. Measurements was recorded at the midpoint of the right arm, located halfway between the lateral tip of the acromion and the olecranon while the arm is bent at a 90° angle. Flexible, non-stretchable measuring tape was used and positioned perpendicular to the long axis of the arm and tightened, avoiding the tape from cutting into the toddler’s skin. All measurements were conducted by the researcher, recorded to the nearest 0.1 cm and repeated three times, using the average value, in order to assure reliability and decrease measurement error (Maqbool *et al.*, 2008:7; Lee & Nieman, 2003:172).

v Head circumference

HC was measured with a flexible, non-stretchable measuring tape, after the removal of any hair pins or obstructions around the head. Measurements were recorded while the toddler was in a standing or sitting position, depending on personal level of comfort. The lower edge of the measuring tape was positioned above the eyebrows (supraorbital ridge), above the ears and around the occipital prominence of the head

(maximum circumference of the head), ensuring enough tension to compress the child's hair. All measurements were conducted by the researcher, recorded to the nearest 0.1 cm and repeated three times, using the average value, in order to ensure reliability and decrease measurement error (Lee & Nieman, 2003:172-173).

3.5 Validity and reliability and foreseen limitations

Validity and reliability are essential in paediatric nutritional assessment, while all studies have limitations which should be addressed as far as possible.

3.5.1 Validity

Validity refers to the ability measuring of the instrument to successfully measure the desired aspect that it was intended to (Leedy & Ormrod, 2005:92), In this study, validity was attained by implementing a combination of existing validated questionnaires – dietary diversity of the toddler's usual dietary intake was assessed by using the standardized nine food group dietary diversity 24-hour recall questionnaire by Kennedy *et al.* (2013:24), whereas the standardized seven group Minimum dietary diversity system by the WHO (2010:35-36) was used for analysis.

Furthermore, all anthropometric measurements were conducted using standardized measuring techniques (Lee & Nieman, 2003:171-173), whereas results were interpreted according to the WHO z-score SD cut-off values and analysed according to the current WHO growth standards (WHO, 2015a: Online), as indicated in Table 3-2 and Table 3-3.

3.5.2 Reliability

Reliability refers to the consistency to which the measuring instrument can produce the same accurate results when the measurement is repeated (Pilot & Beck, 2006:324-325). Reliability was ensured by the fact that data collection was performed by the researcher; a Registered Dietician, with only one trained assistant for assisting in recumbent length measurements. All anthropometric measurements were recorded using recommended standardized techniques. Each question from the questionnaires was carefully explained to the caregivers, in their language of choice, in order to eliminate misunderstandings. Basic visual aids (pictures of main food groups, utensils

and hand gestures) was used, where required, in order to improve understanding and communication skills.

3.5.3 Limitations

Technically it was a limitation of this study to base the assessment of energy, macronutrient and fibre intakes on a single 24-hour recall, as this does not necessarily represent usual / habitual dietary intake. To adequately represent nutrient intake levels in the usual diet, dietary intake data from at least three non-consecutive days, or preferably up to a week or even a month, is required to ensure adequate reliability (Hammond, 2012:140; Collins *et al.*, 2010:1105). Recording more than one 24-hour recall was logistically impossible in this study. Due to the nature of this study (being a mini dissertation) and the associated time constraints, a longer / ideal reference period was not practical. The dietary analysis was enhanced by reporting and interpreting the energy, macronutrient and fibre intakes in the context of the overall dietary diversity (reflecting the number of different food groups consumed per day), as well as the number of servings from each food group compared to recommendations.

3.6 Study procedures

This study was conducted according to the following procedures:

Step 1:

- i) Approval to conduct this study was obtained from the Ethics Committee of the Faculty of Health Sciences, UFS (ECUFS NR 14/2015).
- ii) Permission was obtained from the Principal of each included day care centre (**Appendices E**).
- iii) Headmasters distributed the informed consent letters to the caregivers / secondary caregivers.
- iv) Informed consent was obtained from caregivers / secondary caregivers (**Appendix G**).

Step 2:

- i) A pre-study information session was scheduled between the researcher and each headmaster, in order to explain procedures and request assistance during measurements and interviews, if required.
- ii) Headmasters assisted the researcher in explaining procedures to caregivers / secondary caregivers during contact sessions or when children were fetched from school, and provided them with an official information document (**Appendix F**).
- iii) The pilot study were performed on five participants, all of whom were included in the final study, since no procedural changes to study design or questionnaires were required.

Step 3:

- i) All toddlers who met the inclusion criteria at the 19 located day care centres, were invited to participate in the study.
- ii) Six of the day care centres agreed to participate, and a total of 55 toddlers' caregivers / secondary caregivers provided informed consent.
- iii) Anthropometric measurements were conducted on the participants in the morning between 08h00 and 10h00, since the period from 11h00 to 13h00 was nap time at the centres.
- iv) Interviews with caregivers / secondary caregivers were conducted during pre-arranged times and took approximately 15-20 minutes per questionnaire.
- v) 24h-recalls were completed first, followed by the socio-demographic and child food security questionnaire.
- vi) Data collection was completed between **20 April and 27 May 2015**.

Step 4:

- i) Data was coded, captured on Excel and analysed by the Department of Biostatistics of the Faculty of Health Sciences. Statistics was generated by SAS® software (**SAS, 2001**). Categorical data was presented as

frequencies and percentages, whereas continuous data was presented as medians and percentiles.

3.7 Pilot study

A pilot study was performed on a convenience sample of five participants from one of the day care centres. As no changes to study procedures and / or any of the questionnaires were necessary based on this pilot, all five of these participants were included in the main study.

3.8 Statistical analysis

Statistical analysis was conducted by the Department of Biostatistics of the Faculty of Health Sciences, UFS. Statistics was generated by SAS® software (copyright, SAS Institute – SAS and all other SAS Institute Inc. products or services names are registered trademarks or trademarks of SAS Institute Inc., NC, and USA). Categorical data were presented as frequencies and percentages, and continuous data were expressed as means and standard deviations.

Associations between variables were assessed with appropriate inference statistics depending to the distribution of the data for each variable and a p-value of < 0.05 was considered statistically significant. According to Nord & Hopwood (2007:534) it would be inappropriate to assess the association between food security and anthropometrical data using conventional inferential analyses based on these raw scores, because the food security raw scores are not linear. As the growth z-scores for weight-for-age and height-for-age were strongly correlated (Pearson correlation analysis) (see page 129), the differences in the growth z-scores for the food security categories were calculated using SAS proc GLM to perform multivariable analysis of variance (manova analysis).

3.9 Ethical aspects

Caregivers / secondary caregivers provided consent on behalf of toddlers included in the study, by completing the provided informed consent form (**Appendix G**). Documents on the information regarding the study, including a detailed description of the study's purpose and procedures (**Appendix F**), was provided and explained in the language of choice (either English or Afrikaans).

The researcher ensured that each caregiver/ secondary caregiver fully understood the information provided through thorough explanation, in the language of choice, with assistance from Principals where required.

Voluntary participation and the right to withdrawal at any point of time was stressed and caregivers / secondary caregivers were informed of the fact that results will be published and presented, as well as assured of identity confidentiality (Joubert *et al.*, 2008:60-64). No remuneration was provided and all costs involved were carried by the researcher.

Only one of the toddlers were identified to be at significant nutritional risk (z-score of $< -3SD$) in terms of the measured anthropometric parameters.

Caregivers / secondary caregivers of toddlers identified to be at mild to moderate risk (z-score of between $-1SD$ to $-2SD$ for any of the anthropometric measurements, or overall poor eating habits) were provided with a copy of the SA paediatric FBDG for children at the end of the interviews.

3.10 Challenges and limitations experienced during data collection

During the execution of this study, several challenges and limitations were encountered as discussed below.

3.10.1 Small number of day care centres willing to participate

The researcher hoped to include most if not all of the 20 day care centres identified in Newton Park, Nelson Mandela Bay, but only six agreed to participate. There seemed to be a fear of being reviewed as a day care centre, which was of course not at all the intent of the study

3.10.2 Financial constraints

The researcher had no sponsorship for this study and carried all costs herself, including petrol and printing. Anthropometric equipment (the scale, including the stadiometer and the recumbent length board) was borrowed from Port Elizabeth (PE) Provincial Hospital, with permission from the Dietetic Supervisor. Should sponsorship or additional financial aid have been available, the researcher would have offered compensation for participants, as well as the schools – toddlers would have received

a soft toy in the form a fruit / vegetable at arrival, in order to improve acceptance and participants, followed by healthy age appropriate snack packs post study procedures. Parents would have received monetary compensation, as well as a colour printed pamphlet on general healthy dietary guidelines for toddlers. Furthermore, schools would have received a gift basket with age appropriate toys for the kids, dietary educational colouring books for each child and colour posters illustrating dietary guidelines for toddlers.

3.10.3 Recruiting constraints

Significant resistance was experienced from the principals of day care centres, as well as from caregivers / secondary caregivers, delayed and complicated the recruitment process for the researcher. The researcher overcame these challenges through persistence, patience and emphasis on the fact that the purpose of the study was not to evaluate the quality of service provided by the day care centre, but rather the quality and adequacy of nutritional intake and nutritional status of toddlers. Benefits of the study for the participants, namely a free anthropometric (growth) assessment, as well as free dietary advice on request, were also emphasised.

3.10.4 Time constraints

Data collection was postponed by a month (from March until April 2015) due to the following: delayed approval of the protocol due to technical changes of the questionnaires required, delay and difficulty in obtaining formal permission from schools, as well as from caregivers / secondary caregivers, and difficulty in identifying all available day care centres in the study area.

Furthermore, interviews with caregivers / secondary caregivers proved challenging, due to limited time available on their part, necessitating conduction of interviews after hours and on alternative days than anthropometric assessments.

Due to the scope of the study (mini dissertation) and the associated time constraints, the researcher was prevented from including a larger, more statistically representable sample, with toddlers from suburbs that represent low, middle and high socio-economic status.

The researcher overcame these challenges through multiple visits to each day care centre, thorough explanation of procedures and emphasis of the benefits of the study for principals, as well as caregivers / secondary caregivers; a free anthropometric assessment of their children, as well as free dietary advice. The researcher aimed to decrease the burden of interviews through communication with caregivers regarding suitable times and location.

CHAPTER 4: RESULTS

This chapter provides a summary of the research results for socio-demographic information, nutritional status (including anthropometric measurements, nutrition-related clinical signs), dietary intakes, dietary diversity and food security of the participants.

4.1 Introduction

A total of 55 toddlers (participants) and their primary caregivers participated in, and completed the study.

4.2 Socio-demographic information

Socio-demographic information referred to the age, gender, and ethnicity of the participants, age of the caregiver and relationship to the participating toddler, as well as living conditions (location / type of dwelling, number of household occupants), household income and person responsible for food preparation.

Socio-demographic information were summarised and presented under four categories - basic socio-demographic information (Table 4-1), living conditions (Table 4-2), reported household income (Table 4-3) and reported household income compared to the 2011 census statistics on income per suburb of participants (Table 4-4 and Table 4-5).

The median age of the participants was 26 months (14 to 36 months) and the mean age was 26.2 months (± 7.1) SD.

For analysis of the anthropometric parameters (see 4.4 Anthropometry, page110) the sample were stratified in the following age categories:

- i. early phase of toddlerhood (12 – 20 months):
- ii. middle phase of toddlerhood (21 – 28 months): and
- iii. late phase of toddlerhood (29 – 36 months).

The majority of participants were in the middle phase of toddlerhood (21 – 28 months old) (40%; n = 22), although there was a relatively even distribution among the three age groups (Table 4-1).

Regarding gender, there were slightly more males (54.6%; $n = 30$) than females (45.5%; $n = 25$), but participants were relatively evenly distributed across the six included day care centres.

Regarding ethnicity, more than half (56.4%) of the sample were Caucasian, followed by coloured participants (21.8%). Only about a tenth of participants were black (12.7%).

The home language of most participants was English (56.4%). Six out of the seven Black participants were being raised in a household where Xhosa was the home language (10.9%).

In accordance with the inclusion criteria of the study, only primary caregivers were interviewed. The majority (94.6%) were the mother of the participant and were of childbearing age. Only three participants were raised by their grandmothers.

Mothers (67.3%) were in charge of food preparation in most cases. A fifth of the caregivers reported that cooking responsibilities were shared by both parents (20.0%).

Results on location and living conditions of the participants is summarised in Table 4-2. Nelson Mandela Bay has a total of 124 suburbs (Statistics SA for the 2011 Census, Nelson Mandela Bay); 24.2% ($n = 30$) of suburbs were represented in the study.

All the participants in this study were being raised in brick houses. Most households consisted of three to four members (72.7%), made up mostly of two adults (70.9%) and one to two children (92.7%). About a quarter of the sample (21.8%) lived in a larger household of five to six members.

Only six of the participants (10.9%) were raised in a single parent-household.

Table 4-1 Basic socio-demographic information

Variables	Total group of participants (N=55)	
	n	%
Day care centers included		
A	10	18.2
B	11	20.0
C	10	18.2
D	8	14.6
E	8	14.6
F	8	14.6
Gender		
Male	30	54.6
Female	25	45.5
Age of participant (months)		
12 – 20	15	27.3
21 – 28	22	40.0
29 – 36	18	32.7
Home language		
English	31	56.4
Afrikaans	17	31.0
Xhosa	6	10.9
Other	1	1.8
Ethnicity		
Caucasian	31	56.4
Coloured	12	21.8
Indian	2	3.6
Black	7	12.7
Other	3	5.5
Child-caregiver relationship		
Mother	52	94.6
Grandmother	3	5.5
Father	0	0.0
Other	0	0.0
Responsibility of food preparation		
Mother	37	67.3
Grandmother	3	5.5
Father	1	1.8
Mother and grandmother	2	3.6
Mother and father	11	20.0
Other	1	1.8

Table 4-2 Types of dwelling and living conditions

Variables	Total group of participants (N = 55)	
	n	%
Type of dwelling		
Formal (brick house)	50	100.0
Informal (shack)	0	0.0
None / homeless	0	0.0
Total number of inhabitants in household	n	%
2	3	5.5
3	24	43.6
4	16	29.1
5	11	20.0
6	1	1.8
Children in the household (< 18 years)	n	%
1	28	50.9
2	23	41.8
3	4	7.3
Adults in the house (≥ 18 years)	n	%
1	6	10.9
2	39	70.9
3	7	12.7
4	3	5.5

Household income (Table 4-3) was reported in two categories, namely total monthly income of the household, and any additional income, including government subsidies, old age pensions or other. The results reflected the diversity of the sample, with all income categories represented. Most participants (69 %) came from households with a total monthly income above R20 000. Only 5.5% of the households had a monthly income of less than R10 000. Additional financial income sources were reported by five (9.1%) of the caregivers; two receiving old age pension, and the other three undisclosed. No child support grants or adult disability grants were mentioned for any participant in this study.

Table 4-3 Total household income

Variables	Total group of participants (N = 55)	
	n	%
Total monthly household income		
R0 – R10 000	3	5.5
R10 000 – R20 000	14	25.5
R20 000 – R30 000	24	43.6
R30 000 – R40 000	6	10.9
R40 000 – ∞	8	14.6
Government subsidies / additional financial income		
Pension	2	3.6
Adult disability	0	0.0
Child disability	0	0.0
Additional income	3	5.5

Household income was further disseminated according to the 30 suburbs represented in the study and compared per suburb to the estimated household income reported for all residential areas in Nelson Mandela Bay (125 areas in total) in the 2011 Census (Statistics SA, 2011: Online) Table 4-4 summarises the 2011 Census statistics on household income for each of the 30 suburbs. The full 2011 census report on estimated household income for 125 suburbs is attached as **Appendix I**.

Table 4-5 summarises the comparison between total household income data from this study and the 2011 Census statistics. Overall, the results from the current study were very similar to the Census data, with the exception of the R10 000 – R20 000 income category.

Table 4-4 Estimated household income for 30 suburb recorded during the 2011 Census (Statistics SA, 2011: Online).

Residential areas included in study (n=30)	Total group of participants (n = 55)		Estimated household income from 2011 Census	
	N	%	Monthly	Income increment
Korsten	2	3.64	10047.67	R0 – R10 000
Sydenham, including Heath Park	3	5.45	14330.33	R10 000 – R20 000
Richmond Hill, including Central	1	1.82	15888.33	
Malabar	1	1.82	16003.75	R20 000 – R30 000
New Brighton, including Young Park	5	9.09	20618.17	
South End	2	3.64	20682.17	
Gelvandale, including Gelvan Park)	4	7.27	21804.75	
Steytler Place	1	1.82	23246.33	
Kabega	2	3.64	24467.75	
Zwide (Zweledinga)	1	1.82	2564.25	
Newton Park	4	7.27	25758.83	
Charlo	1	1.82	27994.67	
Cotsworld	2	3.64	28006.67	
Glenhurd	1	1.82	28091.83	
Rowallan Park	2	3.64	28094.75	
Bridgemead	2	3.64	29325.83	
Westering	1	1.82	29651.42	
Overbaken	1	1.82	29991.08	R30 000 – R40 000
Sherwood	4	7.27	30110.0	
Lorraine	3	5.45	31069.8	
Framesby	2	3.64	33390.1	
Kabega Park	1	1.82	36197.6	
Bluewater Bay	2	3.64	36718.5	
Fernglen	1	1.82	36853.0	R40 000 – ∞
Mangold Park	1	1.82	41208.9	
Providentia	1	1.82	42018.3	
Sunridge Park	1	1.82	42991.7	
Walmer	1	1.82	44569.1	
Lovemore Heights	1	1.82	50147.6	
Lovemore Park	1	1.82	59508.1	

¹Unemployment rate: 36.6%

Table 4-5 Total household income from study compared to estimated household income from 2011 Census

Household income increments	Total household income reported by study participants (N=55)		Estimated household income per suburb (2011 Census)	
	n	%	n	%
R0 – R10 000	3	5.5	2	3.6
R10 000 – R20 000	14	25.5	5	9.1
R20 000 – R30 000	24	43.6	29	52.8
R30 000 – R40 000	6	10.9	13	13.0
R40 000 – ∞	8	14.6	6	10.9

4.3 Physical examination of bilateral pitting oedema

No participants displayed any signs of bilateral pitting oedema, when examined according to the guidelines in Table 3-12 (WHO, 2015b: Online; Open Learn Works, 2014: Online).

4.4 Anthropometry

Anthropometric measurements recorded in this study included current length (recumbent length and standing height as appropriate according to the age of each participant), weight, BMI, MUAC and HC. From these measurements weight-for-age, length/height-for-age weight-for-length/height, BMI-for-age, MUAC-for-age and HC-for-age were calculated (Hammond & Litchford, 2012:165) and interpreted in terms of the WHO z-score cut-off values (WHO, 2015a: Online). For the purpose of this study, as indicated in Table 3-2 and Table 3-3, results were evaluated according to the following age increments.

- i. 12 – 23 months;
- ii. 24 – 35 months; and
- iii. 36 months.

4.4.1 Weight-for-age

The mean weight-for-age z-score (WAZ) of the total sample (gender combined) was 0.5 (± 1.0) SD; 0.6 (± 1.0) SD and 0.4 (± 0.9) SD for males and females, respectively. The majority of participants (63.6%; $n = 35$) were of normal weight-for-age ($-1SD$ to $+1SD$ z-score), with no WAZ below $-2SD$ or $-3SD$. Conversely, 5.5% ($n = 3$) were classified as overweight (z-score above $+2SD$) and 23.6% ($n = 13$) as at increased risk of becoming overweight (z-score above $+1SD$). Results are summarised in Table 4-6 to Table 4-8.

4.4.2 Length/height-for-age

Although the mean length/height-for-age z-score of the total sample (0.1 (± 1.2) SD) was within the normal growth standard range, almost a tenth (7.3%; $n = 4$) of the participants were stunted – of these 1.8% were severely stunted (z-score below $-3SD$). Stunting was predominantly seen in the older (36 months) group (18.2%; $n = 2$), and severe stunting in the 24 to 35 months age group (4.2%; $n = 1$) (Table 4-9).

When stratified according to gender, female participants presented with the highest prevalence of stunting (8%) and of these the majority was in the older group (20%; $n = 1$). Severe stunting was only seen in the male participants (3.3%) in the 24 – 35 months subgroup (6.7%; $n = 1$). (Table 4-10 and Table 4-11).

Table 4-6: Weight-for-age z-scores of the total sample

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=55)	0(0.0)	0(0.0)	4(7.3)	35(63.6%)	13(23.6)	3(5.5)	0(0.0)	0.5 ± 1.0
12 – 23 mnths (n=20)	0(0.0)	0(0.0)	1(5)	12(60)	7(35)	0(0.0)	0(0.0)	0.7±0.9
24 – 35 mnths (n=24)	0(0.0)	0(0.0)	2(8.3)	15(62.3)	5(20.8)	2(8.3)	0(0.0)	0.6±1.0
36 mnths (n=11)	0(0.0)	0(0.0)	1(9.1)	8(72.7)	1(9.1)	1(9.1)	0(0.0)	0.03±1.0

Table 4-7: Weight-for-age z-scores of male participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=30)	0(0.0)	0(0.0)	2(6.7)	16(53.3)	10(33.3)	2(6.7)	0(0.0)	0.6 ± 1.0
12 – 23 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	4(44.4)	5(55.6)	0(0.0)	0(0.0)	1.0±0.7
24 – 35 mnths (n=15)	0(0.0)	0(0.0)	2(13.3)	8(53.3)	4(26.6)	1(6.7)	0(0.0)	0.5±1.2
36 mnths (n=6)	0(0.0)	0(0.0)	0(0.0)	4(66.7)	1(16.7)	1(16.7)	0(0.0)	0.4±1.1

Table 4-8: Weight-for-age z-scores of female participants

Groups	<-3SD	<-2SD	<-2SD	-1SD to +1SD	>+1SD	>+2.SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=25)	0(0.0)	0(0.0)	2(8.0)	19(76.0)	3(12.0)	1(4.0)	0(0.0)	0.4 ± 0.9
12 – 23 mnths (n=11)	0(0.0)	0(0.0)	1(9.1)	8(72.7)	2(18.2)	0(0.0)	0(0.0)	0.4±0.9
24 – 35 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	7(77.8)	1(11.1)	1(11.1)	0(0.0)	0.7±0.8
36 mnths (n=5)	0(0.0)	0(0.0)	1(20)	4(80)	0(0.0)	0(0.0)	0(0.0)	-0.4±0.7

Table 4-9 Length/height-for-age z-scores of total sample

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean \pm SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n(%)	n(%)	
Total (n=55)	1(1.8)	3(5.5)	4(7.3)	35(63.6)	11(20)	1(1.8)	0(0.0)	0.1 \pm 1.2
12 – 23 mnths (n=20)	0(0.0)	1(5)	1(5)	13(65)	5(25)	0(0.0)	0(0.0)	0.3 \pm 1.0
24 – 35 mnths (n=24)	1(4.2)	0(0.0)	3(12.5)	17(70.8)	2(8.3)	1(4.2)	0(0.0)	-0.1 \pm 1.2
36 mnths (n=11)	0(0.0)	2(18.2)	0(0.0)	5(45.5)	4(36.4)	0(0.0)	0(0.0)	0.2 \pm 1.4

Table 4-10 Length/height-for-age z-scores of male participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean \pm SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=30)	1(3.3)	1(3.3)	1(3.3)	21(38.2)	6(10.9)	0(0.0)	0(0.0)	0.2 \pm 1.1
12 – 23 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	8(88.9)	1(11.1)	0(0.0)	0(0.0)	0.6 \pm 0.4
24 – 35 mnths (n=15)	1(6.7)	0(0.0)	1(6.7)	11(73.3)	2(13.3)	0(0.0)	0(0.0)	-0.1 \pm 1.2
36 mnths (n=6)	0(0.0)	1(16.7)	0(0.0)	2(33.3)	3(50.0)	0(0.0)	0(0.0)	0.5 \pm 1.5

Table 4-11 Length/height-for-age z-scores of female participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1 SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=25)	0(0.0)	2(8.0)	3(12.0)	14(56.0)	5(20)	5(20)	0(0.0)	-0.03±1.2
12 – 23 mnths (n=11)	0(0.0)	1(9.1)	1(9.1)	5(45.5)	4(36.4)	0(0.0)	0(0.0)	0.0±1.3
24 – 35 mnths (n=9)	0(0.0)	0(0.0)	2(22.2)	6(66.7)	0(0.0)	1(11.1)	0(0.0)	-0.1±1.2
36 mnths (n=5)	0(0.0)	1(20)	0(0.0)	3(60)	1(20)	0(0.0)	0(0.0)	-0.1±1.4

4.4.3 Weight-for-length/height

Although the mean weight-for-length/height z-score ($0.6 (\pm 1.2)$ SD) of the total sample was within the normal growth standard range, based on this variable, 1.8% of participants were severely wasted (z-scores below $-3SD$). There were no moderately wasted participants (z-scores below $-2SD$). All the severely wasted participants were female (4%) in the older age subgroup (20.0%; $n = 1$).

Based on weight-for length/height, 5.5% were classified as overweight (z-score above $+2SD$), and a further 1.8% were classified as obese (z-score above $+3SD$). All the overweight participants (z-score above $+2SD$) were male (10%), all of which were in the 24 to 35 months subgroup (20.0%; $n = 3$), while all the obese participants were female (4.0%) in the 24 - 35 months subgroup (11.1%; $n = 1$). These results are summarised in Tables 4-12 to 4-14.

4.4.4 BMI-for-age

The mean BMI-for-age z-score of the total sample ($0.6 (\pm 1.2)$ SD) was within the normal growth standard range. Based on this variable, about a tenth (7.3%) of participants were classified as overweight (z-score above $+2SD$) and 1.8% as obese (z-score above $+3SD$). Additionally, about a third (32.7%) of the sample were at risk for becoming overweight (z-score above $+1SD$). Based on BMI, 13.3% of males (all in the younger and middle age groups) were overweight, with no obese male participants. Conversely, 4% of females were obese; all in the middle age group. These results are summarised in Tables 4-15 to 4-17.

4.4.5 Mid-upper arm circumference

The mean MUAC measurement for the total sample (168mm), as well as the mean MUAC-for-age z-score ($1.3 (\pm 0.9)$ SD) fell within the normal growth range. However, approximately a quarter (20.0%) of the sample had z-scores above $+2SD$, indicative of either increased muscle mass or excess body fat percentage. The majority of participants from this group were females (24.0%) in the 24 – 35 months subgroup (44.4%; $n = 4$).

Additionally, a small percentage of participants had z-scores above the $+3SD$, which is associated with significantly higher than normal muscle mass or obesity; all these

were males in the 24 - 35 months subgroup (6.7%; n = 1). These results are summarised in Tables 4-18 to 4-20.

4.4.6 Head circumference-for-age.

The mean HC-for-age z-score for the total sample was within the normal growth standard range; 1.1 (± 0.8) SD, and no participants presented with a smaller than normal HC (z-score less than -2SD). However, 12.7% of the sample presented with a larger than normal HC (z-score above +2SD), of which the majority were male (12.3%), in the 12 – 23 months group (33.3%; n = 3) or early toddler phase. These results are summarised in Tables 4-21 to 4-2.

Table 4-12 Weight-for-length/height z-scores of the total sample

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=55)	1(1.8)	0(0.0)	3(5.5)	30(55.0)	17(30.9)	3(5.5)	1(1.8)	0.6±1.2
12 – 23 mnths (n=20)	0(0.0)	0(0.0)	0(0.0)	11(55.0)	9(45.0)	0(0.0)	0(0.0)	0.7±0.9
24 – 35 mnths (n=24)	0(0.0)	0(0.0)	1(4.2)	14(25.5)	5(20.8)	3(12.5)	1(4.2)	0.8±1.1
36 mnths (n=11)	1(9.1)	0(0.0)	2(18.2)	5(45.5)	3(27.3)	0(0.0)	0(0.0)	-0.2±1.5

Table 4-13 Weight-for-length/height z-scores of male participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=30)	0(0.0)	0(0.0)	3(10.0)	15(50.0)	9(30.0)	3(10.0)	0(0.0)	0.7±1.2
12 – 23 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	4(44.4)	5(55.6)	0(0.0)	0(0.0)	1.0±1.0
24 – 35 mnths (n=15)	0(0.0)	0(0.0)	1(6.7)	9(60.0)	2(13.3)	3(20)	0(0.0)	0.7±1.2
36 mnths (n = 6)	0(0.0)	0(0.0)	2(33.3)	2(13.3)	2(13.3)	0(0.0)	0(0.0)	0.1±1.3

Table 4-14 Weight-for-length/height z-scores of female participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to 1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=25)	1(4.0)	0(0.0)	0(0.0)	15(60.0)	8(32.0)	0(0.0)	1(4.0)	0.5±1.2
12 – 23 mnths (n=11)	0(0.0)	0(0.0)	0(0.0)	7(63.6)	4(36.4)	0(0.0)	0(0.0)	0.5±0.8
24 – 35 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	5(55.6)	3(33.3)	0(0.0)	1(11.1)	0.9±1.0
36 mnths (n = 5)	1(20.0)	0(0.0)	0(0.0)	3(60.0)	1(20.0)	0(0.0)	0(0.0)	-0.5±1.7

Table 4-15 BMI-for-age z-scores of total sample

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=55)	1(1.8)	0(0.0)	3(5.5)	28(50.9)	18(32.7)	4(7.3)	1(1.8)	0.6±1.2
12 – 23 mnths (n=20)	0(0.0)	0(0.0)	0	11(55.0)	8(40.0)	1(5.5)	0(0.0)	0.7±0.9
24 – 35 mnths (n=24)	0(0.0)	0(0.0)	1(4.2)	12(50.0)	7(29.2)	3(12.5)	1(4.2)	0.9±1.1
36 mnths (n = 11)	1(9.1)	0(0.0)	2(18.2)	5(45.5)	3(27.3)	0(0.0)	0(0.0)	-0.2±1.6

Table 4-16 BMI-for-age z-scores of male participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=30)	0(0.0)	0(0.0)	3(10.0)	14(46.7)	9(30.0)	4(13.3)	0(0.0)	0.7±1.2
12 – 23 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	4(44.4)	4(44.4)	1(11.1)	0(0.0)	1.0±1.0
24 – 35 mnths (n=15)	0(0.0)	0(0.0)	1(6.7)	8(53.3)	3(20.0)	3(20.0)	0(0.0)	0.8±1.2
36 mnths (n = 6)	0(0.0)	0(0.0)	2(33.3)	2(33.3)	2(33.3)	0(0.0)	0(0.0)	0.0±1.5

Table 4-17 BMI-for-age z-scores of female participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n(%)	n (%)	
Total (n=25)	1(4.0)	0(0.0)	0(0.0)	14(56.0)	9(36.0)	0(0.0)	1(4.0)	0.5±1.3
12 – 23 mnths (n=11)	0(0.0)	0(0.0)	0(0.0)	7(63.6)	4(36.4)	0(0.0)	0	0.6±0.8
24 – 35 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	4(44.4)	4(44.4)	0(0.0)	1(11.1)	1.0±1.1
36 mnths (n = 5)	1(20.0)	0(0.0)	0(0.0)	3(60.0)	1(20.0)	0(0.0)	0(00.0)	-0.5±2.0

Table 4-18 Mid-upper-arm circumference-for-age z-scores of the total sample

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=55)	0(0.0)	0(0.0)	0(0.0)	19(3.5)	24(43.6)	11(20.0)	1(1.8)	1.3±0.9
12 – 23 mnths (n=20)	0(0.0)	0(0.0)	0(0.0)	5(25.0)	12(21.8)	3(15.0)	0(0.0)	1.4±0.8
24 – 35 mnths (n=24)	0(0.0)	0(0.0)	0(0.0)	8(33.3)	9(37.5)	6(25.0)	1(4.2)	1.4±1.0
36 mnths (n = 11)	0(0.0)	0(0.0)	0(0.0)	6(54.5)	3(27.3)	2(18.2)	0(0.0)	1.0±0.9

Table 4-19 Mid-upper-arm circumference-for-age z-scores of male participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=30)	0(0.0)	0(0.0)	0(0.0)	11(36.7)	13(43.3)	5(16.7)	1(3.3)	1.2±0.9
12 – 23 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	3(33.3)	4(44.4)	2(22.2)	0(0.0)	1.5±0.9
24 – 35 mnths (n=15)	0(0.0)	0(0.0)	0(0.0)	5(33.3)	7(46.7)	2(13.3)	1(6.7)	1.2±1.0
36 mnths (n = 6)	0(0.0)	0(0.0)	0(0.0)	3(50.1)	2(33.3)	1(16.7)	0(0.0)	0.9±1.0

Table 4-20 Mid-upper-arm circumference-for-age z-scores of female participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to 1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	95% CI	n (%)	95% CI	
Total (n=25)	0(0.0)	0(0.0)	0(0.0)	8(32.0)	11(44.0)	6(24.0)	0(0.0)	1.3±0.8
12 – 23 mnths (n=11)	0(0.0)	0(0.0)	0(0.0)	2(18.2)	8(72.7)	1(9.1)	0(0.0)	1.3±0.6
24 – 35 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	3(33.3)	2(22.2)	4(44.4)	0(0.0)	1.6±1.0
36 mnths (n = 5)	0(0.0)	0(0.0)	0(0.0)	3(60.0)	1(20.0)	1(20.0)	0(0.0)	1.1±0.9

Table 4-21 Head circumference z-score of the total sample

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	95% CI	n (%)	95% CI	
Total (n=55)	0(0.0)	0(0.0)	0(0.0)	23(41.8)	25(45.5)	7(12.7)	0(0.0)	1.1±0.8
12 – 23 mnths (n=20)	0(0.0)	0(0.0)	0(0.0)	7(35.0)	10(50.0)	3(15.0)	0(0.0)	1.3±0.6
24 – 35 mnths (n=24)	0(0.0)	0(0.0)	0(0.0)	10(41.7)	11(45.8)	3(12.5)	0(0.0)	1.1±0.9
36 mnths (n = 11)	0(0.0)	0(0.0)	0(0.0)	6(54.5)	4(36.4)	1(9.1)	0(0.0)	1.0±0.9

Table 4-22 Head circumference z-scores of male participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=30)	0(0.0)	0(0.0)	0(0.0)	14(46.7)	12(40.0)	4(12.3)	0(0.0)	1.1±0.8
12 – 23 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	4(44.4)	2(22.2)	3(33.3)	0(0.0)	1.3±0.8
24 – 35 mnths (n=15)	0(0.0)	0(0.0)	0(0.0)	8(53.3)	6(40.0)	1(6.7)	0(0.0)	1.0±0.8
36 mnths (n = 6)	0(0.0)	0(0.0)	0(0.0)	2(33.3)	4(66.7)	0(0.0)	0(0.0)	1.2±0.7

Table 4-23 Head circumference z-scores of female participants

Groups	<-3SD	<-2SD	<-1SD	-1SD to +1SD	>+1SD	>+2SD	>+3SD	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total (n=25)	0(0.0)	0(0.0)	0(0.0)	9(36.0)	13(52.0)	3(12.0)	0(0.0)	1.2±0.8
12 – 23 mnths (n=11)	0(0.0)	0(0.0)	0(0.0)	3(27.3)	8(72.7)	0(0.0)	0(0.0)	1.2±0.5
24 – 35 mnths (n=9)	0(0.0)	0(0.0)	0(0.0)	2(22.2)	5(55.6)	2(22.2)	0(0.0)	1.4±0.9
36 mnths (n = 5)	0(0.0)	0(0.0)	0(0.0)	4(80.0)	0(0.0)	1(20.0)	0(0.0)	0.7±1.1

4.5 Dietary intake

Dietary intake, based on a 24h-recall, was analysed in terms of nutritional value as compared to age-related DRI's. Number of servings from each of the five main food group were compared to recently published standardised daily portion (serving) reference range recommendations proposed for one to four year old children (More & Emmett (2014:138-146). Additionally, dietary diversity scoring was used as a proxy measure to reflect the adequacy of micronutrient intakes.

4.5.1 Energy, macronutrient and fibre intake

Energy, macronutrient and fibre intake compared to age-specific DRI reference ranges for energy, macronutrients and fibre, including the % AMDR for macronutrient intake, are presented in Table 4-24.

Table 4-24 Energy, macronutrient and fibre intake compared to DRI and %AMDR (Smuts & Wolmarans, 2013:S96; FAO/WHO, 2008:3-4; IOM, 2006:74,88,102,107,119,122-123,144).

Variable	Mean intake	% of mean TE	% x DRI	% AMDR		
				Lower	Within range	Higher
Energy (kJ/d) (n=55) Males (n=30) Females (n=25)	5835.2 5989.0 5650.7	*N/A	136.3 135.6	*N/A		
Total CHO (g/d) (n=55)	169.4	49.0	130.3		Yes	
Added sugar (g/d) (n=55)	35.3	10.3	*N/A	*N/A		
Protein (g/d) (n=55)	52.2	15.2	401.5		Yes	
Total fat (g/d) (n=55)	50.5	32.9	*N/A		Yes	
Fibre (g/d) (n=55)	11.7	*N/A	61.6	*N/A		

*N/A – Not applicable

The mean total energy intakes for both males and females, were higher than age-related recommendations (136.6% and 135.6% of recommended DRI, respectively). Similarly, mean total CHO was 30% higher than age-related recommendations (130.3% of DRI. Mean protein intake was about four times higher than the

recommended daily intake (401.5% of DRI). Dietary fibre intake was insufficient at only about two thirds (61.6%) of the daily recommendation.

No recommendations for quantified fat intake (in gram) are available for participants. Mean fat consumption, expressed as percentage of TE (32.9%), for the total group of participants was however, within the recommended % AMDR guidelines. CHO and protein intake expressed as percentage of TE for were also within normal % AMDR recommendations (49.0%, 15.2%, respectively). Added sugar contributed 10.3% of TE.

4.5.2 Servings consumed from each of the five main food groups

As explained in chapter 3, the total number of servings consumed from each food group in the 24h prior to the survey, were calculated according to the recently published standardised portion (serving) reference range recommendations proposed for one to four year old children (More & Emmett, 2014:138-146), as listed in Table 2-15. The lower half and upper half of portion ranges were considered adequate for younger participants (1 – 2 years) and older participants, respectively, while serving sizes above or below these cut-off values were considered as excessive and inadequate, respectively (Table 4-25).

Table 4-25 Number of servings consumed by participants from the five food groups

Food groups	Insufficient		Adequate		High	
	N	%	n	%	n	%
1.Grains (bread, rice, potatoes, pasta and other starchy foods)	23	41.8	12	21.8	20	36.4
2a Fruit	35	63.6	6	11.0	14	25.5
2b Vegetables	39	71.0	10	18.2	6	11.0
3 Protein (meat, fish, eggs, nuts and pulses)	7	12.7	10	18.2	38	69.1
4 Dairy (Milk, yoghurt and cheese)	30	54.5	9	16.3	16	29.1
5a Fats and oils	9	16.3	8	14.5	38	69.1
5b Pudding and snacks	0.0	0.0	47	85.5	8	14.5
5c Sauces and sweet/savoury spreads	0.0	0.0	43	78.2	12	21.8
5d Confectionary savoury snacks and sweet drinks	0.0	0.0	1	1.8	54	98.2

Considering all five food groups as a whole, less than half of participants had adequate intakes from any of the food groups in the 24h prior to the interview. Most participants failed to consume adequate amounts of grains and starchy foods (41.8%), fruit (63.6%), and vegetables (71.0%). Notably, 12% of the sample consumed no fruit or vegetables in the 24h prior to the interviews, while around 30% consumed too much grains and starchy foods. Only 16.3% consumed an adequate number of dairy servings per day, while more than half (54.5%) had insufficient intake, and a third (29.1%) had excessive intake. Only a small percentage (5.5%) of the sample were still consuming infant milk formula.

Around 70% of participants consumed excessive amounts of protein-rich foods, as well as added fats and oils. Almost all of the participants (98.2%) consumed snacks excessively. Crispy chips (30.9%), SSB (35.5%), fruit juice (40%) and sweet biscuits (25.5%) were the most commonly consumed snack foods.

Additionally, the 24-hour recall data reflected that all participants received at least two relatively balanced meals (breakfast and lunch) and two glasses of non-carbonated SSB between meals at their respected day care centre, while snacks were provided by caregivers. Therefore, participants consumed more than half of their daily meals at day care centres.

4.6 Dietary diversity

Dietary diversity scores were calculated based on foods consumed from the seven food groups in the 24 hour period to the interviews (Appendix C2), and interpreted according to cut-off values specified in Table 3-8. The results are presented in Table 4-26.

All participants (100%; n = 55) consumed one or more foods from the grains, roots and tubers and meat, fish and organ meat food group, while the majority also consumed one or more foods from the dairy products (96.4%) and the other fruit and vegetables group over the relevant 24-hour period (98.2%).

Almost a quarter (23.6%) failed to consume any food items from the Vitamin-A rich fruit and vegetable group during a 24h period. Intake from eggs and nuts / seeds were

inadequate , with only 14.6% and 38.2% consuming eggs and one or more foods from the nuts and seeds group, respectively.

Table 4-26 Representation of the seven food groups used for dietary diversity scoring (WHO, 2010:35-36), in the diets of the participants in the 24h prior to the interviews

Seven food groups	Consumed within the prior 24 hours		Not consumed within the prior 24 hours	
	N	%	n	%
Grains, roots and tubers	55	100	0	0
Nuts and seeds	21	38.2	34	61.8
Dairy products	53	96.4	2	3.6
Meat, fish and organ meat	55	100	0	0
Eggs	8	14.6	47	85.5
Vitamin-A rich fruit and vegetables	42	76.4	13	23.6
Other fruit / vegetables	54	98.2	1	1.8

Interpretation of the dietary diversity scores (Table 4-27) according to standard cut-off values indicated in Table 3-8, indicated that the majority of the participants (98.2%) had an adequate dietary diversity score (≥ 4 out of 7). However, 63.6% scored only between four and five, in other word just within minimum requirements. Only 5.5% ($n = 3$), consumed an optimal variety of food (a score of seven).

Table 4-27 Dietary diversity scores of the participants, based on the seven food groups (WHO, 2010:35)

Dietary diversity score	Interpretation	n	%
0 – 2	Inadequate	0	0.0
3		1	1.8
4	Adequate	7	12.7
5		28	50.9
6		16	29,1
7		3	5.5

4.7 Food security

The eight question Children's Food Security Scale (Appendix D) was used to assess food security in participants and food security scores were interpreted according to reference ranges specified in Table 3.10. Table 4.28 summarises the food security scores. None of the participants were classified as having very low food security

(indicated by a score of five to eight), but a quarter of the sample (25.5%) presented with low food security (indicated by a score of two to four).

Table 4-28 Food security scores of participants

Food security score	Interpretation	Mean number of participants	
		n	%
0 – 1	High / Marginal food security	41	74.5
2 - 4	Low food security	14	25.5
5 – 8	Very low food security	0	0.0

The responses to the individual questions of the Children's Food Security Scale are presented in Table 4-29. A third of the caregivers reported that in the household where the participants were being raised, they sometimes had to rely on a limited variety of cheap foods to feed children (30.9%), and or cut the size of children's meals, due to financial restrains and household food shortage (36.4%). A third (27.3%) also reported that they could not afford balanced meals for the children.

Table 4-29 Responses to the eight individual questions of the Children's Food Security Scale section of the USDA Household Food Security Questionnaire (Nord & Hopwood, 2007:535).

Q nr	Questions	Often true		Sometimes true		Never true	
		n	%	n	%	n	%
1	We relied on few kinds of low cost foods to feed children because we were running out of money to buy food	1	1.8	17	30.9	38	69.1
2	We couldn't feed our children a balanced meal, because we couldn't afford that	0	0.0	15	27.3	40	72.7
3	Children were not eating enough, because we just couldn't afford enough food	0	0.0	0.0	0.0	55	100
Question 4 - 8 completed if one or more affirmative responses to first three questions							
4	In the last 12 months, did you ever cut the size of any of the children's meals, because there wasn't enough money for food?	0	0.0	20	36.4	0	0.0
		Yes		No			
		n	%	n	%		
5	In the last 12 months, were the children ever hungry, but you just couldn't afford more food?	0	0.0	20	36.4		
6	In the last 12 months, did any of the children ever skip a meal, because there wasn't enough money for food?	0	0.0	20	36.4		
7	If affirmative, how often did this happen?	Almost every month		Some months, but not every month		Only in 1 to 2 months	
		n	%	n	%	n	%
		0	0.0	0	0.0	0	0.0
		Yes		No			
		N	%	n	%		
8	In the last 12 months, did any of the children not eat for a whole day because there wasn't enough money for food?	0	0.0	20	36.40		

4.8 Association between food security level and anthropometry

Because the food security raw scores are not linear, and z-scores weight-for-age and height-for-age were strongly correlated. ($R = 0.78$; $p < 0.0001$), the differences in the growth z-scores for the two food security categories that were present in this study (high/marginal and low food security) were calculated to perform a manova analysis. This analysis revealed that food security level was significantly associated with weight-for-age z scores ($F = 6.0$, $DF = 1$, $p = 0.0173$), as well as length/height-for-age z-scores ($F = 5.2$, $DF = 1$, $p = 0.0016$). This is also evident in figures 4-1 and 4-2.

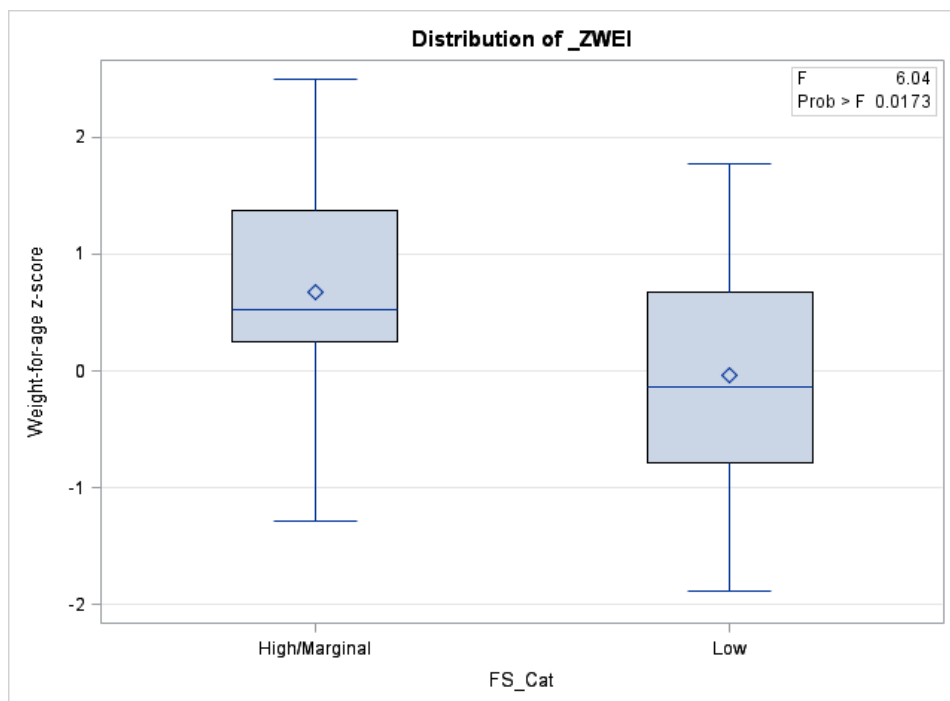


Figure 4.1 Distribution of weight-for-age z-scores across food security categories

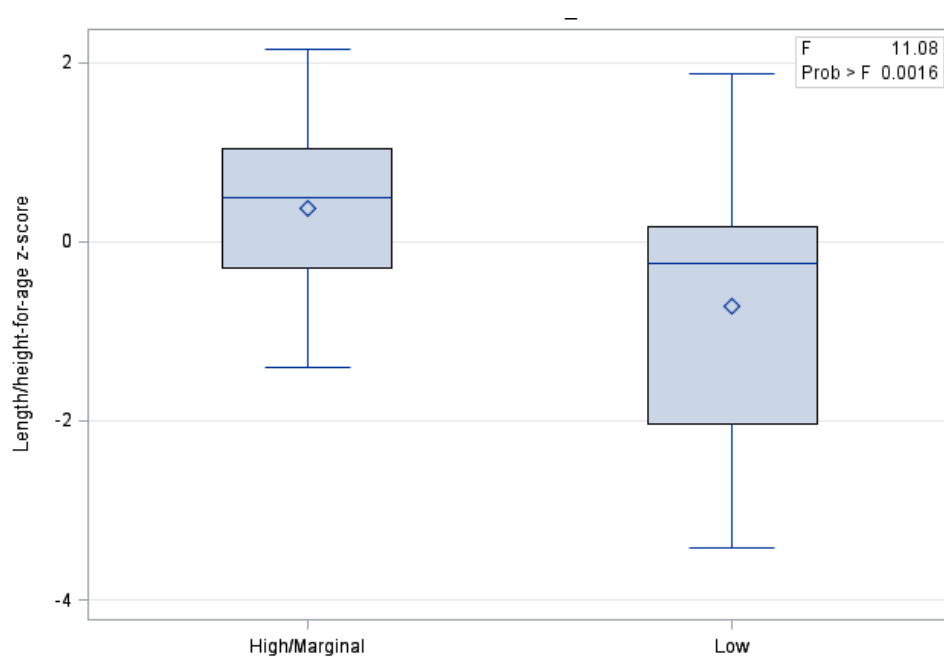


Figure 4.2 Distribution of length/height-for-age z-scores across food security categories

4.9 Summary

The majority of participants in this study were Caucasian, in the middle phase of toddlerhood (40%; n = 22), were being raised in a household with more than one adult, were fed by their mother, and resided in formal housing settings (brick houses) (100%; n = 55), with monthly household incomes of between R10 000 and R30 000 (69.1%; n = 38).

Anthropometric analysis indicated that although the majority of participants were growing according to normal recommended growth standard, 7.3% (n = 4) were stunted, based on height/length-for-age z-scores. When assessing appropriateness of a participant's weight for his/her height using weight-for-height z-scores and BMI z scores, 1.8% (n = 1) were wasted, 7.3% (n = 4) overweight and 1.8% (n = 1) obese, based on BMI-for-age z-scores. Additionally, 20.0% (n = 11) had larger than normal MUAC-for-age (z-score above +2SD).

TE intake of both males and females in the 24h prior to the interviews was about 30% above current recommendations for age. Similarly, CHO and protein intakes were 130.3% and 401.5% of the recommendations, respectively. On the other hand, mean dietary fibre intake only amounted to 61.6% of the recommendation.

Fruit and vegetable consumption in the 24h prior to the interviews were insufficient in a third, and totally absent in 12.4% of the sample. Less than a quarter of participants consumed the recommended daily number of servings from the dairy group, as well as the grains and cereal group. Conversely, a third of participants exceeded the serving recommendations for dairy and about 70% of consumed excessive numbers of servings from the protein food, as well as the added fat/oil group. Basically all participants (98.2%), consumed excessive amounts of savoury and sweet snacks and sweet drinks. Three quarters (75.5%) consumed fruit juice or SSB at least once in the 24h prior to the interview.

The majority (98.2%) of participants had adequate dietary diversity, although only 5.5% of this sub-sample consumed foods from all seven food groups in the reference a day. Eggs, nuts and seeds and vitamin A-rich fruit and vegetables were the food groups most frequently omitted by participants.

A quarter of the sample presented with low food security (25.5%), and about a third of all the caregivers reported that they were occasionally dependant on low cost meals

with poor variety, nutritional content and suboptimal portion sizes due to financial constraints. Level of food security was also significantly associated with both weight-for-age and length/height-for age.

CHAPTER 5: DISCUSSION OF RESULTS

5.1 Introduction

In this chapter, the study results in terms of socio-demographic information, physical examination of clinical signs, anthropometry, dietary intake, dietary diversity and food security are discussed in the context of the current scientific literature. Limitations of the study are also discussed in terms of the possible impact on the results.

5.1 Socio-demographic information

Socio-demographic information collected for the current study included basic information (gender, age, ethnicity, home language, caregiver-toddler-relationship and cooking/feeding responsibilities), housing and living conditions, and household income.

5.1.1 Basic socio-demographic information

The 2011 Census indicated that 35% of the population in Nelson Mandela Bay were children under 20 years, of which 10% were infants and toddlers (Statistics SA, 2011: Online). This suggests that participants in the current study were part of a relatively small population subsample, increasing the relevance of the results despite the small sample size.

Gender distribution in the current sample (55.5% male, 45.5% female) was more or less similar to that in the 2011 Census for the larger Nelson Mandela Bay area (48% male; 52% female). More than half (56.4%) of the participants in the current study were Caucasian, 21.8% were Coloured and only 12.7% were Black. These results indicate that the ethnic distribution of toddlers attending day care centres in Newton Park differed from that of the Nelson Mandela Metropole recorded in the 2011 Census (Statistics SA, 2011: Online) as 14.4% Caucasians, and 60.1% Blacks. No published data could be found to confirm the ethnic distribution of the work force in Newton Park in order to contextualise this finding. It can only be speculated that the majority black parents/primary caregivers who work in Newton Park, preferred to enrol their toddlers in day care centres in other residential areas (maybe closer to their own residential areas) instead – due to personal preference, or because tuition fees of Newton Park

day care centres may be more expensive. It may also indicate that the majority of black toddlers do not attend day care centres, but may be cared for by relatives or other secondary caregivers while parents/primary caregivers are at work. Conversely, the low representation of black toddlers in this study may indicate that the current sample were not adequately representative of toddlers in Nelson Mandela Bay.

The majority (72.7%) of participants in the current sample was in the middle / late phase of toddlerhood (21 – 36 months old), indicating that most of them were developmentally able to express their needs, feed themselves with skill, and express their desire to be around their peers (Chiocca, 2015:34-35; CDC, 2014a: Online). Therefore, caregivers and day care centre personnel play an essential role to provide age-appropriate portioned meals and snacks. Furthermore, current literature confirms that children at this age are highly impressionable (Chiocca, 2015:34-35; CDC, 2014a: Online) and shows a strong tendency to consume the same food as their parents; while in addition, this age group may be susceptible to overconsumption of food if provided with large portions of energy-dense foods, which in turn may lead to excessive weight gain (Anzman *et al.*, 2010:1116-1120; Birch *et al.*, 2007:3). This highlights day care centres as an ideal environment to target parents/primary caregivers and personal for nutrition education to protect this vulnerable age group from malnutrition (Anzman *et al.*, 2010:1117; Hart *et al.*, 2009:397; Birch *et al.*, 2007:3; Hoerr *et al.*, 2006:1766).

Similar results were observed regarding home language – the home language of participants in the current study was mostly English (56.4%) and Afrikaans (31%), and only 10.9% Xhosa; as appose to 13.3% English and 28.9% Afrikaans, and 53.2% Xhosa recorded in the 2011 Census for the larger Nelson Mandela metropole(Statistics SA, 2011: Online). Of the seven black participants in the current study, only one were not being raised in a Xhosa household.

The 2011 Census (Statistics SA, 2011: Online) indicated that just over half of the population of Nelson Mandela Bay were adults of working age (20 to 64 years) and unmarried.. The majority of the primary caregivers in the current study were the biological mother of the child – thus women of child-bearing age. However, unlike 2011 Census statistics, which indicated that 41% of households in Nelson Mandela Bay were headed by females, only 10.9% of the participants in the current study were

raised by a single parent. Mothers were predominantly in charge of cooking and feeding the participants, but in 20% of cases, fathers also assisted. Therefore, it may be assumed that participants from the current study represented a subsample of households in Nelson Mandela Bay with more evident family structure. Furthermore, it is evident that mothers in the current study were the main meal providers, as well as the main role models regarding nutrition for participants. Based on current research, it could therefore be assumed that the dietary patterns recorded for participants in this study, would have been similar to that of their parents, specifically their mothers (Anzman *et al.*, 2010:1117; Hart *et al.*, 2009:397; Birch *et al.*, 2007:3, Hoerr *et al.*, 2006:1766).

5.1.2 Living conditions

All participants in the current study resided in one of 30 suburbs, which represents a relatively small section (24%) of Nelson Mandela Bay. All participants lived in formal housing, which is in line the 2011 Census findings that indicated that 87% Nelson Mandela Bay residents lived in formal dwellings (Statistics SA, 2011: Online). Additionally, most participants in the current study came from households with three to four members (72.7%), which was also in line the 2011 Census (Statistics SA, 2011: Online), and reported a general adult-to-child-ratio of two adults (70.9%) to one to two children (92.7%). Therefore, none of the participants in the current study came from an overpopulated household.

5.1.3 Household income

The 2011 Census (Statistics SA, 2011: Online) reported 36.6% unemployment; no income in 15.8% of households; R0 to R5000 per month in 4.4% of household; and R10 000 to R40 000 in 37.5% of households (Statistics SA, 2011: Online). In the current study most participants (80%) were from households which earned between R10 000 and R40 000, and 5.5% less than R10 000 per month, suggesting that the participants predominantly represented the lower end to middle of the income scale in Nelson Mandela Bay, but earned above the current tax threshold (R6139 per month) (SARS, 2015: Online). Only 14.6% of households in the current study reported monthly income of R40 000 and higher, compared to 40.5% in the 2011 Census for the whole metropole (Statistics SA, 2011: Online).

Only 9.1% (n = 5) of participants in the current study reported income from government subsidies and other additional unspecified income. Only two caregivers reported receiving income from pensions, which indicates that the majority of participants from the current study were being raised by younger caregivers (<65 years, mostly their mothers) and did not have a grandparent or geriatric member that contributed to the household income.

Therefore, in the current study, the majority of participants lived in households with middle to high monthly income; which, considering a mean household size of three to four members, could potentially affect household food security negatively.

5.1.4 Summary of socio-demographic data

In summary, the current sample did not represent the overall Nelson Mandela Bay population as reflected in the 2011 Census. Rather, they presented a very specific, predominantly Caucasian and Coloured subgroup, with English or Afrikaans as home language, who were being raised in formal housing in suburbs representing only 24% of the metropole. In contrast to the high prevalence of female-headed households in the overall population, the households that the current study population resided in, seemed to have more structured family environments with mothers as the primary caregivers responsible for feeding their toddlers, while in 20% of cases, the fathers were also involved in this role. The reported household incomes varied from R0 – R5000 to >R40000 per month, reflecting a diverse socio-economic profile. The majority were from households with monthly incomes between R10 000 and R30 000, which, although above the tax return threshold (R6138 per month), may not necessarily be sufficient to maintain the predominant household size in this study population of three to four members. This may increase the risk for food insecurity and suboptimal toddler nutrition in the study population. Therefore, based on the socio-demographic information, day care centres in Newton Park seem to be a relevant starting point to target parents and teachers for intervention regarding optimal child nutrition.

5.2 Physical examination of bilateral pitting oedema

None of the participants in the current study presented with bilateral pitting oedema, which, in combination with a severe wasting and a MUAC < 115 mm are considered

as diagnostic criteria for SAM (WHO, 2015b: Online); thus it can be assumed that the acute nutritional status of this sample was not severely compromised, although a small subgroup (discussed below) did display signs of chronic malnutrition, such as moderate to severe stunting (a length/height-for-age z-score below -2 SD and -3SD).

5.3 Anthropometry

Growth was evaluated based on weight-for-age, length/height-for-age weight-for-length/height, BMI-for-age, MUAC-for-age and HC-for-age, interpreted according to WHO growth standards (WHO, 2015a: Online). In this section, the prevalence of moderate and severe undernutrition (acute; wasting and chronic; stunting), moderate or severe overnutrition (overweight / obesity), and the incidence of the DBD in the current study population is discussed.

5.3.1 Weight-for-age

Globally, 15% of under-five year olds are underweight (Thompson *et al.*, 2013: Online). Similarly SANHANES-1 (Shisana *et al.*, 2013:206-209) reported that 11.8% of SA children between birth and three years old were underweight, and 3.3% were severely underweight. The majority of participants in the current study (63.6%) had a normal weight-for-age, with a mean z-score of 0.5 (± 1.0) SD for the gender-combined group. However, a small percentage (5.5%) were classified as overweight (z-scores above +2SD), and a quarter were at risk of overweight (z-scores above +1SD). Based on this measure of acute malnutrition, therefore, about a quarter of participants may have experienced excessive weight gain. However, weight-for-length/height and BMI-for-age measurements provide more suitable growth assessment tools for this purpose.

5.3.2 Length/height-for-age

Although the majority of participants in the current study had a normal growth pattern in terms of length/height-for-age, with a mean z-score of 0.1 (± 1.2) SD, 7.3% of the participants were stunted, of which 5.5 % were moderately stunted and 1.8% severely stunted; which is indicative of chronic malnutrition (WHO, 2015a: Online).

Stunting was the major form of undernutrition found in the current study population. Similarly, the latest global statistics, by the Joint Database on Child Malnutrition for under five-year olds (Thompson *et al.*, 2013: Online), as well as national statistics for

SA children, by SANHANES-1 (Shisana *et al*, 2013:207), both reported stunting as the main form of undernutrition for children between the ages of birth and 14 years (19.2% of the total group). In both reports, the highest incidence of stunting also occurred in the toddler group (53.6%).

Analysis according to gender in the current study, indicated that the total prevalence of stunting was relatively even among male (6.6%), than female participants (8%). SANHANES-1 (Shisana *et al.*, 2013:207-208) reported the same trend with stunting among males (26.9%) and females (25.9%) in the birth to three years age group.

Pettifor (2006:98) pointed out that toddlers around three years of age, living in the central regions of Limpopo province, tend to present with the highest incidence of stunting, and that there seems to be trend of progressive increase in the severity stunting from the age of one years (first phase of toddlerhood). In the current study, moderate stunting predominantly affected participants from the oldest group (females: 20%; n = 1; males 16.7%; n = 1), thus possibly indicating a similar trend of stunting which becomes more evident towards the end of toddlerhood. This confirms the importance of optimal nutrition during the first three years of life (Eriksson, 2011:7; Ong & Loos, 2006:904-908).

In the current study, severe stunting was also only found among male participants (3.3%). Similarly, SANHANES-1 (Shisana *et al.*, 2013:202;208), found that young boys in the Eastern Cape Province in comparison to the rest of the country had the lowest heights, and among the highest incidence of severe stunting.

Numerous confounding factors may have contributed to the stunting in the current study population, specifically in the oldest group of participants. These may have including premature birth and low birth weight, and delayed growth since birth, followed by lack of complete catch-up growth by 24 months; delayed introduction of solids; and/or overall poor quality nutrition during the first two years. If exposed to rapid weight gain after 24 months, these stunted toddlers may also be at risk of overweight / obesity in later childhood to adulthood, which increases their risk of developing NCD in later life (Pettifor, 2006:98; Ong & Loos, 2006:904-908).

5.3.3 Weight-for-length/height and BMI-for-age

For the purpose of the current study, results from weight-for-length/height and BMI-for-age charts were discussed in combination, since both of these measurements focus on the interpretation of weight in terms of length/height.

5.3.3.1 Prevalence of wasting

In the current study, 1.8% of participants were classified as wasted, according to weight-for-length/height and BMI-for-age measurements, hence approximately half the incidence of stunting observed. These results were in line with global statistics reported by the Joint Database on Child Malnutrition (Thompson *et al.*, 2013: Online).

Wasted participants from the current study were all female and in the oldest subgroup (20%; n = 1). National results from SANHANES-1 (Shisana *et al.*, 2013:208-209) reflected the opposite, with a notably higher prevalence of wasting in male participants (5.7%), as compared to females (1.8%). The third highest incidence of wasting was seen in the Eastern Cape Province among females (birth to 14 years) (3.2%). Conversely, males from this province had the lowest rate of stunting (1.6%) (Shisana *et al.*, 2013:208-209). Therefore, these results were comparable to the current study and suggestive of a possible correlation between current results and the incidence of wasting in toddlers from the rest of Nelson Mandela Bay.

Additionally, in the current study, it was noted that the oldest subgroup of female participants were also most affected by moderate stunting (20%). Although this age subgroup was small (9% of the total sample), it was noteworthy that female participants towards the end of toddlerhood, were most affected by both moderate acute malnutrition (wasting), as well as chronic malnutrition (stunting). Therefore, these results suggest that the effects of poor nutritional status, particularly among females, became most apparent during the late stages of toddlerhood following the first growth spurt.

5.3.3.2 Prevalence of overweight / obesity

In the current study, prevalence of overweight/obesity was interpreted according to BMI-for-age, since this tool has been proven to be more sensitive for detecting overnutrition than length/weight-for-age charts (WHO, 2015a: Online). Results

indicated that 7.3% of participants were overweight, which was just as high as the most prevalent form of undernutrition (stunting) observed in this study. Additionally, 32.7% of the current sample had BMI-for-age z-scores above +1SD, indicating that these participants may have been at risk for overweight.

Global statistics from the Joint Database on Child Malnutrition were comparable to these results, indicating that SA had the highest prevalence of overweight under-five-year-old children (18%) (Thompson *et al.*, 2013: Online).

In the overweight, but not obese, category, all participants from the current study were male (13.3%; $n = 4$), across all age subgroups. Obesity affected only females from the middle age subgroup (11.1%; $n = 1$). Results from SANHANES-1 (Shisana *et al.*, 2013:204-206) reflected the opposite - significantly more girls (between two and 14 years), were classified as both overweight and obese, compared to boys from the same age group (16.5%; 7.1% and 11.5%; 4.7%, respectively). However, gender differences were only marginal for the two to five year old children included.

Therefore, results from the current study suggest that male participants presented with overweight from as early as one year of age, peaking at between 24 and 35 months, which could be due to the higher rate of stunting seen in males from this study. However, the fact that only females between 24 and 35 months were affected by obesity, indicate that results from this study are in line with research (Shisana *et al.*, 2013:204-206).

Additionally, this trend of excess early weight gain observed in the current study, was in line with research from the Early Bird 36 Study by Gardner *et al.* (2009:67), where excess rapid weight gain before the age of five years resulted in an early adiposity rebound (before the age of four to six years). Early adiposity rebound has been proven to predispose young children to becoming overweight and developing NCD's in adulthood (Lucas *et al.*, 2012:389).

5.3.4 MUAC-for-age

MUAC is an indicator of LBM in young children (Shaw & McCarthy, 2015:5-6) and has proven accuracy in detecting changes in nutritional status, since MUAC increases rapidly during the age period of six to 60 months (Mwangome *et al.*, 2012:887-888;

WHO, 2009:2). Therefore, research supports the use of MUAC for identifying SAM in young children (six to 60 months of age), providing specified cut-off values for this purpose (WHO, 2015a: Online).

Overall, 20.0% from the current sample had a larger than normal (z-score above +2SD) MUAC-for-age, while 1.8% (3.3% of male participants only) presented with a MUAC-for-age z-score above + 3SD. A recent study by Craig *et al.* (2014:763) reported that MUAC-for-age can be used with moderate accuracy in school-aged and adolescent children to identify overweight/obesity. Additionally, it was found that MUAC-for-age may also be a relevant clinical indicator for the identification of overweight/obesity in younger children, although more research is required in this regard (Craig *et al.*, 2014:763). The larger than normal MUAC-for-age seen in about a quarter (20.0%) of participants in the current study, could be the result of increased rate of growth with rapid muscle mass gain, and/or excess gain in fat mass, due to overnutrition. Conversely, the normal MUAC-for-age detected in the severely wasted and stunted participant (1.8%; n = 1) may have been a result of chronic malnutrition.

5.3.5 HC-for-age

None of the participants from the current study presented with suboptimal growth in terms of HC-for-age (z-score below -2SD or -3SD). However, 12.7% presented with a larger than normal HC-for-age z-score (z-scores above +2SD).

Research indicates that a HC-for-age of more than two SD above the mean, is suggestive of macrocephaly (a large HC), although a trend of steady excessive HC increase over time is required to confirm this diagnosis (Geraedts *et al.*, 2011:213).

In a recent systemic review by Natale, & Rajagopalan (2014:1,7), in which data from the WHO's Multi-center Growth Reference Study (MGRS) were compared with data from recent internal studies conducted in 55 ethnic diverse countries, great variation in HC (up to ~2.5 SD deviation from the norm) was noticed. A trend towards larger head sizes of between 0.5 and 1 SD above the MGRS mean, was seen, indicating that the current MGRS HC-for-age reference ranges may not be valid in terms of use on a global level. Therefore, larger head size observed in 12.7% of the current sample, may not reflect a truly increased HC.

5.3.6 Double burden of malnutrition

The DBM refers to the coexistence of persistent undernutrition and progressively increasing overnutrition in members of the same population from low and middle income countries (Kimani-Murage *et al.*, 2015:1371).

A large body of literature supports the existence of the DBM. However, undernutrition among under-five-year-old children on the one hand, still fails to meet Millennium Developmental Goals, while on the other, the prevalence of overweight is progressively rising (Thompson *et al.*, 2013: Online).

In SA, at national level, the DBM is reflected in SANHANES-1 (Shisana *et al.*, 2013:205-206,208-209), which found a combined high rate of stunting (53.3%) and overweight (36.4%) in children two to five years. In addition to high stunting rates, the same survey reflected a high prevalence of overweight and obese adolescent children, suggesting a predisposition towards overweight in later childhood, following undernutrition in the first three years of life (Shisana *et al.*, 2013:205-206). Similar trends were seen in provincial studies in Mpumalanga (Kimani-Murage *et al.*, 2010:158), the THUSABANA study in the North-West Province (Vorster *et al.*, 2011:434) and in a Limpopo Cohort study (Pettifor, 2006:98).

The DBM was evident in the current study, as proven by undernutrition (wasting and stunting) (9.1%) and overnutrition (overweight/obesity) (9.1%), coexisting within the same population of toddlers attending day care centres in Newton Park.

5.3.7 Summary of anthropometrical data

Results from the current study indicated that the main forms of malnutrition were stunting (7.3%; n = 4), and overweight (7.3%; n = 4) and obesity (1.8%; n = 1), in addition to a small percentage of wasting (1.8%; n = 1). Furthermore, stunting and wasting affected predominantly the older participants. This suggests that the consequences of undernutrition becomes most evident in late toddlerhood, as supported by current literature (Pettifor, 2006:98).

On the other hand, a third of participants were possibly at risk for overweight (z-scores above +1SD) and overnutrition among participants, from as young as one year of age, were also identified. These toddlers are predisposes to early adiposity rebound, which

results in overweight / obesity and high risk for developing NCD's in adulthood (Lucas *et al.*, 2012:389; Gardener *et al.*, 2009:67). About a quarter of participants presented with a larger than normal MUAC-for-age (z-score above +2SD and +3SD), which was also possibly an early indication of overnutrition in this study population.

Therefore, although only a small percentage of participants in this study presented with malnutrition, the DBM was evident as indicated by a relatively even proportion of participants who presented with overnutrition (9.1%) and undernutrition (9.1%), or a combination of both. This supports the need for intervention in the form of education for caregivers in this population on optimal toddler nutrition and physical activity guidelines.

5.4 Dietary intake

Dietary intake in the current study referred to energy, macronutrient and fibre intakes, and daily number of servings from the five major food groups. Additionally, dietary diversity, (as proxy for micronutrient intake), as well as food security levels, were assessed. Due to logistical constraints, all dietary data for this study were derived from a single 24h recall. Although this limits the extent to which the dietary intake may reflect habitual intakes, many other studies, including Sichiera *et al.*(2008:199); Bradlee *et al.* (2008:798); Faber *et al.* (2001:401) and the US NHANES (CDC, 2014b: Online), have relied on the same methodology, due to similar logistical constraints.

5.4.1 Total energy intake

Optimal energy intake is essential for toddlers, as they require additional energy for optimal growth and development and to prevent growth faltering (IOM, 2006:88). Therefore, the IOM (2006:82-83; 2005:5) recommends a daily energy intake of 4393 kJ and 4166 kJ in male and female toddler, respectively, as the DRI (EER). In the current study, however, excessive mean energy intake of around 35% above the age-related DRI was observed for both male and female participants. Research indicate that excess energy intake in this age group leads to overweight / obesity, which in turn predispose toddlers to early adiposity rebound and greater risk for overweight / obesity that tracks into adulthood, and promotes chronic disease of lifestyle (Lucas *et al.*, 2012:389).

These results were in line with high mean energy intakes reported for US participants from the WIC programme (Poza *et al.*, 2004:71); for children aged two to five years from the 1999-2010 NHANES, as well as children (one to nine years old) from the 1999 NFCS (Labadarios *et al.*, 2005:538), suggesting a global trend of energy-dense dietary consumption in children younger than five years.

Additionally, provincial data from the 1999 NFCS reflected that energy intake of children in the Eastern Cape Province ranked second highest among all provinces, suggesting that the energy intake patterns observed in the current study, may be representative of typical energy consumption of toddlers in Nelson Mandela Bay.

5.4.2 Intake of carbohydrate and fibre, and food from the starch and grains group

The IOM (2006:103,107) recommends that toddlers consume 45 – 65% of energy from CHO, which amounts to at least 130 grams per day. A total intake of 19 grams of dietary fibre is also recommended, predominantly from whole grain starches, fruit and vegetables.

In the current study, mean CHO consumption was around 30% higher than age-related DRI. However, since mean energy intake was also 30% above recommendations, the % AMDR for CHO at 49% of TE, was within recommendations. This suggests that CHO was among the major contributors of the high energy intake observed.

NHANES (Ervin & Ogden, 2013:2) and the 1999 NFCS (Labadarios *et al.*, 2005:538), reported a similar pattern for toddlers in the US and SA, respectively. In both surveys, toddlers consumed excessive amounts of energy to which CHO contributed between half and two thirds of the kJ, which amounted to normal % AMDR, but excessive actual intakes of CHO. Additionally, provincial data from the 1999 NFCS (Labadarios *et al.*, 2005:538) indicated that young children in the Eastern Cape Province consumed the highest percentage of energy from CHO, and presented with the second highest energy intakes among all the provinces. This suggests that the pattern of high CHO intake observed in the current study, may represent typical CHO intakes of toddlers in Nelson Mandela Bay.

The most recently published evidenced-based standardised serving recommendations and nutritional intake guideline for children aged one to four years

(More & Emmett, 2014:138-146), recommends that toddlers should consume five age-appropriate servings per day from the starch and grains food group, preferably in the form of wholegrains, to meet daily nutritional requirements. Since these guidelines were only developed recently, no studies using these recommendations could be located. All of the participants in the current study consumed at least one or more serving from starch and grains food group, which is in line with results from the 1999 NFCS for children between one and five years (Steyn *et al.*, 2003:641–642). However, despite the excessive total CHO consumption observed for participants in the current study, 41.8% failed to meet the serving recommendations from the starch and grains group. Moreover, intakes from other food groups that contribute to overall CHO intake, such as fruits, vegetables and dairy were also low (see 5.4.3 and 5.4.4). This finding may allude to the high intakes of other CHO-sources, including crisps, SSB and sweets (see 5.4.6 and 5.4.7), which are exceptionally energy dense. This may also explain the low dietary fibre intake observed in the current study (11.7 gram; 61.1% of DRI). The 1999 NFCS (Steyn *et al.*, 2003:641–642) reported that the majority of SA children consumed low-fibre cereals on a daily basis, which may also have contributed to low fibre intake in the current study population, but which was not investigated as such. Kranz *et al.* (2012:49-50), recently concluded that research regarding the role of dietary fibre in the prevention of chronic disease in children is sparse, as appose to well-established gastrointestinal benefits in adults. However, current evidence does support the beneficial role of fibre in gastrointestinal health (including prevention of constipation), as well as in the prevention of obesity and T2DM for the general population. Therefore, the low dietary fibre intake in the current study may not only predispose participants to constipation, but also to excessive weight gain and increased risk for of developing T2DM in later life.

5.4.3 Intake of fruit and vegetables

The evidenced-based nutritional serving recommendations for children (one to four years) by More & Emmett (2014:138–146) suggest that toddlers should consume three age-appropriate servings of fruit and vegetables each daily, in order to meet nutritional requirements.

Fruit and vegetables are not only rich sources of fibre and numerous vitamins and minerals (Dodd, 2012:233), but also contain a variety of phytochemicals.

Phytochemicals are nutritive plant chemicals which are associated with the prevention of chronic disease, such as CVD, diabetes, cancer and osteoporosis. Mechanisms involved include acting as anti-oxidants, scavenging free radicals, reducing cancer-associated inflammation and carcinogenesis, as well as inhibiting the synthesis of LDL, and decreasing inflammation associated with CVD (Chen *et al.*, 2007:2).

In the current study, the majority of participants failed to meet the recommendation for fruit and vegetables. Only around a third (37% and 29%, respectively) consumed the recommended number of servings, or more, from the fruit and vegetables (potatoes excluded) groups. While 88% did consume at least one serving of fruit / vegetable per day, which was in line with results from the 2008 FITS (May & Dietz, 2010:12) (70% consuming vegetables and 73% fruit), as well as the UK NDNS (2014:77); (80% consuming vegetables and 93% fruit), 12% of participants did not eat any fruit and 12% did not eat any vegetables during the 24-hour reference period.

Thus, fruit and vegetable consumption was not optimal in the current study. This may have contributed to the inadequate fibre intake. In addition low fruit and vegetable consumption poses a risk for deficiency in various micronutrients and phytochemicals, which increases the risk for CVD and cancer in adulthood (Slavin & Loyed, 2012:506; Chen *et al.*, 2007:2).

5.4.4 Intake from the dairy food group

The evidenced-based nutritional serving recommendations for children (one to four years) by More & Emmett (2014:138–146) suggest that toddlers should consume three servings of dairy – e.g. milk, yoghurt and cheese. Dairy foods are rich sources of high biological value protein, as well as a wide variety of micronutrients, including calcium, vitamin D, B-vitamins, potassium, phosphorus, zinc and magnesium (Gunnars, 2015: Online).

Only a small subgroup of the current sample (5.5%) consumed formula milk, suggesting that the majority of participants had transitioned to cow's milk products, had transitioned to cow's milk as recommended from the age of 12 months (AHA, 2014: Online). Similar results were observed in the 2008 FITS, where baby formula milk was only reported as the primary milk source up to the age of 12 months (May & Dietz, 2010:12).

Dairy foods are the main source of calcium and vitamin D in the diets of young children. Both these micronutrients are key dietary factors for optimal bone mass (FAO, 2013: 122). Research indicates that inadequate dairy intake increases the risk of calcium and Vitamin D deficiency, since dairy is the best dietary source of calcium and one of the main food sources of vitamin D. Calcium deficiency is a primary cause of suboptimal BMD, while a lack of vitamin D leads to poor calcium utilisation and increased bone resorption (breakdown) (Escott-Stump, 2015:952,963; Lucas *et al.*, 2012:393).

In the current study, more than half (54.5%) of the participants did not consume adequate amounts of dairy. These findings echo those from the 1999 NFCS which reported that about half of SA children between one and five years failed to consume any dairy during the day (Steyn *et al.*, 2003:638).

Bone remodelling, which is the ongoing process of bone resorption and formation, takes place throughout the life cycle, but occurs at an increased rate during adolescence, due to rapid growth and elongation of bones (FAO, 2013:121). Therefore, nutritional requirements of calcium and vitamin D are increased and optimal intake is critical during this phase (Stang & Larson, 2012:417-418), given the fact that approximately half of adult peak bone mass (the maximum attainable bone mass over the lifespan) is acquired during the adolescent years (FAO, 2013:121). The adolescent phase is thus a window of opportunity for ensuring optimal adult bone health and prevention of osteoporosis (Stang & Larson, 2012:417).

Dietary habits are established during the toddler phase (Birch *et al.*, 2007:2). Therefore, inadequate dairy intake during this period, as seen in current study, may predict poor dairy consumption during adolescence (12 to 21 years), and suboptimal bone health in adulthood. Moore *et al* (2008:667) confirmed the link between early optimal dairy intake and future bone health in a recent prospective study. Results from this study indicated that adequate dairy consumption (two or more servings) from an early age (between three and five years), resulted in higher BMD both at the start and at the end of adolescence. This emphasises the fact that optimal dairy intake during the toddler phase is crucial for future bone health.

Conversely, excessive dairy consumption in toddlers have been associated with iron deficiency, due to the dismissible iron content of cow's milk, poor non-heme iron absorption in the presence of excess calcium and casein from milk (Ziegler, 2011:37). Furthermore, research suggests that high milk consumption (more than two cups a day), tend to displace iron-rich foods in the diet of toddlers, increasing their risk for iron deficiency anaemia (Freuman, 2016: Online; Baker & Greer, 2010:1044-1046).

In the current study, almost a third (29.1%) had above recommended intakes of dairy per day. These participants may be at risk of not meeting their dietary iron requirements, as well as be predisposed to iron deficiency anaemia and impaired physiological, cognitive and psychomotor development, among others (Chiocca, 2015:205; Baker & Greer, 2010:1040).

5.4.5 Intake of protein and food from the meat, fish, eggs, nuts and pulses group

Protein recommendations for infants and participants were developed to provide sufficient protein to maintain nitrogen equilibrium, in addition to ensuring protein deposition for adequate growth (IOM, 2006:150). The recommended DRI (RDA) for protein in toddlers is 13 grams, which should contribute 5 – 20% of TE (% AMDR) (IOM, 2006:145). The evidenced-based nutritional serving recommendations for children (one to four years) by More & Emmett (2014:135–146) suggest that toddlers should consume two age-appropriate servings of food from the meat, fish, eggs, nuts and pulses group (protein group), in order to meet nutritional requirements.

Total protein intake in the current study was about four times higher than recommended (52.2 grams; 401.5% of DRI), and consisted predominantly of animal flesh. This is in keeping with the majority of participants (69.2%) exceeding the daily recommended number of servings from protein sources. Such high protein intakes contribute to the excessive energy intake observed in this study, which has been associated with an increased risk for premature adiposity rebound, increased BMI, and a higher body fat percentage by the age of seven years (Gunther *et al.*, 2007:1626). Furthermore, a recent study by the InterAct Consortium (2012:47) in Europe, confirmed a link between high meat (red and total) intake and increased incidence of T2DM, while there is currently convincing evidence that any form of processed meat

and/or high intakes of red meat increase the risk of developing colorectal cancer in the general population (Aune *et al.*, 2013:611).

Due to the high mean energy intakes in the current study, % AMDR for protein was within the recommended range (15.2%). This is similar to the findings of the 1999 – 2010 NHANES (Ervin & Ogden, 2014:2) report.

5.4.6 Intake from fats, spreads and oils

Dietary fat (lipids) are the most energy-dense macronutrient and only required in small dietary quantities for maintenance of normal physiological function. No DRI has been established for toddlers, due to the lack of sufficient evidence for a defined limit of dietary adequacy, although the IOM (2006:123) recommends % AMDR of 30 – 40% for fat intake in all members of the population. The SA FBDG suggest that infants and toddlers consume diets providing 40 – 60% of TE from fat during the first six months of life, followed by a gradual decrease to between 30% and 35% of TE by the age of 24 months (Smuts & Wolmerans, 2012:95-96). Evidenced-based serving recommendations by More & Emmett (2014:145-146) for one to four year old children, suggest a total intake of no more than two servings per day from the fats, spreads and oils group, because these foods are energy-dense with low nutritional density.

In the current study, mean fat TE (% AMDR) from dietary fat (32.9%), which is in line with results from the NDNS (2014:83). The high energy intake observed in the current study masked the true fat consumption to some extent, since almost three quarters of participants (69.1%), exceeded the recommended number of servings from the fats, spreads and oils group. Many participants in the current study consumed meals cooked or fried in extra oils, and / or large portions of butter or margarine on bread, as evident from the 24-h recall (May & Dietz, 2010:12). The 2008 FITS found that the main form of potatoes, a commonly consumed food item, was French fries and other fried potato varieties.

5.4.7 Intake of sauces, sweet and savoury snacks, and sugar-sweetened beverages

Added sugars refer to simple CHO (mono and disaccharides, including fructose and sucrose), of which large amounts are added to processed foods like confectionary

(cakes, pies etc.) and SSB, (Vorster, 2013:30; Gallagher, 2012:38; IOM, 2006:10). Recommendations by the ITF (2010a: Online) stipulates that foods containing added sugars and fat should be limited, since higher consumption in children has been associated with dental caries, overweight / obesity, as well as an increased risk of chronic disease later in life (WHO, 2015c: Online; IOM, 2006:103). While the IOM (2006:103) recommends that consumption of added sugars should not exceed 25% of TE intake, the latest recommendation by the WHO (2015c: Online) is 10% of TE.

As specified by More & Emmett (2014:146), foods containing added sugars and fats were divided into three food subgroups – namely pudding, cakes and biscuits; sauces and spreads; and confectionary, savoury snacks and SSB. For the first two groups, intake should be limited to one or fewer serving per day, and for the last food group, to only one serving per week (More & Emmett, 2014:144-146).

Participants in the current study consumed 10.3% of TE from added sugars, which was within recommendations. However, all participants consumed at least one serving from each of these three food subgroups per day. This was in line with results from the 1999 NFCS (Steyn *et al.*, 2003:638), which found that 82.6% of young children (one to five years) consumed some form of added sugar during the day. Furthermore, 98.2% of the current participants exceeded serving recommendations for the confectionary, savoury snacks and SSB group, suggesting that these energy-dense foods often took preference to more nutrient dense foods, which puts toddlers at risk for micronutrient deficiencies. Research indicate adequate dietary variety and nutrient density of food intake is vital for toddlers to prevent such deficiencies (Kennedy *et al.*, 2013:5, Arimond & Ruel: 2004:2579).

Among the most commonly consumed items from the confectionary, savoury snacks and SSB group, were SSB (35.5%) and fruit juice (40%). This is similar to intake reported for toddlers in the 2008 FITS (May & Dietz, 2010:12), which found that half of the participants consumed at least one SSB each day; as well as to data from the NDNS (Public Health England, 2014:76,78), which found that the majority (62%) of the youngest children consumed fruit juice.

Research in adults indicates that consumption of more than one to two servings of SSB increases the risk for obesity and NCD, such as the insulin resistance, MS, T2DM,

and CVD in all members of the population (Van den Berg, 2011:257). Recent data by De Boer *et al.* (2013:1) found a strong association between excessive intake of SSB during the toddler phase, and obesity by the age of five years.

Excessive consumption of fruit juice intake, even pure 100% fruit varieties, is also associated with overnutrition, as well as dental caries. Too much fruit juice may displace nutrient-dense foods (AAP, 2001:1212) and may predispose toddlers to an increased risk of developing iron deficiency anaemia (Harris, 2004:154). Recent data also supports a link between high fruit juice consumption and higher risk for MS and liver dysfunction in later life. This has been attributed to the general higher sucrose-to-fibre ratio in fruit juice, as compared to whole fresh fruit (Wojcicki & Heyman, 2012:1630).

As eating habits are established during the toddler phase (ITF, 2010b:3; Cowbrough, 2010: Online), the high intake of SSB, fruit juice and other energy-dense foods observed in the current study, may predict poor future eating habits. Additionally, due to this eating pattern may predispose close to half of the participants in the current study to iron deficiency, excess weight gain, obesity in later childhood and/or adulthood and NCD's in adulthood.

Sweet biscuits and crispy chips were also over-consumed by just over a quarter of the sample, further exposing them to high levels of not only added sugar and fat, but also excess salt and TFA. TFA, which are substrates produced predominantly during the industrial process of partial hydrogenation of vegetable oils (Smuts & Wolmarans, 2013:94), are predominantly found in commercially baked goods, such as biscuits (IOM, 2006:126). TFA is associated with an increased risk for CHD, MS and T2DM (Smuts & Womarans, 2013:94; FAO/WHO, 2008:9). In SA, the updated "Regulations related to trans-fat in foodstuff" (Act number 54 of 1972 published in the SA Government Gazette), states that the TFA content of any oil or fat consumable, may not exceed a dose of 2 gram per 100g product (SA DOH, 2011: Online). However, surveillance of TFA content in unlabelled baked goods remains questionable. In addition, large and frequent servings from these food sources, adds up to inappropriate TFA intake.

The average packet of crispy chips in SA contains about 500mg of sodium (~1250 mg of salt) (Fatsecret SA, 2016: Online) and contributes about a quarter of the daily salt allowance. The current SA-FBDG recommends that all members of the population should limit their salt intake to less than five grams per day (less than 2000mg sodium), since high salt consumption has been associated with detrimental effects on cardiovascular health among all members of the population (Wentzel-Viljoen *et al.*, 2013:111-112). A recent international analysis by the World Action on Salt and Health (WASH), of the salt content in children's meals from popular fast food chains, reported that SA featured among the top 10 countries with production of the saltiest children's fast food meals, thus predisposing the SA paediatric population, including participants of the current study, to CVD in later life (Health 24, 2015: Online). Therefore, SA legislation on mandatory sodium reduction in the food industry, was signed by the Minister of health in March 2013, and published in the SA Government Gazette under "Regulations relating to the reduction of sodium in certain food stuffs and related matters", act number 124. Initial sodium reduction have been stipulated for 13 common food stuffs, such as bread, potato crisps and breakfast cereals, which is to be implemented by June 2016, followed by further reductions in 2019 (SA DOH, 2013: Online).

5.4.8 Summary of dietary intakes

The dietary pattern presented by the toddlers in this study, is indicative of a nutrition transition which is commonly found in developing countries (Vorster *et al.*, 2011:430). The nutrition transition is associated with high intakes of energy-dense, nutrient-poor foods, such as added sugar, SSB and processed high fat items, with suboptimal intake of high fibre, nutrient-dense fruit, vegetables and whole grains. Lack of dietary nutrient density increases the risk for micronutrient deficiencies, which may result in poor cognitive, psychological and immunological development in young children (Faber & Wenhold, 2007:396; SCN, 2003: Online). Furthermore, energy-dense dietary intake predispose young children towards early rapid weight gain and an increased risk for NCD in adulthood (Ong & Loos, 2006: 904-908).

5.4.9 Dietary diversity

Adequate dietary diversity is critically important for toddlers, since they require nutrient-dense diets in order to meet increased nutritional requirements (Steyn *et al.*,

2006:644; Arimond & Ruel, 2004:2579). The WHO (2007:7) recommends recording dietary diversity in terms of seven dietary diversity food groups (which differs from the five main food groups depicted in the USDA FGP); and scoring the results. A score of four or more out of seven is considered to indicate adequate dietary diversity, while a score of three or less reflects low dietary diversity.

In the current study, 98.18% of the participants consumed diets with adequate dietary diversity; hence a dietary diversity score of ≥ 4 out of 7. However, only 5.5% ($n = 3$) of participants consumed an optimal variety of food (a score of seven). Overall, 63.6% of participants scored only four or five, thus just within the minimum recommendations. Therefore, almost three quarters of participants from the current study were at risk for suboptimal micronutrient intakes which, in times of stress on micronutrient stores, could deteriorate to deficiencies. These results were in line with data from a recent study by Sealey-Potts & Potts (2014:1040), which found that the majority of toddlers had at least minimum dietary diversity (a score of four or more out of seven), while only a small subgroup consumed diets with optimal dietary diversity (foods eaten from all seven food groups).

This study also draws attention to the fact that individuals can have adequate dietary diversity, while still not consuming appropriate **amounts** of food from the different food groups such as fruits and vegetables. Thus, considering the individual components of the dietary diversity questionnaire, it is evident that all participants in the current study consumed at least one food type from the starchy staples, as well as the meat, fish and organ meat groups; 96.4% consumed at least one food from the dairy group (although 54.5% did not meet the recommended number of servings for dairy); 76.4% consumed Vitamin-A rich fruit or vegetables; and 98.2% consumed a food from the “other fruit and vegetables” group (although 60-70% did not meet the recommended number of servings from the fruit and vegetable groups). These findings are similar to those of Sealey-Potts & Potts (2014:1040).

It is noteworthy that the “other fruits and vegetable group” also included fruit juice, which is considered a SSB and thus an added sugar serving (More & Emmett, 2014:146). Since almost half of participants consumed fruit juice during the day, this beverage contributed to a significant portion of food consumed from the “other fruit and vegetable group” in these participants. Furthermore, the quarter of participants

who failed to consume any yellow / orange fruit and vegetables from the Vitamin-A rich fruit and vegetables group, are at increased risk of developing Vitamin A deficiency.

The lowest intake observed in the current study was from eggs and the nuts and seeds group - only 14.6% and 38.2% of participants consumed one or more eggs and foods from the nuts and seeds group, respectively. Poor egg and legume consumption, may be associated with a neophobic response, since these foods have lumpy and slimy textures, which requires more chewing skills, leading to it being perceived as a “foreign food”. Research indicates that a neophobic response to one or more foods are common in participants from the age of two years (Cowbrough, 2010: Online; ITF, 2010a:10; Weaver *et al.*, 2008:43; Addessi *et al.*, 2005:264) which accounts for the majority of participants in the current study. The low intakes of eggs and legumes, in addition to, low intake of nuts and seeds, suggests that the excessive protein intake which was observed, consisted predominantly of animal protein sources rather than plant protein foods, which are sources of dietary fibre and phytochemicals. These results were in line with the 1999 NFCS (Steyn *et al.*, 2003:638), which found that that only 18% of young children (one to five years) consumed pulses, nuts and oil seeds (plant protein), as well as with Sealey-Potts & Potts (2014:1040), who found that a mere 30% of Caribbean toddlers consumed any form of pulses during the day.

Eggs are highly nutrient-dense foods, consisting of high biological value protein, as well as 18 different vitamins and minerals. Anti-oxidants, including selenium and zinc, exerts protective mechanisms against CVD (Miranda *et al.*, 2015:708-709). Therefore, poor egg consumption observed in the current study, may have contribute to poor micronutrient intake and increased risk of deficiency in participants.

Legumes (pulses), including peas, lentils, beans and soy beans, are rich in soluble fibre, exert numerous health benefits - protects against hypercholesterolaemia by lowering serum cholesterol and increases satiety, by slowing gastric transit and stabilising blood glucose levels (Escott-Stump, 2015:946). Legumes also contain a wide variety of vitamins and minerals, such as iron, zinc, folate, magnesium and phytochemicals (saponins, and tannins). Saponins and tannins exert anti-oxidant and anti-carcinogenic effects. Consumption of pulses are also associated with improved serum lipid profiles and thus modification of cardiovascular risk factors (Mudryj *et al.*,

2014:1197). The poor mean legume intake in the current study may thus have further contributed to low reported dietary fibre consumption, while also contributing to the increased risk for NCD.

In the current study, the focus was not on the types of foods consumed per food group. No information was gathered to specifically assess the intake of soy and soy milk formulas. Oral consumption of soybean protein, either as intact or partially hydrolysed peptides, have been shown to exert antioxidative, antimicrobial, antihypertensive, anticarcinogenic and immunomodulatory effects (Agyei, 2015:100). Additionally, soybean protein sources are also rich in phytoestrogens (isoflavones), which have been linked to a decreased risk of developing osteoporosis and CVD, as well as improvement of menopausal symptoms in adults. The use of soy-based formulas in infants and toddlers, on the other hand, remain controversial, since soy-based formulas exposes them to much higher doses of phytoestrogens than what is obtained from food. Phytoestrogens are potent non-pharmacological estrogen-like compounds and is therefore suspected of potentially altering the reproductive development in young children. However, there is currently a lack of sufficient research data in this regard (Patisaul & Jefferson, 2010:20-21).

Although the toddlers in the current study population had adequate dietary diversity, there are clearly a need for nutrition education regarding important protective foods like eggs and legumes.

5.5 Food security

Optimal food security is of utmost importance in households with young children, since research indicates that even marginal food insecurity can have detrimental effects on the physiological growth and development of a child (Cook *et al.*, 2013:52,57).

The 8-question Children's Food Security Scale by Nord & Hopwood (2007:534) is one of the most widely used tools to assess food security of infants and young children, stipulating food security scores for high/marginal food security (0 – 1), low food security (2 – 4) and very low food security (5 – 8).

The majority of participants (74.5%) in the current study was food secure. One in five participants were classified as having low food security, but there was no incidence of very low food security. The level of food insecurity among the subgroup of Nelson Mandela Bay residents, who comprised the study population, was therefore slightly lower than that reported for the Eastern Cape Province (31.4%) by SANHANES-1 (Shisana *et al.*, 2013:144). However, results from the current study were probably in line with the ethnic breakdown in SANHANES-1, which reflected that about 90% of Caucasian households in the Eastern Cape Province were food secure.

Responses to individual components of the Children's Food Security Scale (Table 4.26) by caregivers, indicated that between a third and three quarters of the households that the participants resided in, did not experience optimal access to food, resulting in inability to provide balanced, appropriately portioned meals to the children in the household. Food insecurity is associated with the risk for hunger, poor general health status, including iron deficiency anaemia, increased hospitalisation, developmental delay and impaired quality of life (Cook, 2013:1105-1106).

Rapid recent increase in SA food prices is likely to have been a confounding factor in the suboptimal food security observed for participants of the current study. According to the latest Nutrition and Food Security Working Group report (Humanitarian Response, 2015: Online), severe recent droughts in SA have destroyed a large portion of corn crops in the main production areas, which resulted in significant shortage and a price increase of 27% for maize, in addition to an overall food price increase of 6.4%. This affects the affordability, and therefore access to basic food such as bread, milk, eggs, chicken, staple maize-based cereals and fruit and vegetables (National Agricultural Marketing Council, 2015: Online).

In the current study the level of food security was statistically significantly associated with both weight-for age and length/height-for-age z-scores, indicating that being food insecure may have a direct negative affect on growth in these toddlers.

These results were in line with results from a recent study by Saaka & Osman (2013:1), concluding that household food security was associated with a 46% higher protection against chronic malnutrition (stunting) in children between the ages of six and 24 months, as appose to household food-insecurity. Furthermore, data from Dos Santos

& Gigante. (2013:984) concluded that any degree of food insecurity, even marginal, had a negative impact on height/length-for-age indices of children younger than five years; and Naser *et al.* (2014:304), indicated that household food insecurity were associated with a two-fold higher and three-fold higher risk for underweight and stunting in children (two to 12 years), respectively.

Conversely, some studies have also reported a link between food insecurity and an increased risk for overweight in young children, possibly due to poor dietary diversity and overeating during times of food access (Child Trends Data Bank, 2014: Online). However, these associations were not evident in the current study though.

Current research links food insecurity with a high incidence of stunting in young children, while stunting have been shown to predispose children to overweight / obesity towards the later toddler phase (Pettifor, 2006:98). Therefore, 25% of participants in the current study who were food insecure and thus likely consuming low-cost, energy-dense and nutrient-poor diets, may be predisposed to micronutrient deficiencies, suboptimal development, and risk for NCD's in later life.

5.5.1 Summary

Participants in the current study consumed energy-dense diets, consisting largely of refined CHO, high fat and low fibre sources, as confirmed by the excessive consumption of animal protein sources, added fat, sugars and processed food, in detriment of fruit, vegetable, legumes, whole grain starches and dairy. Furthermore, only three toddler from the sample (5.5%) consumed diets with optimal dietary diversity (a score of seven), suggesting a trend of energy-dense foods taking preference over nutrient-dense sources, hence characteristic of the nutrition transition.

It was further noted that all participants received two relatively balanced meals (breakfast and lunch) and two glasses of non-carbonated SSB between meals at their respective day care centres, while snacks were provided by caregivers. This suggest that day care centres contributed to regular meal patterns and balanced food intake in participants. However, day care centres also promoted intake of added sugar (SSB), along with the caregivers, who provided energy-dense snacks, high in TFA and / or added sugar. Research indicates that energy-dense foods may promote overweight / obesity, as well as NCD in later life (De Boer *et al.*, 2013:1; van den Berg, 2011:257;).

Therefore, a proportion of participants from the current study were at increased risk of excessive weight gain and future health problems.

Overall, dietary intake in the current study, was suggestive of the nutrition transition (Vorster *et al.*, 2011:430) taking place, as well as of increased risk for several micronutrient deficiencies, excessive weight gain, early adiposity rebound and thus overweight and NCD's in adulthood (Lucas *et al.*, 2012:389; Gardner *et al.*, 2009:67). Additionally, poor consumption of eggs, vegetables and legumes, contributed to poor nutrient density and inadequate fibre intake. This may be due to a neophobic response to foods with different textures, which is common in participants from the age of two years (Cowbrough, 2010: Online; Weaver *et al.*, 2008:43; Addessi *et al.*, 2005:264), but needs to be addressed before the toddler's dietary patterns become set.

Low food security was observed for one in five participants of the current study, with reports of suboptimal access to balanced meals in adequate quantities, which might have contributed to less than optimal dietary diversity and increased risk for overweight in the current sample. Furthermore, a statistically significant association was observed between food security and weight-for-age / length/height-for-age, indicating that participants with suboptimal food security were at significant increased risk for malnutrition.

This study identified a clear need for nutrition education, since results indicated that caregivers tend to over or underfeed their toddlers. This may be due to a number of possible reasons, including a lack of knowledge on nutritional content of food, appropriate portioning of meals and the importance of dietary diversity, with regards to feeding children in the toddler phase.

5.6 Challenges and limitations

The scope of this study (for a mini-dissertation), as well as time and financial restraints contributed to several challenges and limitations encountered in this study which may have affected the data. Firstly, the small sample size resulted in the current study group being less representative of the total toddler population of Newton Park. Furthermore, this led to exclusion of lower socio economic areas. Only six of the 20 day care centres (30%) identified in Newton Park, Nelson Mandela Bay, agreed to participate in the current study. One reason appeared to be fear of being reviewed.

Lack of financial support and sponsorship limited the researcher in terms of offering the day care centres, caregivers and/or toddlers incentives such as nutritional education material, and/or healthy refreshments post study procedures. This may have contributed to the resistance of schools, as well as caregivers, to be included in the current study. Also, caregivers probably had their own time restraints and may have been reluctant to offer up the time for the interviews. This decreased the strength of association between parameters, yet significant associations between anthropometry and food insecurity categories were still found.

Due to the logistical complications, dietary intake data were recorded by means of a single day 24-hour recall questionnaire. A reference period of at least three non-consecutive days are required for an adequate representation of usual / habitual dietary intake (Hammond, 2012:140; Collins *et al.*, 2010:1105) and to accurately reflect micronutrient status. However, the US NHANES and many other surveys (Sichiera *et al.*, 2008:199; Bradley *et al.*, 2008:798; Faber *et al.*, 2001:401), as well as the US NHANES (CDC, 2014b: Online), have recognised similar logistical constraints and also used one 24-hour recall for dietary analysis

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The current study was the first to describe the nutritional status of toddlers attending day care centres in Newton Park, Nelson Mandela Bay. In this chapter, conclusions and recommendations will be discussed in terms of results obtained for the following study objectives: socio-demographic information, clinical information, anthropometry and dietary information, including dietary intake, dietary diversity and child food security.

6.2 Challenges and limitations

The main limitation of this study was the small sample size which resulted from the limited scope of the study, lack of finances, limited time, as well as recruitment restraints. Only six of the 20 day care centres (30%) identified in Newton Park, Nelson Mandela Bay, agreed to participate in the current study. Causative factors may have included lack of financial support and sponsorship which limited the researcher in terms of offering participants and day care centres with incentives; fears of heads of the centres that participation in the study would open them up to criticism; as well as time constraints of caregivers who were in a hurry when dropping off or picking up their toddlers at the centres. The sample was therefore not as representative of the total population as would have been desired. Even though the smaller sample decreased the strength of association between parameters, significant associations between anthropometry and food insecurity categories were still found.

Dietary intake data were recorded by means of a single day 24-hour recall questionnaire. Although research recommends a recall period of at least three non-consecutive days for determining usual dietary intake (Hammond, 2012:140; Collins *et al.*, 2010:1105), a single 24-hour recall has also been used in many dietary surveys (CDC, 2014b: Online) due to similar logistical constraints as encountered in the current study.

6.3 Conclusions

Current research highlights optimal nutrition during the first three years of life (toddlerhood), specifically the first 1000 days, as a major nutrition priority. Crucial physical and neurological development takes place during this phase, which increases the risk for stunting, followed by rapid early weight gain and predisposition to development of NCD's in later life (Ong & Loos, 2006:904-908; Eriksson, 2011:7). Therefore, toddlerhood represents a unique window for establishing healthy food preferences and appropriate eating habits (Cowbrough, 2010: Online).

Global statistics from the Joint Database on Child Malnutrition by UNICEF, WHO and the World Bank (Thompson *et al.*, 2013: Online) indicates that Africa is currently among the countries with the highest prevalence of all four malnutrition parameters in under-five-year-old children. These results reflect a trend of persistent undernutrition and a progressively increasing prevalence, of overweight / obesity in this age group (18%), hence the DBM (Kimani-Murage *et al.*, 2015:1371).

The current study found that the majority of the participants lived in formal dwellings with three to four members (72.2%). Therefore, the majority of participants resided in non-overpopulated households, with access to basic municipal services. Average income for 80% of households was low (R10 000 to R40 000), but above the tax return threshold. Considering the average household size this level of household income may pose a risk for the development of low food security, particularly in light of rapid recent increases in SA food prices (Humanitarian Response, 2015: Online).

Most participants (72.7%) were in the middle/late phase of toddlerhood (21 – 36 months old) which is characterised by self-sufficient feeding and the desire to be around peers and to mimic their eating behaviours (Chiocca, 2015:34-35; CDC, 2014a: Online). This is thus a critical time for establishing good eating habits.

Participants were predominantly English speaking (56.4%) Caucasians (56.4%). Unlike many African cultures, caregivers from this study population probably does not view larger physical size as indicative of better health status in children (ITF, 2010a:9; Anzman *et al.*, 2010:1116-1120; Birch *et al.*, 2007:3). Therefore, it was less likely that the caregivers of overweight / obese participants purposefully overfed their child.

In line with global (Thompson *et al.*, 2013: Online), as well as recent SA statistics (Shisana *et al.*, 2013:207), both overweight/obesity, as well as stunting, affected around 10% of in this study population, hence the DBM (Kimani-Murage *et al.*, 2015:1371). Stunting affected mostly the older group of participants, suggesting that the impact of factors which negatively affect growth, only becomes evident in later toddlerhood. This notion is supported by current literature (Pettifor, 2006:98). Food insecurity, related to poverty, is one of the major factors that may negatively impact growth in young children (Chilton *et al.*, 2007:262). In the current study, one in five participants had a low food security level. Food security level was also statistically significantly associated with both weight-for age and length/height-for-age z-scores, supporting a direct link between food insecurity and poor growth, development and thus nutritional status (Naser *et al.*, 2014:304; Saaka & Osman, 2013:1; Dos Santos & Gigante, 2013:984).

Conversely, in the current study, based on BMI and weight-for-height, overnutrition was also identified in toddlers as young as one year of age. This was possibly supported by above normal MUAC-for-age which was identified in a quarter of participants. Excessive adiposity predisposes toddlers to early adiposity rebound, which in turn, results in overweight/obesity throughout childhood and adolescence, and increased the risk for NCD that tracks into adulthood (Gardener *et al.*, 2009:67; Lucas *et al.*, 2012:389).

The dietary intakes of toddlers reflected typical signs of nutrition transition (Vorster *et al.*, 2011:430), characterised by high intakes of animal protein, added fat, added and natural sugars (in the form of fruit juice), and processed foods, combined with inadequate intakes of fruit, vegetable, legumes, whole grain starches and dairy. Thus, the overall eating habits of these toddlers reflected a preference for energy-dense, nutrient-poor, low-fibre foods. The neophobic response to different textures, such as “lumpier” foods, which is common in toddlers around the age of 24 months (Cowbrough, 2010: Online; ITF, 2010a:10; Weaver *et al.*, 2008:43; Addessi *et al.*, 2005:264) may have contributed to poor consumption of eggs, vegetables and legumes in the study group. However, since dietary habits are established during the toddler phase, refusals of food groups need to be addressed, before a set pattern is established (ITF, 2010b:3; Cowbrough, 2010: Online).

Overall dietary diversity, defined by the inclusion of food from at least four out of seven different food groups per day, was adequate in this study population (98.2%). However, only 3 participants (5.5%) consumed an optimal variety of food (achieving a score of seven), while the majority (63%) had scored at the lower end of the acceptable range (4 to 5). Day care centres contributed to dietary diversity by ensuring that the toddlers consumed at least one relatively balanced meal during per day. However, both the centres and caregivers provided the toddlers with inappropriate snacks (high in fat and/or added sugar) and energy-dense SSB.

These results highlighted the fact that a toddler may have adequate dietary diversity, meaning that he/she consumes food from at least four different food groups in the course of a day (as was the case in 98.2% of this population); yet the actual amount of food consumed from a specific group may not meet the recommendations (as reflected by 30 – 50% of the study population failing to consume adequate numbers of servings from key food groups such as fruit, vegetables and dairy). Overall, in this study population energy-dense foods seemed to take preference over nutrient-dense foods, which increases the risks for micronutrient deficiencies, excessive weight gain, early adiposity rebound; and NCD in adulthood (Gardner *et al.*, 2009:67, Lucas *et al.*, 2012:389).

In conclusion, the results from the current study supported the DBN and, despite some limitations, identified many opportunities for a nutrition education intervention targeting caregivers and day care centre personnel.

6.4 Recommendations

Based on the conclusions, the following recommendations are suggested:

6.4.1 Recommendations for policy and intervention programmes

- I. This study confirms the need for SA government to address the nutrition transition trends and the increasing DBM. Possible intervention strategies may include taxing energy-dense, processed foods, like SSB, in a bid to promote healthy, nutrient-dense foods which may improve dietary diversity in toddlers. The most recent Strategic Plan for the Prevention and Control of NCD, published by the Department of Health (Health-e News, 2016: Online),

identified the need for such legislation. A recent review by Manyema *et al.* (2014:1) reflected that a 20% tax increase on SSB is predicted to reduce obesity incidence by 6% (220 000 obese people) in SA.

- II. Since research highlights the first three years of life as a critical developmental phase, there is a need in SA for more comprehensive nutrition guidelines for infants and toddlers, similar to those recently developed by the ITF (2016a: Online) in the UK (Ong & Loos, 2006:904-908; Eriksson, 2011:7). Current SA-FBDG for toddlers (12 to 24 months) only stipulate general feeding guidelines, but does not provide parents/caregivers with practical advice on age-appropriate serving sizes, the importance of dining together as a family, strategies for handling food refusals, and the importance of parenting styles.
- III. Nutrition interventions, in the form of educational outreach programmes, should be developed and implemented by registered dietitians. Currently no such programmes are in place in Nelson Mandela Bay. Ideally the nutrition intervention programmes should aim to include day care centres from all 124 suburbs in Nelson Mandela Bay, targeting toddlers from both high and low socio-demographic areas. Essential program components should include basic anthropometric screening, fun nutrition-related activities with toddlers, and nutrition education sessions with caregivers. The aim of this program should be to timely identification of toddlers with suboptimal nutritional status, and provision of nutrition information to caregivers on the following key aspects: age-appropriate serving sizes, the importance of adequate dietary diversity, basic, budget-friendly nutritious meal planning guidelines, the importance of limiting energy-dense snacks, and guidelines on the management of “picky eating” and food refusal (ITF, 2016a: Online; More & Emmett, 2014:138-146).

6.4.2 Recommendation for day care centres

- I. Basic nutrition education lesson plans, designed by registered dietitians, should be included in the curriculum of day care centres. The main aim of such programmes should be to increase awareness of the different food groups and ability to differentiate between healthy and unhealthy foods in these young children. Principals from each institution, should be

approached directly regarding this educational addition, since day care centres are not under the jurisdiction of the Department of Education.

- II. Since the current results indicate that participants consume more than half of their daily nutrition intake (two meals and snacks) at day care centres, there is a need for professional menu planning and nutritional analysis of current menus, in order to ensure optimal nutrition for toddlers while away from home. Furthermore, day care centres should be encouraged to offer water and fruit, instead of SSB (or even fruit juice) between meals. This may limit added sugar intake, while increasing fibre and micronutrient intakes.
- III. The importance of providing toddlers with nutrient-dense snacks should be communicated to caregivers, emphasising the proven negative health impacts of excessive intakes of added fat and sugar (including fruit juice) in young children (WHO, 2015c: Online; IOM, 2006:123-124; FAO/WHO, 2008:3).
- IV. Day care centres should create opportunities for toddlers to have meals and snacks together in a group, while seated at tables, in order to establish mealtime routine. Routine during meal times promote food acceptance, since research indicates that toddlers tend to imitate what their peers eat (ITF, 2010a:10).

6.4.3 Recommendation for future research

- I. The current study provided baseline data for nutritional status of toddlers attending day care centres in Newton Park, but was not representative of toddlers in Nelson Mandela Bay as a whole. A more comprehensive survey should include day care centres from all 124 suburbs, in order to represent the ethnic and socio-demographic profile of the metropole.
- II. Future studies may collect 24-hour-recall data over a period of three days or more (although logistically difficult), or by means of a quantified FFQ, in order to enable more reliable and representative analysis of energy, macro and micro nutrient intakes.

Therefore, the current study provided valuable baseline data for future, more extensive research on the nutritional status of toddlers in Nelson Mandela Bay. Comprehensive data would enable stakeholders to design and implement structured nutrition intervention programmes, aimed at improving nutritional status and future health of the toddler population

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APPENDICES A – D: QUESTIONNAIRES

Appendix A: Socio-demographic questionnaire

Sociodemographic Questionnaire

Subject number

Today's date: d d m m y y

Mark the appropriate option with a **X** or write your answer in the space provided:

1 Location of Day care centre:

Name of Day care centre: _____

2 Gender:

- | | |
|---|--------|
| 1 | Male |
| 2 | Female |

3 Toddler's date of birth: (YEAR / MONTH / DAY)

4 Caregiver's date of birth: (YEAR / MONTH / DAY)

5 Home language

- | | |
|---|--------------------------|
| 1 | English |
| 2 | Afrikaans |
| 3 | Xhosa |
| 4 | Other Specify _____ |

6 Ethnicity

For office use only:

1 - 4

d d m m y y
 5-10

11

12

/ / 13-22

/ / 23-32

33

34

35

- 1 Caucasian
- 2 Coloured
- 3 Indian
- 4 Black
- 5 Other (indicate) _____

36

7 Child-caregiver relationship

- 1 Mother
- 2 Grandmother
- 3 Father
- 4 Other (Indicate) _____

37

38

8 Who is responsible for food preparation?

- 1 Mother
- 2 Grandmother
- 3 Father
- 4 Other (Indicate) _____

39

40

9 Type of dwelling

- 1 Formal (brick house)
- 2 Informal (Shack)
- 3 None / homeless

41

10 Suburb where household is situated: _____

42

11 Number of people residing in dwelling: _____

- 1 Children (birth - 18 years)
- 2 Adults (<18 years)

43-44

45

46

12 Total income: _____

								.		
--	--	--	--	--	--	--	--	---	--	--

47-56

13 Monthly salary earned: _____

								.		
--	--	--	--	--	--	--	--	---	--	--

57-66

14 Number of monetary grants received by members in the household:

- | | |
|---|-------------------|
| 1 | Pension |
| 2 | Adult dissability |
| 3 | Child dissability |

	67
	68
	69
	70

15 Other source of income: _____

								.		
--	--	--	--	--	--	--	--	---	--	--

71-81

Appendix B: Anthropometry data sheet

Anthropometrical Assessment data form

Subject number

--	--	--	--

 1 - 4

Today's date:

d	d	m	m	y	y

d	d	m	m	y	y

 5 - 10

Record each of the following measurement three times:

1 Current body weight (CBW) in kg:

		.				.				.	
--	--	---	--	--	--	---	--	--	--	---	--

 11 - 22

2 Current length/ stature (cm)

(12 - 24* months): Recumbant length

		.				.				.	
		.				.				.	

 23 - 37
38 - 52

(24* - 36 months): Stature

** Record either length and stature*

3 Mid-upper arm circumference (mm)

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

 53 - 61

4 Head circumference (cm)

		.				.				.	
--	--	---	--	--	--	---	--	--	--	---	--

 62 - 73

5 Oedema

1	Yes
2	No

--

 74

Appendix C1b: Dietary intake questionnaire part B

Dietary Intake Questionnaire - Section B

Mark each **food group** with "1 = YES" if one / more item was consumed and "0 = NO" if none was consumed during the previous 24 hours

Question number	Food Group	Food Item	
1	Starchy staples	Corn, rice, maize, oats, quinoa, wheat, barley, rye, sorghum, millet, any product containing these ingredients.	1
2	Dark green leafy vegetables	Broccoli, spinach, kale, seaweed, lettuce	2
3	Other Vitamin A rich fruit and vegetables		3
	<i>Vegetables</i>	Butternut, beets, summer squash	
	<i>Fresh fruit</i>	apricots, canteloups, mango, papaya, passion fruit, peaches, persimmon, tomato	
	<i>Dried fruit with added sugar</i>	Peaches, mango, apricot, peaches	
4	Other fruits and vegetables		4
	<i>Vegetables</i>	Atichoke, asparagus, beans (any kind)	

		cabbage, brussel sprouts, cauliflower, celery,	
		cucumbers, mielies, egg plant, green pepper,	
		leek, mushrooms, onions, green peas, radish,	
		zucchini.	
	Fresh fruits	Apple, avocado pear, banana, blackberry,	
		blackcurrent, blueberry, prickly pear, cherries,	
		cranberries, raspberries, strawberries, figs,	
		dates, grapes, grapefruit, plum, kiwi, nectarine,	
		pineapple, litchi, pomegranate, pear, olive,	
		prune, star fruit, watermelon.	
	Dried fruit with added sugar	Raisins, dates, prunes	
5	Organ meat	Liver, kidney, geart, brains or any other animal-based	5
		intestine.	
6	Meat and fish		6
	Red meat	Beef, goat, lamb, mutton, pork, rabbit	
	Poultry	Chicken, duck, goose, guineafowl, turkey, pigeon, or any	
		other domestic birds.	
	Seafood	Any fresh / dried / canned fish or shellfish.	
7	Eggs	Eggs from any bird	7
8	Legumes, nuts and seeds	Broad beans, white beans, baked beans, lima beans,	8
		mung beans, soybeans.	
		Lentils, chiskpeas, sweet peas.	
		Almond, peanutbutter, cashew, shestnut, hazelnut, pecan,	
		macadamia, pistachio, and walnuts and any spread made from nuts	

9	Milk and milk products	Infant formula, whole, low fat or skim milk (fresh / powder)	9
		Custard, yoghurt, sour milk (Amasie)	
		Ice cream, dairy-based puddings	
		Hard, soft and processed cheese	
10	Sweets	Sugar, honey, sugar-sweetened beverages,	10
		sugar-sweetened food (eg. Chocolates, cookies, toffees, candies)	
11	Fats and oils	All oils, butter, all margarines, lard, mayonnaise and any other	11
		added fat to food or used for cooking.	
TOTAL			12

Appendix C2: Analysis of dietary diversity scores

Analysis of Dietary Diversity Scores

Use scores of Questionnaire C1 part (b) to complete the final Dietary Diversity Scores

Question number	Food Group	Correlation with WDDS food groups
1	Grains, roots and tubers	1
2	Legumes and nuts	8
3	Dairy and dairy products (milk, yoghurt, cheese)	9
4	Flesh foods (meat, fish, poultry and organ meats)	5, 6
5	Eggs	7
6	Vitamin A rich fruits and vegetables	3
7	Other fruits and vegetables	2, 4
TOTAL		

	1
	2
	3
	4
	5
	6
	7
	8

Appendix D: Children's Food Security Questionnaire

Children's Food Security Questionnaire

Subject number:

d	d	m	m	y	y

Today's date:

The following questions are directed at the caregiver of the child
Mark the appropriate option with a X

Choose one of the following statements that is true for the last 12 months

1 I relied on low variety / low-cost food to feed my child(ren), because I ran out of money.

- | | |
|---|----------------|
| 1 | Often true |
| 2 | Sometimes true |
| 3 | Never true |

2 I couldn't feed my child / children a balanced meal, because I couldn't afford it.

- | | |
|---|----------------|
| 1 | Often true |
| 2 | Sometimes true |
| 3 | Never true |

My child / children weren't eating enough because I just couldn't afford enough food.

For office use only:

				1-4	
d	D	m	m	y	y
5 -					
10					

	11
--	----

	12
--	----

	13
--	----

3

- 1 Often true
- 2 Sometimes true
- 3 Never true

4 Did you ever cut the size of your child / children's meals due to limited money for food?

- 1 Yes
- 2 No

5 Was your child / children ever hungry, but you just couldn't afford more food?

- 1 Yes
- 2 No

6 Did your child / children ever skip meals because there wasn't enough money for food?

- 1 Yes
- 2 No
- 3 Do not know or refuse

7 If yes, how often did this happen?

- 1 Almost every month
- 2 Some months, but not every month
- 3 Only 1 or 2 months

8 Did your child / children ever not eat for the whole day, because of money shortages?

- 1 Yes
- 2 No

14

15

16

17

APPENDICES E – G: INFORMATION AND CONSENT DOCUMENTS

Appendix E1: Request of permission from schools

The Principal

RE: Permission to Conduct a Research Study at your Day Care Centre

To whom it may concern

I, Carli Rauch, am currently in the process of completing my Master's Degree in Nutrition through the Department of Nutrition and Dietetics at the University of the Free State. As part of my degree I am conducting a Descriptive research project titled "**Nutritional status of toddlers attending Day care centres in Newton Park, Nelson Mandela Bay**". Therefore, I kindly request permission to complete this study at your Day Care centres in Newton Park.

Purpose

Purpose of this study is to evaluate the **Nutritional status** of toddlers (1 – 3 years) living / attending Day Care in Newton Park. Nutritional status will determine whether the toddler is eating the correct type and amounts of food to meet his / her requirements.

Procedure

The study will be submitted for approval to an Evaluation Committee of the school of Allied professionals as well as the Ethics Committee of the faculty of Health Science of the University of the Free State (UFS).

If approval is granted, the study will be conducted according to the following procedures:

- Weight, height, mid-upper arm circumference and head circumference will be measured on arrival.
- Toddlers will be assessed for clinical signs of nutritional deficiencies.
- The researcher will interview each caregiver (face-to-face), in order to complete three questionnaires – a *Dietary diversity*-, *Socio demographic* and a *Household Food Security questionnaire*.
- Each questionnaire will take +/- 15 - 30 minutes to complete.
- The study procedures will start and end at times as agreed upon by Headmasters of each school.

All toddlers attending any one of the Day care centres located in Newton Park will be invited to participate and the Descriptive study will be completed between the period of 20 April and 27 May 2015.

Possible risks and benefits

Study procedures will involve no risk of harm to participants. Subjects will benefit from receiving a free nutritional assessment and caregivers will gain knowledge on the subject of adequate nutrition for their toddlers. Additionally, data obtained through this study could be used to conduct larger studies on toddlers throughout Nelson Mandela Bay.

Subject's rights

Participants will have the right to withdraw from the study at any time. All personal information collected will remain confidential unless disclosure is required by law. Identity will remain confidential in the event of results being published and publically presented. Toddlers identified to be at a high nutritional risk will be referred to their nearest clinic / hospital. Caregivers of toddlers who are not meeting their requirements through their diet and / not growing like they should, will be provided with a copy of the South African paediatric food-based dietary guidelines at the end of study procedures.

Compensation

Participants will not be compensated for participation.

Any questions or queries may be directed to the researcher at +27 726 622 629 or the Secretary at the Ethics Committee of the Faculty of Health Sciences, UFS, Mrs. MGE Marais at +27(0)51 401 7794/5.

Sincerely,

Carli Rauch

Student number: 2005075532

Contact number: 072 6622 629

Approved by:

_____ / ____ / _____

Printed name and title

Signature

Date

Appendix E2: versoek om toestemming van dagsorg sentrums

Die Prinsipaal

RE: Toestemming om kinders van u dagsorgsentrum in te sluit in my Navorsingsprojek

Vir wie dit mag aangaan

Ek, Carli Rauch, is tans in die proses om my Meestersgraad in Voeding deur die Universiteit van die Vrystaat se Departement van Voeding en Dieëtkunde te voltooi. As deel van my graad voer ek 'n Beskrywende navorsingsprojek uit met die volgende titel – “**Die voedingstatus van kleuters wat ingeskryf is by dagsorgsentrums in Newtonpark, Nelson Mandelabaai**”. Hiermee rig ek dus 'n vriendelike versoek om toestemming dat kleuters van u dagsorgsentrum mag deelneem aan hierdie studie.

Doel

Die doel van hierdie studie is om die **voedingstatus** van kleuters (1 – 3-jariges) wat in Newtonpark bly / skoolgaan te bepaal. Die voedingstatus bepaal of die kleuter die korrekte tipe en hoeveelheid kos eet om in sy / haar daaglikse voedingstofbehoefte te voorsien.

Studieprosedures

Die studie sal vir formele toestemming voorgelê word aan die Evalueeringskomitee van die Departemente vir Gesondheidsverwante Beroepe, sowel as die Etiekkomitee van die Fakulteit van Gesondheids-wetenskappe aan die Universiteit van die Vrystaat.

Sodra formele toestemming ontvang is, sal die studie uitgevoer word volgens die volgende prosedures:

- Gewig, lengte, middel-bo-arm-omtrek en kopomtrek sal eerste gemeet word.
- kleuters sal assesser word vir die teenwoordigheid van enige kliniese tekens van voedingstoftekorte.
- Die Navorsers sal 'n persoonlike onderhoud met elkeen van die versorgers voer, met die doel om drie vraelyse te voltooi – 'n Dieëtdiversiteits-, Sosiodemografie- en Huishoudelike voedselsekutiteitsvraelys.
- Elke vraelys sal ongeveer 15 – 30 minute neem om te voltooi.
- Die studieprosedures sal begin en eindig volgens tye vooraf bespreek met prinsipale van dagsorgsentrums.

Alle ingeskrewe kleuters aan enige van die Dagsorgsentrums in Newtonpark, sal uitgenooi word om deel te neem aan hierdie Beskrywende studie, wat uitgevoer sal word oor die tydperk van 20 April na 27 Mei 2015.

Moontlike risikos en voordele

Die studieprosedures hou geen risiko in vir studiedeelnemers nie. kleuters wat deelneem sal voordeel trek uit die feit dat hulle 'n gratis voeding-assessering ontvang, terwyl hulle versorgers kennis sal opdoen rakende optimale voeding vir kleuters. Data verkry van hierdie studie sal dan ook nuttig wees vir die uitvoering van toekomstige soortgelyke studies op 'n groter skaal.

Regte van kleuters wat deelneem aan studie:

Studiedeelnemers sal die reg hê om op enige stadium te onttrek van die studie. Alle persoonlike inligting sal vertroulik bly behalwe in die geval van 'n regsbevel om inligting te verklaar. In die geval dat studieresultate gepubliseer word of voorgestel word tydens 'n akademiese sitting, sal identiteite van studiedeelnemers te alle tye konfidensieël bly.

Enige kleuters met 'n ernstige suboptimale voedingstatus sal verwys word na die naaste kliniek / hospitaal. Versorgers van kleuters wat nie ten volle hulle voedingstofbehoefte bereik deur middel van dieëet nie, of nie groei soos hulle veronderstel is nie, sal voorsien word van 'n kopie van die Suid Afrikaanse Pediatryse Voedselgebaseerde Dieëtriglyne aan die einde van die studieprosedures.

Vergoeding

Studiedeelnemers en versorgers sal nie vergoeding ontvang vir deelname nie.

Enige navrae kan aan my, die navorser, gerig word by +27 726 622 629, of die Sekretaresse van die Etekkomitee van die Fakulteit van Gesondheidswetenskap aan die Universiteit van die Vrystaat, Mev. MGE Marais, by +27(0)51 401 7794/5.

Die uwe,

Carli Rauch

Studentenommer: 2005075532

Kontaknummer: 072 6622 629

Goedgekeur deur:

_____ / ____ / _____

Gedrukte naam en van

Handtekening

Datum

Appendix F1: Information document

Study title: Nutritional status of toddlers attending Day care centres in Newton Park, Nelson Mandela Bay

Dear Caregiver

I, Carli Rauch, a student at the University of the Free State, am inviting your child to take part in the above-mentioned study as part of my Master's Degree in Nutrition at the Department of Nutrition and Dietetics.

The purpose of this study is to evaluate the **Nutritional status** of toddlers (1 – 3 years) living in Newton Park. Determining the nutritional status will indicate whether the toddler is eating the correct type and amounts of food to meet his / her nutritional requirements.

Procedure

The study will be submitted for approval to an Evaluation Committee of the school of Allied professionals as well as the Ethics Committee of the faculty of Health Science of the University of the Free State (UFS).

If approval is granted, the study will be conducted according to the following procedures:

- Weight, height, mid-upper arm circumference and head circumference will be measured on arrival.
- Toddlers will be assessed for clinical signs of nutritional deficiencies.
- The researcher will interview each caregiver (face-to-face), in order to complete three questionnaires – a *Dietary diversity*-, *Socio demographic* and a *Household Food Security questionnaire*.
- Each questionnaire will take +/- 15 - 30 minutes to complete.
- The study procedures will start and end at times as agreed upon by Headmasters of each school.

All toddlers attending any one of the Day care centres located in Newton Park will be invited to participate and the Descriptive study will be completed between the period of 20 April and 27 May 2015.

Possible risks and benefits

Study procedures will involve no risk of harm to toddlers. Toddlers will benefit from receiving a free nutritional assessment and caregivers will gain knowledge on the amounts and types of food their toddlers need each day.

Subject's rights

Participants will have the right to withdraw from the study at any time. All personal information collected will remain confidential unless disclosure is required by law. Identity will remain confidential in the event of results being published and publically presented. Toddlers identified to be at a high nutritional risk will be referred to their nearest clinic / hospital. Caregivers of toddlers who are not meeting their requirements through their diet and / not growing like they should, will be provided with a copy of the South African paediatric food-based dietary guidelines at the end of study procedures.

Compensation

Participants will not be compensated for participation.

Any questions or queries may be directed to the researcher at +27 726 622 629 or the Secretary at the Ethics Committee of the Faculty of Health Sciences, UFS, Mrs. MGE Marais at +27(0)51 401 7794/5.

Appendix F2: Inligtingsdokument

Studietitel: Voedingstatus van kleuters wat ingeskryf is aan Dagsorgsentrum in Newtonpark, Nelson Mandelabaai

Geagte Versorger van studiedeelnemer

Ek, Carli Rauch, 'n student aan die Universiteit van die Vrystaat, nooi u en u kleuter vriendelik uit om deel te neem aan die bogenoemde studie, as deel van my Meestersgraad in Voeding aan die Departement van Voeding en Dieëtkunde. Die doel van hierdie studie is om die **voedingstatus** van kleuters (1 – 3-jariges) wat in Newtonpark bly / skoolgaan te bepaal. Die voedingstatus bepaal of die kleuter die korrekte tipe en hoeveelheid kos eet om sy / haar daaglikse voedingstofbehoefes te bereik.

Studieprosedures

Die studie sal vir formele toestemming voorgelê word aan die Evalueringskomitee van die Departemente vir Gesondheidsverwante Beroepe, sowel as die Etiekkomitee van die Fakulteit van Gesondheids-wetenskappe aan die Universiteit van die Vrystaat. Sodra formele toestemming ontvang is, sal die studie uitgevoer word volgens die volgende prosedures:

- Gewig, lengte, middel-bo-arm-omtrek en kopomtrek sal eerste gemeet word.
- kleuters sal assessee word vir die teenwoordigheid van enige kliniese tekens van voedingstoftekorte.
- Die Navorser sal 'n persoonlike onderhoud met elkeen van die versorgers voer, met die doel om drie vraelys te voltooi – 'n Dieëtdiversiteits-, Sosiodemografie- en Huishoudelike voedselsekutiteitsvraelys.
- Elke vraelys sal ongeveer 15 – 30 minute neem om te voltooi.
- Die studieprosedures sal begin en eindig volgens tye vooraf bespreek met hoofde van dagsorgsentrum.

Alle ingeskrewe kleuters aan enige van die Dagsorgsentrum in Newtonpark, sal uitgenooi word om deel te neem aan hierdie Beskrywende studie, wat uitgevoer sal word oor die tydperk van 20 April na 27 Mei 2015.

Moontlike risikos en voordele

Die studieprosedures hou geen risiko in vir studiedeelnemers nie. kleuters wat deelneem sal voordeel trek uit die feit dat hulle 'n gratis voeding-assesering ontvang, terwyl hulle versorgers kennis sal opdoen rakende optimale voeding vir kleuters. Data verkry van hierdie studie sal dan ook nuttig wees vir die uitvoering van toekomstige soortgelyke studies op 'n groter skaal.

Regte van kleuters wat deelneem aan studie:

Studiedeelnemers sal die reg hê om op enige stadium te onttrek van die studie. Alle persoonlike inligting sal vertroulik bly behalwe in die geval van 'n regsbevel om inligting te verklaar. In die geval dat studieresultate gepubliseer word of voorgestel word tydens 'n akademiese sitting, sal identiteite van studiedeelnemers te alle tye konfidensieël bly. Enige kleuters met 'n ernstige sub-optimale voedingstatus sal verwys word na die naaste kliniek / hospitaal. Versorgers van kleuters wat nie ten volle hulle voedingstofbehoefes bereik deur middel van dieëet nie, of nie groei soos hulle veronderstel is nie, sal

voorsien word van 'n kopie van die Suid Afrikaanse Pediatriese Voedselgebaseerde Dieëtriglyne aan die einde van die studieprosedures.

Vergoeding

Studiedeelnemers en versorgers sal nie vergoeding ontvang vir deelname nie. Enige navrae kan aan my, die navorser gerig word by +27 726 622 629, of die Sekretaresse van die Etiekommitee van die Fakulteit van Gesondheidswetenskap aan die Universiteit van die Vrystaat, Mev. MGE Marais, by +27(0)51 401 7794/5.

Appendix G1: Consent form

Nutritional status of toddlers attending day care centres in Newton Park, Nelson Mandela Bay

INFORMED CONSENT FOR PARTICIPATION

Respondent number _____

Dear Caregiver,

Your toddler has been invited to participate in the above-mentioned research study during the period of 20 April and 27 May 2015.

If you approve, please complete the following section

Mark box with "x"

I confirm that I have read and understand the study information document

I confirm that I have received a signed copy of this form

I was given the opportunity to ask questions

I understand that participation of the child in my care is voluntary

I understand that I can withdraw him / her from the study at any time

I agree to allow my child to participate in this study

I agree to my confidential data being published / stored for the use of future study

Any questions or queries may be directed to the researcher at +27 726 622 629 or the Secretary at the Ethics Committee of the Faculty of Health Sciences, UFS, Mrs. MGE Marais at +27(0)51 401 7794/5.

Name of caregiver	Date	Signature

Name of caregiver	Date	Signature

Name of witness 1	Date	Signature

Name of witness 2	Date	Signature

Appendix G2: Ingeligte toestemmingsvorm

Voedingstatus van kleuters ingeskryf aan dagsorgsentrum in Newtonpark, Nelson Mandelabaai

Ingeligte toestemming vir studiedeelname

Respondent nommer _____

Geagte Versorger van studiedeelnemer,

U kleuter word vriendelik uitgenooi om deel te neem aan die bogenoemde navorsingsprojek tydens ddie periode van 20 April tot 27 Mei 2015.

Indien u instem, voltooi asseblief die volgende afdeling

Merk die blokkie met "x"

Ek bevestig dat ek die studieinligtingsdokument gelees het en ten volle verstaan

Ek bevestig dat ek 'n ondertekende weergawe van hierdie dokument ontvang het

Ek bevestig dat ek die geleentheid tot navrae gegun is

Ek verstaan dat deelname van die kleuter in my sorg opsioneel is

Ek verstaan dat ek die reg het hom / haar enige tyd te onttrek van die studie

Ek gee toestemming dat die kleuter in my sorg mag deelneem aan die studie

Ek stem in dat my vertroulike data gepubliseer / gestoor mag word vir toekomstige gebruik

Enige navrae kan aan my, die navorser gerig word by +27 726 622 629, of die Sekretaresse van die Etiekkomitee van die Fakulteit van Gesondheidswetenskap aan die Universiteit van die Vrystaat, Mev. MGE Marais, by +27(0)51 401 7794/5.

Naam van Versorger	Datum	Handtekening
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Naam van Navorser	Datum	Handtekening
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Naam van Getuie 1	Datum	Handtekening
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Naam van Getuie 2	Datum	Handtekening
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Appendix H: Food portion guide (Cowin & Emmet, 2007:254).

Table 1 Guide portion sizes for 1–4-year-old children in household measures and amounts (g) with weights as eaten in Avon Longitudinal Study of Parents and Children (ALSPAC) and National Diet and Nutrition Survey (NDNS) (median and 25th and 75th centiles of the range) and proposed portion size weights from CWT Photo resource (Crawley & Hocking, 2009)

Proposed portion range	Weight (g)	NDNS 1995 Wrieden et al., 2008		ALSPAC 18 months			ALSPAC 43 months			CWT Photo resource (g)	
		Median (g)	Range (g)	Median range (g)	25th centile (g)	75th centile (g)	Median (g)	25th centile (g)	75th centile (g)		
Food group 1: Bread, rice, potatoes, pasta and other starchy food – five servings per day or four for vegetarians											
Breads and crackers											
Bread slices	1/2–1 medium slices	18–36	21–31	14–42	22–36	12.00	36.00	30–36	20–27	44–72	20–25
Bread roll	1/4–3/4 roll	14–42	34	21–46	22–27.5	17–24	45–48	33–50	22–28	45–50	20
Bread sticks	1–3 large breadsticks	6–18			7	3	7		10	7	14
Bagel	1/4–1/2 bagel	21–42									50
Chapati	1/2–1 chapatis	22–45									20
Cream/wholemeal crackers	1–3 crackers	7–23			7–8	7	11	14–16	7–11	16–22	20
Crispbread	1/2–2 crispbread	5–20			7.50	2.75	10		10	10	20
Naan bread	1/8–1/5 naan	17–45									20
Outcakes	1–2 outcakes	11–22									20
Pitta bread	1/2–1 mini or 1/4–1/2 pitta	15–35			37	18	37		56	33	75
Rice cakes	1–3 rice cakes	7.5–22.5			7	7	7		7	3	14
Tortilla	1/4–1/2 large tortilla	10–20									20
Potatoes, pasta, rice and couscous											
Baked potato	1/2–1 1/2 egg sized potatoes	24–72	49–54	28–82	40–120	30–97.5	77–160	40–80	40–45	80–120	80
Baked potato	1/4–1/2 medium potato	45–90	70	40–80	80–90	44–54.5	96.5–100	84–100	61–87	92–104	90
Mashed potato	1–4 tablespoons	20–80	60	35–90	52–66	33–45	87.5–90		67	45	90
Roast potatoes	1/2–1 small potato	25–50	36	18–27	33–41	25–33	50–66		50	34–50	84–100
Potato wedges	2–4 medium	25–50									65
Potato chips	4–8 chips	26–52	56	36–85	60–70.5	34.5–66	86–106.75		50–112	30–100	100–220
Couscous	2–4 heaped tablespoons	40–80									80
Noodles	1/2–1 small cup	30–75			42	26	60.50		56–70	40–56	140
Pasta (cooked)	2–5 tablespoons	26–65	63	37–94	39–75	19–29	60–84		75–84	57	120
Pasta in tomato sauce e.g. spaghetti hoops in tomato sauce)	2–4 tablespoons	36–72	86	50–126	90	53	135		100	56	150
Potato croquettes	1–2 small croquettes	30–60							60	40	92
Potato Waffles	1/2–1 waffles	30–60	39	25–54	80	80	155		75	50	160
Rice – boiled	2–5 tablespoons	26–65	50	30–77	40–44	25	72		66–80	35–57	90–120
Rice – fried	2–4 tablespoons	24–48									80
Plantain – boiled	1–3 tablespoons	20–60									80

Table 1 (Continued)

Proposed portion range	Weight (g)	NDNS 1995 Wrieden et al., 2008		ALSPAC 18 months			ALSPAC 43 months			CWT Photo resource (g)	
		Median (g)	Range (g)	Median range (g)	25th centile (g)	75th centile (g)	Median (g)	25th centile (g)	75th centile (g)		
Plantain – fried	1–3 tablespoons	20–60									80
Breakfast cereals											
Corn flakes/Weetabix/Krispies/Cheerios	3–6 heaped tablespoons	12–24	18–19	11–26	12–15	8–9	16–21		20	12–15	20–25
Muesli	2–4 tablespoons	16–32			19.00	12.00	26.50		30	15–16	44–50
Raw porridge/rye/Ready Brek	2–4 tablespoons	16–32			15–29	10–15	20–31.5		15–17	11–15	20–30
Porridge/Ready Brek made up with milk	5–8 tablespoons	80–128			91.50	80	142.50		145–160	110–112	170–176
Porridge or Ready Brek made up with water	5–8 tablespoons	80–128			84.00	22.50	116.00		145	97	175
Sugar coated/frosted /chocolate coated e.g. Honey Nut Cheerios, Coco Pops, Sugar Puffs)	3–6 tablespoons	12–24	21	14–30	13.5–15	7–11	12–30		20	14–15	28
Wheatbix											
Wheatbix	1/2–1 1/2 biscuits	9–28	19	15–27	20.00	18.00	21.00		20	20	40
Snacks											
Bun (e.g. hot cross)	1/4–1/2 bun	16–32			25–30	12–21.5	25–40		50–60	29–30	50–60
Crummet	1/4–1 crummet	14–35	35	25–49	40				40	26	80
Milk loaf	1/2–1 slice	17–35			35	24	35		35	35	70
Scone	1/2–1 scone	29–58			24	12	42				30
Tea bread	1/2–1 1/2 slices	17–50			17	9.50	40.50		12–48	12–42	24–60
Food group 2: fruits and vegetables											
Fruits – three servings per day											
Apple	1/4–1/2 medium apple	30–60	63	38–94	40–50	24	56		50–100	29–67	80–100
Avocado	1/2–2 tablespoons flesh	8–32			55	9	75				
Banana	1/4–1 medium banana	20–80	68	47–88	80	50	100		87	50	100
Berries: blackberries, blueberries, raspberries, strawberries	3–10 small berries	15–60			16–40	16.5–24	40–60		46–64	26–36	63–84
Clementine/orange/mandarin	1/2–1 fruit	35–70	49	37–65	60–70	35–50	60–70		50–60	44–50	50–60
Dried apricots/prunes	1–4 pieces	8–32			11.50	7.75	24		40	22	56
Dried fruit: raisins, sultanas	1/2–2 tablespoons	6–26	15	9–21	10–15	1.5–8	15–30		15–30	2–15	25–30

Table 1 (Continued)

	Proposed portion range	Weight (g)	NDNS 1995 Wiedem et al., 2008			ASPPAC 18 months			ASPPAC 48 months			CWT Photo resource (g)
			Median (g)	Range (g)	Median range (g)	25th centile (g)	75th centile (g)	Median (g)	25th centile (g)	75th centile (g)		
Pan/bun – fried	1–3 tablespoons	20–60									80	
Breakfast cereals												
Cornflakes/Krispies/Cheerios	3–6 heaped tablespoons	12–24	18–19	11–26	12–15	8–9	16–21	20	12–15	20–25	20	
Muesli	2–4 tablespoons	16–32			19.00	12.00	26.50	30	15–16	44–50	30	
Raw porridge/fry Ready/Brek	2–4 tablespoons	16–32			15–29	10–15	20–31.5	15–17	11–15	20–30		
Porridge/Ready/Brek made up with milk	5–8 tablespoons	80–128			91.50	80	142.50	145–160	110–112	170–176	100	
Porridge or Ready/Brek made up with water	5–8 tablespoons	80–128			84.00	22.50	116.00	145	97	175	100	
Sugar coated/frosted/Chocolate cereals: e.g. Honey Nut Cheerios, Coco Pops, Sugar Puffs	3–6 tablespoons	12–24	21	14–30	13.5–15	7–11	12–30	20	14–15	28		
Wheatals	1.0–1 1/2 biscuits	9–28	19	15–27	20.00	18.00	21.00	20	20	40	20	
Snacks												
Bun (e.g. hot cross)	1/4–1/2 bun	16–32			25–30	12–21.5	25–40	50–60	29–30	50–60	30	
Crumpet	1/4–1 crumpet	14–55	35	25–49	40			40	26	80		
Malt loaf	1.0–1 slice	17–35			35	24	35	35	35	70	40	
Scone	1.0–1 scone	29–58			24	12	42				30	
Tea bread	1.0–1 1/2 slices	17–50			17	9.50	40.50	12–48	12–42	24–60		
Food group 2: fruits and vegetables												
Fruits – three servings per day												
Apple	1/4–1/2 medium apple	30–60	63	30–94	40–50	24	56	50–100	29–67	80–100	40	
Avocado	1.0–2 tablespoons fresh	8–32			55	9	75					
Banana	1/4–1 medium banana	20–80	68	47–88	80	50	100	87	50	100	40–80	
Berries: blackberries, blueberries, raspberries, strawberries	3–10 small berries	15–60			16–40	16.5–24	40–60	46–64	26–36	63–84	40	
Clementine/tangerine/mandarin	1.0–1 fruit	35–70	49	37–65	60–70	35–50	60–70	50–60	44–50	50–60	40	
Dried apricots/prunes	1–4 pieces	8–32			11.50	7.75	24	40	22	56	20	
Dried fruit: raisins, sultanas	1.0–2 tablespoons	6–26	15	9–21	10–15	1.5–8	15–30	15–30	2–15	25–30	40	

Table 1 (Continued)

	Proposed portion range	Weight (g)	NDNS 1995 Wiedem et al., 2008			ASPPAC 18 months			ASPPAC 48 months			CWT Photo resource (g)
			Median (g)	Range (g)	Median range (g)	25th centile (g)	75th centile (g)	Median (g)	25th centile (g)	75th centile (g)		
Pan/bun – fried	1–3 tablespoons	20–60									80	
Breakfast cereals												
Cornflakes/Krispies/Cheerios	3–6 heaped tablespoons	12–24	18–19	11–26	12–15	8–9	16–21	20	12–15	20–25	20	
Muesli	2–4 tablespoons	16–32			19.00	12.00	26.50	30	15–16	44–50	30	
Raw porridge/fry Ready/Brek	2–4 tablespoons	16–32			15–29	10–15	20–31.5	15–17	11–15	20–30		
Porridge/Ready/Brek made up with milk	5–8 tablespoons	80–128			91.50	80	142.50	145–160	110–112	170–176	100	
Porridge or Ready/Brek made up with water	5–8 tablespoons	80–128			84.00	22.50	116.00	145	97	175	100	
Sugar coated/frosted/Chocolate cereals: e.g. Honey Nut Cheerios, Coco Pops, Sugar Puffs	3–6 tablespoons	12–24	21	14–30	13.5–15	7–11	12–30	20	14–15	28		
Wheatals	1.0–1 1/2 biscuits	9–28	19	15–27	20.00	18.00	21.00	20	20	40	20	
Snacks												
Bun (e.g. hot cross)	1/4–1/2 bun	16–32			25–30	12–21.5	25–40	50–60	29–30	50–60	30	
Crumpet	1/4–1 crumpet	14–55	35	25–49	40			40	26	80		
Malt loaf	1.0–1 slice	17–35			35	24	35	35	35	70	40	
Scone	1.0–1 scone	29–58			24	12	42				30	
Tea bread	1.0–1 1/2 slices	17–50			17	9.50	40.50	12–48	12–42	24–60		
Food group 2: fruits and vegetables												
Fruits – three servings per day												
Apple	1/4–1/2 medium apple	30–60	63	30–94	40–50	24	56	50–100	29–67	80–100	40	
Avocado	1.0–2 tablespoons fresh	8–32			55	9	75					
Banana	1/4–1 medium banana	20–80	68	47–88	80	50	100	87	50	100	40–80	
Berries: blackberries, blueberries, raspberries, strawberries	3–10 small berries	15–60			16–40	16.5–24	40–60	46–64	26–36	63–84	40	
Clementine/tangerine/mandarin	1.0–1 fruit	35–70	49	37–65	60–70	35–50	60–70	50–60	44–50	50–60	40	
Dried apricots/prunes	1–4 pieces	8–32			11.50	7.75	24	40	22	56	20	
Dried fruit: raisins, sultanas	1.0–2 tablespoons	6–26	15	9–21	10–15	1.5–8	15–30	15–30	2–15	25–30	40	

Table 1 (Continued)

	Proposed portion range	Weight (g)	NDNS 1995 Wrieden et al., 2008		ASPAC 18 months			ASPAC 43 months			CWT Photo resource (g)
			Median (g)	Range (g)	Median range (g)	25th centile (g)	75th centile (g)	Median (g)	25th centile (g)	75th centile (g)	
Plantain – fried	1–3 tablespoons	20–60									80
Breakfast cereals											
Corn flakes/Flax Krispies/Cheerios	3–6 heaped tablespoons	12–24	18–19	11–26	12–15	8–9	16–21	20	12–15	20–25	20
Muesli	2–4 tablespoons	16–32			19.00	12.00	26.90	30	15–16	44–50	30
Raw porridge/oat/Ready Brink	2–4 tablespoons	16–32			15–29	10–15	20–31.5	15–17	11–15	20–30	
Porridge/Ready Brink made up with milk	5–8 tablespoons	80–128			91.50	80	142.50	145–160	110–112	170–176	100
Porridge or Ready Brink made up with water	5–8 tablespoons	80–128			84.00	22.90	116.00	145	97	175	100
Sugar coated/frosted /chocolate cereals (e.g. HoneyNut Cheerios, Coco Pops, Sugar Puffs)	3–6 tablespoons	12–24	21	14–30	13.5–15	7–11	12–30	20	14–15	28	
Weetabix	1.0–1.1/2 biscuits	9–28	19	15–27	20.00	18.00	21.00	20	20	40	20
Snacks											
Bun (e.g. hot cross)	1/4–1/2 bun	16–32			25–30	12–21.5	25–40	50–60	29–30	50–60	30
Crumpet	1/4–1 crumpet	14–55	35	25–49	40			40	26	80	
Milk loaf	1.0–1 slice	17–35			35	24	35	35	35	70	40
Scone	1.0–1 scone	29–58			24	12	42				30
Tea bread	1.0–1.1/2 slices	17–50			17	9.50	40.90	12–48	12–42	24–60	
Food group 2: fruits and vegetables											
Fruits – three servings per day											
Apple	1/4–1/2 medium apple	30–60	63	38–94	40–50	24	56	50–100	29–67	80–100	40
Avocado	1.0–2 tablespoons flesh	8–32			55	9	75				
Banana	1/4–1 medium banana	20–80	68	47–88	80	50	100	87	50	100	40–80
Berries: blackberries, blueberries, raspberries, strawberries	3–10 small berries	15–60			16–40	16.5–24	40–60	46–64	26–36	63–84	40
Clementine/tangerine/mandarin	1.0–1 fruit	35–70	49	37–65	60–70	35–50	60–70	50–60	44–50	50–60	40
Dried apricots/prunes	1–4 pieces	8–32			11.50	7.75	24	40	22	56	20
Dried fruit: raisins, sultanas	1.0–2 tablespoons	6–26	15	9–21	10–15	1.5–8	15–30	15–30	2–15	25–30	40

Table 1 (Continued)

	Proposed portion range	Weight (g)	NDNS 1995 Wrieden et al., 2008		ASPAC 18 months			ASPAC 43 months			CWT Photo resource (g)
			Median (g)	Range (g)	Median range (g)	25th centile (g)	75th centile (g)	Median (g)	25th centile (g)	75th centile (g)	
Plantain – fried	1–3 tablespoons	20–60									80
Breakfast cereals											
Corn flakes/Flax Krispies/Cheerios	3–6 heaped tablespoons	12–24	18–19	11–26	12–15	8–9	16–21	20	12–15	20–25	20
Muesli	2–4 tablespoons	16–32			19.00	12.00	26.90	30	15–16	44–50	30
Raw porridge/oat/Ready Brink	2–4 tablespoons	16–32			15–29	10–15	20–31.5	15–17	11–15	20–30	
Porridge/Ready Brink made up with milk	5–8 tablespoons	80–128			91.50	80	142.50	145–160	110–112	170–176	100
Porridge or Ready Brink made up with water	5–8 tablespoons	80–128			84.00	22.90	116.00	145	97	175	100
Sugar coated/frosted /chocolate cereals (e.g. HoneyNut Cheerios, Coco Pops, Sugar Puffs)	3–6 tablespoons	12–24	21	14–30	13.5–15	7–11	12–30	20	14–15	28	
Weetabix	1.0–1.1/2 biscuits	9–28	19	15–27	20.00	18.00	21.00	20	20	40	20
Snacks											
Bun (e.g. hot cross)	1/4–1/2 bun	16–32			25–30	12–21.5	25–40	50–60	29–30	50–60	30
Crumpet	1/4–1 crumpet	14–55	35	25–49	40			40	26	80	
Milk loaf	1.0–1 slice	17–35			35	24	35	35	35	70	40
Scone	1.0–1 scone	29–58			24	12	42				30
Tea bread	1.0–1.1/2 slices	17–50			17	9.50	40.90	12–48	12–42	24–60	
Food group 2: fruits and vegetables											
Fruits – three servings per day											
Apple	1/4–1/2 medium apple	30–60	63	38–94	40–50	24	56	50–100	29–67	80–100	40
Avocado	1.0–2 tablespoons flesh	8–32			55	9	75				
Banana	1/4–1 medium banana	20–80	68	47–88	80	50	100	87	50	100	40–80
Berries: blackberries, blueberries, raspberries, strawberries	3–10 small berries	15–60			16–40	16.5–24	40–60	46–64	26–36	63–84	40
Clementine/tangerine/mandarin	1.0–1 fruit	35–70	49	37–65	60–70	35–50	60–70	50–60	44–50	50–60	40
Dried apricots/prunes	1–4 pieces	8–32			11.50	7.75	24	40	22	56	20
Dried fruit: raisins, sultanas	1.0–2 tablespoons	6–26	15	9–21	10–15	1.5–8	15–30	15–30	2–15	25–30	40

Table 1 (Continued)

	Proposed portion range	Weight (g)	NDRS 1995 Wrieden et al., 2008		ALSPAC 18 months			ALSPAC 43 months			CWT Photo resource (g)
			Median (g)	Range (g)	Median range (g)	25th centile (g)	75th centile (g)	Median (g)	25th centile (g)	75th centile (g)	
Pan-fry – fried	1–3 tablespoons	20–60								80	
Breakfast cereals											
Cornflakes/Weetabix/Krispies/ Cheerios	3–6 heaped tablespoons	12–24	18–19	11–26	12–15	8–9	16–21	20	12–15	20–25	20
Muesli	2–4 tablespoons	16–32			19.00	12.00	26.50	30	15–16	44–50	30
Raw porridge/oat Ready Brek	2–4 tablespoons	16–32			15–29	10–15	20–31.5	15–17	11–15	20–30	
Porridge/Ready Brek made up with milk	5–8 tablespoons	80–128			91.50	80	142.50	145–160	110–112	170–176	100
Porridge or Ready Brek made up with water	5–8 tablespoons	80–128			84.00	22.50	116.00	145	97	175	100
Sugar coated/frosted /chocolate cereals (e.g. Honey Nut Cheerios, Coco Pops, Sugar Puffs)	3–6 tablespoons	12–24	21	14–30	13.5–15	7–11	12–30	20	14–15	28	
Weetabix	1.0–1 1/2 biscuits	9–28	19	15–27	20.00	18.00	21.00	20	20	40	20
Snacks											
Bun (e.g. hot cross)	1.0–1.2 bun	16–32			25–30	12–21.5	25–40	50–60	29–30	50–60	30
Crumpet	1.0–1 crumpet	14–35	35	25–49	40		40	40	26	80	
Malt loaf	1.0–1 slice	17–35			35	24	35	35	35	70	40
Scone	1.0–1 scone	29–58			24	12	42				30
Tea bread	1.0–1 1/2 slices	17–50			17	9.50	40.50	12–48	12–42	24–60	
Food group 2: fruits and vegetables											
Fruits – three servings per day											
Apple	1.0–1.2 medium apple	30–60	63	38–94	40–50	24	56	50–100	29–67	80–100	40
Avocado	1.0–2 tablespoons flesh	8–32			55	9	75				
Banana	1.0–1 medium banana	20–80	68	47–88	80	50	100	87	50	100	40–80
Berries: blackberries, blueberries, raspberries, strawberries	3–10 small berries	15–60			16–40	16.5–24	40–60	46–64	26–36	63–84	40
Clementine/orange/ mandarin	1.0–1 fruit	35–70	49	37–65	60–70	35–50	60–70	50–60	44–50	50–60	40
Dried apricots (runes)	1–4 pieces	8–32			11.50	7.75	24	40	22	56	20
Dried fruit: raisins, sultanas	1.0–2 tablespoons	6–26	15	9–21	10–15	1.5–8	15–30	15–30	2–15	25–30	40

Table 1 (Continued)

	Proposed portion range	Weight (g)	NDRS 1995 Wrieden et al., 2008		ALSPAC 18 months			ALSPAC 43 months			CWT Photo resource (g)
			Median (g)	Range (g)	Median range (g)	25th centile (g)	75th centile (g)	Median (g)	25th centile (g)	75th centile (g)	
Cake (madeira, swissroll, sponge cake)	1/4–1/2 slice	15–30	35	23–52	15–32	10–25	22–40	30–48	15–38	30–78	
Cup cake/fairy cake	1/2–1 cake	13–25	28	21–40	30.00	20.50	30.00	30	30	30	
Fruit cake or fruit tart	1/2–1 slice	15–30			20–35	11.25–25	30–56	34–70	31–35	45–70	
Croissant	1/2–1 plain	24–47			30.00	26.50	60.00	30	60	30	30
Doughnuts	1/4–3/4 of 60 g doughnut	15–45	50	37–69	30–37	18–37	47–75	45–75	23–46	60–75	
Danish Pastry/ chocolate croissant	1/4–1/2 medium pastry	15–30			30	14	55				
Cereal bars	1/2–1 20 g bar/1/4–1/2 37 g bar	11–21									50
Chocolate coated biscuit	1/2–1 biscuits	10–20	20	14–23	12–21	12	25	12	6	18	
Digestive biscuit (plain)	1/2–1 biscuit	8–15	15	13–23	13	9	15	13	13	26	
Fruit biscuits – fig rolls	1/2–1 biscuit	8–17			15	15	30	15	15	30	
Fruit biscuits – Garibaldi	1–2 biscuits	10–20			8	7.25	8				
Muffin – American style	1/8–1/4 125 g muffin	16–32									
Plain biscuit (e.g. rich tea, marmite, ginger nut, etc.)	1–2 biscuits	8–16	14	9–22	7–13	5–8	10	7–15	7–15	14–30	
Sandwich biscuit (e.g. bourbon creams, custard cream)	1/2–1 sandwich biscuit	6–12	16	12–24	12	11	17	13	11	24	
Paratha	1/8–1/4 paratha	13–27									
S: Sauces & sweets/savoury spreads – one serving per day											
Sweet spreads											
Chocolate spread	Thinly spread – 1 teaspoon	6			8–20			20	10–12	24–36	
Honey/jam/marmalade/ syrup	Thinly spread – 1 teaspoon	8	7	4–11	7–12	4–6	15–20	8–15	5–12	10–26	5
Savoury flavourings											
Gravy – made with granules	1–2 tablespoons	15–30	27	14–45	19–22.5	15.00	30.00	45	30	45	
Gravy – made with meat juices and thickening	1–2 tablespoons	15–30	30	17–45	17.00	13.00	29.00	45	30	45	
Tomato ketchup/brown or barbecue sauce	1–2 teaspoons	6–12	7	5–12	12.00	6.00	12.00	16	8	30	
Marmite/veganite	Thinly spread	1	2	1–3	1.00	0.00	3.00	2	1	3	

Table 1 (Continued)

	Proposed portion range	Weight (g)	NEMS 1995 Wrieden et al., 2008		ALSPAC 18 months			ALSPAC 41 months			CWT Photo resource (g)
			Median (g)	Range (g)	Median range (g)	25th centile (g)	75th centile (g)	Median (g)	25th centile (g)	75th centile (g)	
Cake (madeira, swissroll, sponge cake)	1/4-1/2 slice	15-30	35	23-52	15-32	10-25	22-40	30-48	15-38	30-78	
Cup cake/fairy cake	1/2-1 cake	13-25	28	21-40	30.00	20.50	30.00	30	30	30	
Fruit cake or fruit tart	1/2-1 slice	15-30			20-35	11.25-25	30-56	34-70	31-35	45-70	
Croissant	1/2-1 plain	24-47			30.00	26.50	60.00	30	60	30	
Doughnuts	1/4-3/4 of 60 g doughnut	15-45	50	37-69	30-37	18-37	47-75	45-75	23-46	60-75	
Danish Pastry/ chocolate croissant	1/4-1/2 medium pastry	15-30			30	14	55				
Cereal bars	1/2-1 20 g bar/1/4-1/2 37 g bar	11-21								50	
Chocolate coated biscuit	1/2-1 biscuits	10-20	20	14-23	12-21	12	25	12	6	18	
Digestive biscuit (plain)	1/2-1 biscuit	8-15	15	13-23	13	9	15	13	13	26	
Fruit biscuits - fig rolls	1/2-1 biscuit	8-17			15	15	30	15	15	30	
Fruit biscuits - Garibaldi	1-2 biscuits	10-20			8	7.25	8				
Muffin - American style	1/8-1/4 1.25 g muffin	16-32									
Plain biscuit (e.g. rich tea, mackerel, ginger nut, etc.)	1-2 biscuits	8-16	14	9-22	7-13	5-8	10	7-15	7-15	14-30	
Sandwich biscuit (e.g. bourbon dream, custard cream)	1/2-1 sandwich biscuit	6-12	16	12-24	12	11	17	13	11	24	
Paratha	1/8-1/4 paratha	13-27									
Sc Sauces & sweet/savoury spreads - one serving per day											
Sweet spreads											
Chocolate spread	Thinly spread - 1 teaspoon	6			8-20			20	10-12	24-36	
Honey/jam/marmalade/syrup	Thinly spread - 1 teaspoon	8	7	4-11	7-12	4-6	15-20	8-15	5-12	10-26	5
Savoury flavourings											
Gravy - made with granules	1-2 tablespoons	15-30	27	14-45	19-22.5	15.00	30.00	45	30	45	
Gravy - made with meat juices and thickening	1-2 tablespoons	15-30	30	17-45	17.00	13.00	29.00	45	30	45	
Tomato ketchup/brown or barbecue sauce	1-2 teaspoons	6-12	7	5-12	12.00	6.00	12.00	16	8	30	
Mimimite/vegemite	Thinly spread	1	2	1-3	1.00	0.00	3.00	2	1	3	

Appendix I: 2011 Census statistics: Geography by class of income

Appendix I Nelson Mandela Bay Census 2011 Release v1.1: Annual household income per suburb

Table 1

Geography by Class of income of the household for Person adjusted, Household, 15 - 64, Housing unit

Min	0	1	4801	9601	19601	38201	76401	153801	307601	614401	1228801	2547601
Mid	0	2401	7201	14601	28901	57301	115101	230701	461001	921601	1888201	3821402
Max	0	4800	9600	19600	38200	76400	153800	307600	614400	1228800	2547600	5095202

	No income	R 1 - R 4800	R 4801 - R 9600	R 9601 - R 19 600	R 19 601 - R 38 200	R 38 201 - R 76 400	R 76 401 - R 153 800	R 153 801 - R 307 600	R 307 601 - R 614 400	R 614 001 - R 1 228 800	R 1 228 801 - R 2 457 600	R 2 457 601 or more	Total population per suburb	Total annual household income	Estimated average annual household income
Adcockvale	44	6		4	21	29	155	148	113	26	15	3	564	R 170 167 823	R 301 716
Algoa Park	634	47	111	313	732	1302	2075	1911	742	111	50	32	8060	R 1 442 003 258	R 178 909
Allan Heights	114	72	143	196	378	279	138	103	9		4	4	1440	R 97 609 530	R 67 784
Amsterdamhoe k	10		2	13	14	8	8	48	33	36	2		174	R 65 228 764	R 374 878
Bacelona	257	139	271	298	686	488	133	60	40			2	2374	R 109 658 619	R 46 191
Ben Kamma	60			10	12	20	71	125	268	84	3	4	657	R 260 561 601	R 396 593
Beverley Grove	20			2	9	22	47	80	123	59	8	8	378	R 182 170 166	R 481 932
Beverley Grove	12			1	7	4	11	46	82	46	13	2	224	R 124 709 614	R 556 739
Bluewater Bay	216	26	16	51	87	86	391	742	884	381	97	43	3020	R 1 330 679 847	R 440 622
Brentwood Park	8	1		11	9	23	22	73	62	15	4	14	242	R 124 572 948	R 514 764
Bridge Haven	54		12	16	36	83	141	213	152	56		3	766	R 204 631 015	R 267 142

Bridgemead	93	14	6	55	44	110	269	465	494	121	10	25	1706	R 600 358 038	R 351 910
Broadwood	203	1	4	19	39	88	269	456	659	231	35	25	2029	R 820 951 651	R 404 609
Brymore	32	3	3	3	12	14	50	142	243	119	12	12	645	R 329 945 225	R 511 543
Cape Recife Nature Reserve													0	R 0	
Colleen Glen AH	11		2	18	39	15	68	96	68	53		15	385	R 169 751 989	R 440 914
Cotswold	148	7	10	50	86	189	382	742	636	198	13	28	2489	R 836 502 469	R 336 080
Cotswold Mine					2								2	R 57 802	R 28 901
Cradock Place	57	8	20	55	123	162	164	92	10		2		693	R 62 291 336	R 89 886
Crockarts Hope AH	20	2	6	13	4	18	53	68	22				206	R 33 314 886	R 161 723
Deal Party	1		1	4	4	12	2	7					31	R 2 713 930	R 87 546
Ericdene	20	26	31	87	33					6			203	R 8 039 283	R 39 602
Fairview AH	2	2	9	2	3	2	4	19	17	2			62	R 14 824 060	R 239 098
Ferguson	34	13	14	15	42	83	102	133	52	36			524	R 105 894 090	R 202 088
Fernglen	46			8	16	53	103	265	229	134	5	14	873	R 368 611 741	R 422 236
Forest Hill	34	1		16	12	105	196	159	70	4	11	9	617	R 156 959 992	R 254 392
Framesby	137	5	2	18	36	66	117	358	453	163	28	12	1395	R 558 950 170	R 400 681
Francis Evatt park	19		2	11	19	54	61	177	75	23	2	5	448	R 130 328 934	R 290 913
Gelvan Park	45	6	2	31	87	115	173	174	193	34	15	3	878	R 229 734 736	R 261 657
Glendinningvale	5	2	4	1		18	12	63	63	43	10	10	231	R 142 762 936	R 618 021
Glenhaven	377	70	114	581	825	1038	1047	685	219	18	2	1	4977	R 496 480 701	R 99 755
Glenhurd	80			16	21	26	103	208	192	63	16	10	735	R 277 169 865	R 377 102
Glenroy Park	29		1	1	2	13	43	54	119	18		4	284	R 104 965 259	R 369 596
Goldwater	23	2			32	23	57	76	116	40	8	13	390	R 181 465 580	R 465 296
Gqebera	1748	619	993	2680	3229	2331	661	274	41	6	17		12599	R 470 481 351	R 37 343
Greenacres	10	3		1	1	5	26	40	47	34	2		169	R 69 335 759	R 410 271
Greenbushes	599	305	640	1261	1855	1035	283	97	30	2	18	13	6138	R 290 961 352	R 47 403

Greenbushes AH	39	17	20	65	87	85	61	46	81	6			507	R 69 022 968	R 136 140
Greenshields Park	188		11	18	61	75	218	401	307	74	5	10	1368	R 381 386 490	R 278 791
Helenvale	659	288	680	1440	2383	1813	588	91	17	6	4	2	7971	R 316 606 814	R 39 720
Helenvale Ext 5	466	45	108	143	166	96	22	11	11				1068	R 23 413 102	R 21 922
Holland Park	134	6	21	66	153	229	150	66	11	6		6	848	R 84 693 520	R 99 874
Humewood	568	8	10	58	98	142	286	365	384	110	30	24	2083	R 555 792 039	R 266 823
Humewood Ext	55	9	9	51	70	120	128	139	54	4		3	642	R 96 575 290	R 150 429
Humewood Extention	164	3	11	33	72	109	216	220	121	22	3	4	978	R 181 517 518	R 185 601
Jarman	391	78	114	419	591	1046	1142	848	286	38	2	10	4965	R 620 080 684	R 124 890
Kabega	317	27	30	114	117	425	1145	1767	1197	252	29	52	5472	R 1 606 651 407	R 293 613
Kamma Park	116	13	7	36	25	87	186	486	647	196	49	27	1875	R 814 445 586	R 434 371
Kamma Ridge	21				3	9	33	60	45	27	8	2	208	R 86 619 489	R 416 440
Kensington	55	2		69	99	265	258	237	70	2	4	2	1063	R 152 739 310	R 143 687
Korsten	287	36	94	242	356	406	504	324	113	46	8	3	2419	R 291 664 335	R 120 572
Korsten Dry Lake	7	3	7	20	9			6					52	R 1 993 945	R 38 345
Kunune park	100	1	7	28	32	79	272	493	473	141	20	21	1667	R 616 968 988	R 370 107
Lindsay Road Industrial	1				5	4	8						18	R 1 294 517	R 71 918
Linkside	37			1	2	10	24	62	159	151	36	14	496	R 351 647 073	R 708 966
Linton Grange	101	6	4	22	37	122	302	473	462	146	34	17	1726	R 629 005 442	R 364 430
Lorraine	396	18	27	53	108	284	754	1569	1524	478	93	55	5359	R 1 998 032 918	R 372 837
Lorraine Manor	115	4	19	29	39	98	263	585	480	127	15	12	1786	R 585 047 783	R 327 574
Lovemore Heights	89	7	4	11	18	25	121	241	470	225	51	52	1314	R 790 726 977	R 601 771
Lovemore Park	1				1	4	5	20	31	56	11		129	R 92 118 528	R 714 097
Lovemore Park AH	20	3		15	30	48	30	94	82	50	14	10	396	R 177 513 586	R 448 267
Malabar	462	54	47	325	468	794	1048	933	590	127	43	19	4910	R 942 939 167	R 192 045

Malabar Ext 6	108	126	153	228	262	156	35	13	2	1			1084	R 30 115 576	R 27 782
Mangold Park	31		2	8	1	11	56	153	215	72	36	4	589	R 291 264 662	R 494 507
Markman Industrial	5	3		2				3	3				16	R 2 111 511	R 131 969
McLeenville	198	38	33	125	212	301	363	271	56	4			1601	R 159 332 703	R 99 521
Mill Park	51	2	4	12	16	52	74	167	361	274	118	47	1178	R 872 049 074	R 740 279
Millard Grange	109		10	2	10	15	43	86	109	56	18	9	467	R 196 278 367	R 420 296
Miramar	38	3	1	2	10	13	110	174	208	99	8	5	671	R 275 219 938	R 410 164
More Grove	50	3	6	8	23	73	176	184	111	9	5	3	651	R 148 092 404	R 227 484
Mount Croix	52	4	17	38	34	88	144	221	237	140	29	10	1014	R 405 524 672	R 399 926
Mount Pleasant	77		4	10	36	86	200	261	351	94	14	15	1148	R 421 573 986	R 367 225
Murray Park AH	17			13	24	9	17	4	9	11	7		111	R 31 782 694	R 286 331
Neave Industrial		2	1		2			1					6	R 300 506	R 50 084
Nelson Mandela Metropolitan University						5	6	18	6	8			43	R 15 268 543	R 355 082
Newton Park	306	11	19	62	97	237	509	738	574	194	32	31	2810	R 868 587 035	R 309 106
North End	199	32	40	146	208	339	464	397	127	32	6	10	2000	R 310 509 811	R 155 255
Overbaakens	69	6	15	53	65	117	276	474	467	131	28	21	1722	R 619 735 474	R 359 893
Pari Park	28	2	1	4	3	14	9	68	80	59	7	5	280	R 141 261 857	R 504 507
Parkside	67		18	47	38	99	159	214	158	39	4	3	846	R 203 055 582	R 240 018
Parsons Hill	54	3		10	16	53	87	151	204	110	10	3	701	R 274 268 750	R 391 254
Parsons Vlei	142	10	27	41	48	125	346	622	613	137	29	16	2156	R 717 441 130	R 332 765
Perridgevale	56	3	2	5	21	40	52	122	134	39	2		476	R 138 617 320	R 291 213
Perserverance					3	1	5						9	R 719 509	R 79 945
Port Elizabeth	20219	4129	6952	16149	23316	25010	28770	34496	29024	10677	2282	1519	202543	R 47 006 049 043	R 232 079

Port Elizabeth Central	1049	138	246	567	884	1263	1763	1595	853	308	61	53	8780	R 1 673 993 884	R 190 660
Port Elizabeth Harbour													0	R 0	
Providentia	23			1	7	3	46	59	95	54	9	6	303	R 152 778 586	R 504 220
Redhouse Village	4		1		10	35	40	63	73	14			240	R 67 995 436	R 283 314
Rowallan Park	284	2	18	45	88	232	707	1274	1153	273	52	34	4162	R 1 403 163 412	R 337 137
Salisbury Park						1							1	R 57 301	R 57 301
Schauderville	990	178	392	1038	1739	2038	1726	731	239	26	47	9	9153	R 810 029 972	R 88 499
Schoenmakerskop													0	R 0	
Scotstown	16			2	3	17	6	11	35	33	15	9	147	R 113 581 840	R 772 666
Sherwood	202	14	7	28	39	134	316	638	627	216	32	21	2274	R 821 642 793	R 361 320
Sidwell	130	13	33	131	255	545	677	396	101	5			2286	R 261 230 456	R 114 274
South End	208	7	22	73	99	216	366	537	388	128	17	21	2082	R 591 674 895	R 284 186
Springdale	44	4	17	42	62	125	126	135	62	9		3	629	R 103 687 788	R 164 845
Springfield	119	10	5	9	34	101	240	494	562	99	7	15	1695	R 569 411 491	R 335 936
St Albans Prison	33	2	9	26	20	46	210	257	111	11	9	2	736	R 173 069 805	R 235 149
St Georges Strand	12	6			8	25	17	7	4	2			81	R 8 936 969	R 110 333
Steytler	26	2		8	18	43	66	80	69	11	3	4	330	R 92 055 408	R 278 956
Summerstrand	962	49	84	274	464	406	604	1122	1648	1234	322	218	7387	R 3 707 816 643	R 501 938
Sunridge Park	106	11	5	15	24	43	146	349	490	334	50	25	1598	R 824 408 717	R 515 900
Swartkops	55	7	1	25	77	104	148	139	70	15	7	4	652	R 132 273 201	R 202 873
Sydenham	321	12	36	85	224	405	572	619	295	49		8	2626	R 451 576 513	R 171 964
Taybank	60	3	8	11	9	57	134	236	244	109	2	14	887	R 343 835 441	R 387 639
Theescombe AH	16		7	42	75	114	71	130	207	110	32	9	813	R 339 145 206	R 417 153
Tre Haven	10		2	7	7	15	29	49	62	27	3	3	214	R 86 414 807	R 403 808
Tulbagh	11			3	10	14	38	69	30	8			183	R 42 630 072	R 232 951

Van Der Stel	83	7		19	25	97	163	297	169	33	14	6	913	R 251 539 836	R 275 509
Wadgewood Golf estate	1							7					8	R 1 614 907	R 201 863
Walmer	348	16	5	41	120	202	485	955	1177	677	256	106	4388	R 2 346 829 546	R 534 829
Walmer (X; O and J)	290	165	285	511	681	428	146	48	14		3		2571	R 94 112 981	R 36 606
Walmer Downs	89		3	8	4	32	74	129	219	109	15	4	686	R 285 387 901	R 416 017
Walmer G South	291	160	218	572	657	357	99	9	6				2369	R 65 987 478	R 27 855
Walmer Heights	90	4		17	13	33	97	259	429	293	57	38	1330	R 794 080 078	R 597 053
Well Estate	2318	1049	1516	2507	2725	1378	572	246	122	13	14	11	12471	R 467 039 464	R 37 450
Westering	168	3	1	15	61	131	286	533	505	189	7	26	1925	R 684 947 283	R 355 817
Western Hills	38		2	18	9	31	96	196	263	49		3	705	R 236 446 670	R 335 385
Westlands AH	26	6		6	28	26	55	55	53	44			299	R 86 403 673	R 288 975
Weybridge Park	29		7	2	5	14	44	136	159	139	17	13	565	R 320 645 449	R 567 514
Willow Glen	15		4		1	22	27	50	91	18	3	1	232	R 83 987 018	R 362 013
Woodlands	3				2	8	38	51	70	41	2	4	219	R 105 773 520	R 482 984
Young Park	61		1	3	51	96	193	254	130	35	8	3	835	R 206 594 377	R 247 418
Zweledinga	38	3	11	60	60	47	16						235	R 7 231 297	R 30 771

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SUMMARY

Current research highlights the importance of optimal nutritional status during the first three years of life, specifically toddlerhood (1 – 3 years), since this phase is characterised by crucial physical and neurological development, the establishment of lasting food preferences and eating habits, as well as an increased risk for stunting, rapid early weight gain and predisposition to development of Non-communicable Disease (NCD) in later life.

However, despite the importance of optimal nutritional status in this age group, recent statistics reflect a global trend of children under five years consuming energy-dense diets with inadequate dietary diversity, hence characteristic of the nutrition transition. As a result, the incidence of stunting remains high, with statistics reflecting an increasing rate of overweight and obesity in this age group, which is suggestive of the double burden of malnutrition (DBM). The Eastern Cape Province ranked among the provinces with the highest rate of food insecurity, poor quality dietary intake and stunting in young children, yet no studies on the nutritional status of toddlers in this province could be located. Therefore, the current study aimed to evaluate the nutritional status, including socio-demographic information, clinical signs, anthropometry, dietary intake and child food security, of toddlers attending day care centres in Newton Park, Nelson Mandela Bay.

A quantitative descriptive study was conducted over the period of 20 April to 27 May, recruiting 55 consenting toddlers with their primary caregiver, who attended one of the six consenting day care centres in Newton Park, Nelson Mandela Bay. Socio-demographic, child food security and dietary intake information were recorded via questionnaires by means of one-on-one semi-structured interviews conducted with caregivers, while anthropometric data was collected using standard measuring techniques and interpreted according to the current child growth standards by the World Health Organization's (WHO).

Participants were predominantly English speaking (56.4%) Caucasian (56.4%) and resided in non-overpopulated formal dwellings (100%) with an average of three to four household members (72.7%).

The average monthly household income reported by most caregivers (80%) were above the tax return threshold; R10 000 to R40 000 (low to average monthly income). However, considering a mean household size of three to four members, this level of income may have posed a risk for the development of low food security.

Anthropometric analysis reflected the DBM, in that participants were affected by both stunting (7.3%) and overweight / obesity (9.1%). Stunting affected mostly the older age subgroup, while overnutrition was identified in those as young as one year of age. These results highlighted the presence of the DBM, as well as the associated increased risk for NCDs in adulthood.

A statistically significant association was found between the level of food security and growth (weight-for-age and length/height-for-age measurements) of participants. Therefore, since one in five participants had a low level of food security, food insecurity also contributed to poor growth and development.

Most participants consumed energy-dense diets, consisting largely of refined carbohydrates (CHO), high fat and low fibre sources, as confirmed by the excessive consumption of animal protein sources, added fat, sugars and processed food, in detriment of fruit, vegetables, legumes, whole grain starches and dairy. Additionally, only three participants (5.5%) consumed diets with optimal dietary diversity, suggesting a trend of energy-dense foods, high in added sugar and / or fat, like cookies and sugar-sweetened beverages (SSB), taking preference over nutrient-dense sources, such as fruit, vegetables and wholegrain starches.

In summary, results from the current study supported reflected trends of nutrition transition, leading to the DBM and thus an increased risk of NCD and NCD's in adulthood. Results highlight the need for nutrition intervention in the form of educational sessions aimed at parents and day care centre personnel, aiming to ensure optimal development and better future health in toddlers from Nelson Mandela Bay.

OPSOMMING

Huidige navorsing beklemtoon die uiterste belang van optimale voedingstatus tydens die eerste drie jaar van 'n kind se lewe, met die fokus op kleuters (1 tot 3 jaar), siende dat kinders kritieke fisiese en neurologiese ontwikkeling ondergaan tydens die fase, sowel as die ontwikkeling van blywende kosvoorkeure en eetgewoontes. Dus is dit vanselfsprekend dat kleuters ook meer vatbaar is vir ondervoeding, wat lei tot oormatige vroeë massatoename en 'n verhoogde risiko vir die ontwikkeling van chroniese siektes as volwassenes.

Ten spyte van die feit dat voedingstatus in kleuters 'n internasionale prioriteit moet wees, reflekteer huidige statistieke 'n internasionale patroon van energiedigte dieëtinname met lae dieëtdiversiteit in kinders onder die ouderdom van vyf jaar, wat kenmerkend is van 'n Westerse dieëtpatroon, ook bekend as die "nutrition transition". Vervolgens is daar steeds 'n hoë persentasie kinders met groei-inkorting, terwyl toenemend meer oorgewig en vetsugtige jong kinders voorkom in hierdie ouderdomsgroep, wat beduidend is van die dubbele las van wanvoeding. Die Oos-Kaap Provinsie is tans een van die provinsies met die hoogste voorkoms van lae voedselsekureit, lae-kwaliteit dieëtinname en groei-inkorting in jong kinders, alhoewel geen studies wat die voedingstatus van kleuters in hierdie area ondersoek, gevind kon word nie.

Die doelwit van die huidige studie, was om die voedingstatus, insluitende die sosio-ekonomiese inligting, kliniese tekens, antropometrie, dieëtinname en die kinder voedselsekureit, van kleuters wat ingeskryf is by dagsorgsentrums in Newton Park, Nelson Mandelabaai, te evalueer.

'n Beskrywende, kwantitatiewe studie was uitgevoer oor die periode van 20 April tot 27 Mei, 2015, waartydens 55 kleuters van gewillige dagsorgsentrums in Newton Park genader is, en ingesluit is, met die toestemming van hulle primêre toesighouers

Inligting rondom sosiodemografie, kinder voedselsekureit en dieëtinname is ingesamel deur middel van vraelyste wat voltooi is tydens individuele, semi-gestruktureerde onderhoude tussen die navorser en deelnemende toesighouers. Standaard meettegnieke is toegepas om antropometriese data in te samel, en die

resultate is geïnterpreteer volgens die nuutste groeistandaarde van die World Health Organization (WHO).

Die meerderheid van die deelnemers was Blank (56.4%) en Engelssprekend (54.5%), van wie almal aangedui het dat hulle formele baksteen wonings besit. Daar was gemiddeld drie tot vier mense per huishouding (72.7%), dus nie oorbevolk nie. Die maandelikste huishoudelike inkomste van die meerderheid studiedeelnemers was bo die belastingsafsnypunt (80%); R10 000 to R40 000 (onder gemiddeld na 'n gemiddelde inkomste). Dus kon 'n lae na gemiddelde inkomstevlak moontlik 'n bydraende faktor tot lae voedselsekuriiteit gewees het, siende dat die gemiddelde huishouding uit drie tot vier lede bestaan het.

Antropometriese analise was beduidend van die dubbele las van wanvoeding, siende dat daar beide groei-inkorting (7.3%), sowel as oormassa / vetsug (9.1%) onder studiedeelnemers geïdentifiseer is. Groei-inkorting het meestal die ouer groep studiedeelnemers affekteer, terwyl oormassa / vetsug selfs in die eenjariges waargeneem is. Dus is hierdie studiedeelnemers geneig tot 'n hoër risiko vir chroniese leefstylsiektes as volwassenes.

Daar is 'n statisties betekenisvolle assosiasie tussen die vlak van voedselsekuriiteit en die groei en ontwikkeling van studiedeelnemers (massa-vir-ouderdom en lengte-vir-ouderdom mates). Gevolglik is die waargenome een uit vyf studiedeelnemers met lae voedselsekuriiteit, 'n bydraende faktor tot onvoldoende groei / ontwikkeling.

Meeste van die huidige studiedeelnemers se dieët het bestaan uit energiedigte bronne - oormatig verfynde koölnhidrate, hoë vet en lae veselbronne. Hierdie inname is bevestig deur die hoë inname van dierproteïene en geprosesseerde kosse (hoog in bygevoegte suiker en vette). Gevolglik het studiedeelnemers 'n lae inname van voedingstofryke voedselbronne, soos groente, vrugte, peulgroente en suiwel getoon. Slegs drie studiedeelnemers (5.5%) het 'n dieëtinname met optimale dieëtdiversiteit getoon, wat beduidend was van 'n neiging om voedingstofryke kos, soos vrugte, groente en volgraan stysels, te vervang met energierike bronne, vol ekstra suiker en / of vet, soos koekies en versoete drankies.

Ter opsomming het die resultate van die huidige studie getoon dat alle lede van die bevolking, insluitende jong kinders, toenemend 'n Westerse dieëtpatroon aanneem

("nutrition transition"), wat lei tot 'n hoër voorkoms van die dubbele las van wanvoeding en dus toekomstige chroniese leefstylsiektes in hierdie ouderdomsgroep.

Daar is dus 'n behoefte aan voedingsintervensie, in die vorm van inligting en opleidingsessies vir ouers en personeel van dagsorgsentrums, met die oog op optimale ontwikkeling en beter toekomstige gesondheid van kleuters in Nelson Mandela Baai.

TEN KEY TERMS

1. **Toddler:** A child between the ages of 12 and 36 months (The free dictionary by Farlex, 2015: Online)
2. **Nutritional status:** The balance between nutritional adequacy and nutritional requirements, reflecting the degree to which a Toddler's nutritional needs are met. (Hammond, 2012:129).
3. **Double burden of malnutrition:** Persistent undernutrition occurring alongside progressively increasing rates of overnutrition in members of the same population of low and middle income countries (Kimani-Murage *et al.*, 2015:1371).
4. **Nutrition transition:** A switch from traditional high-fibre starch, fruit and vegetable diet, to a modern Westernized diet, consisting of refined starches and added fat plus sugars (Vorster *et al.*, 2011:430).
5. **Non-communicable disease:** A non-contagious, chronic disease caused by unhealthy dietary and lifestyle habits, which progresses over time (WHO, 2015d: Online).
6. **Dietary diversity:** The variety of food groups consumed over a 24-hour period, reflecting the adequacy of nutritional intake (Kennedy *et al.*, 2013:5; Arimond & Ruel, 2004:2579).
7. **Food insecurity:** Limited and fluctuating availability of nutritionally adequate and safe food, resulting in poor quality diets, regular hunger, increased anxiety and an increased risk for malnutrition in members of a household (NRC, 2006:Online; Blumber *et al.*,1999:1231).
8. **Body mass index-for-age measurements:** A growth measurement of length/height in terms of weight, used to identify overweight / obesity in children from the age of two years and older (Shaw & McCarthy, 2015:7).

9. **Mid-upper arm circumference measurements:** A growth measurement reflecting muscle mass in children younger than five years (Shaw & McCarthy, 2015:5-6).
10. **Carbohydrates:** Macronutrients that serve as the primary source of fuel, maintaining physiological processes within the human body (Gallagher, 2012:33; IOM, 2006:103-104).