NUTRITIONAL STATUS AND MILESTONE DEVELOPMENT OF CHILDREN AGED 3 TO 5 YEARS ATTENDING EARLY CHILDHOOD DEVELOPMENT CENTERS AT CHIEF ALBERT LUTHULI MUNICIPALITY

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Bachelor of Science in Nutrition (BSCNP)

Dissertation submitted in fulfilment of the requirements of

MASTER OF SCIENCE IN PUBLIC NUTRITION

In the

DEPARTMENT OF NUTRITION

FACULTY OF HEALTH SCIENCES

UNIVERSITY OF VENDA

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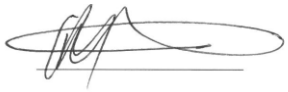
DECLARATION

I, **MTHOKOZISI KHUMALO** declare that this mini dissertation hereby submitted to the University of Venda for the qualification Master of Science in Public Nutrition has not been previously submitted by me at this or any other university, and that it is my own effort and work. The literature sources that we have used have been acknowledged by means of complete references.



Khumalo Mthokozisi: _____

Signature

23 August 2023

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Date

DEDICATION

I dedicate this study to my son, Roana Solethu; my partner, Khodani Nemavhundi; my mother, Marian Lucy Khumalo; my uncle, Easter Boy Khumalo and his family; my sister, Nomthandazo Ulaine Khumalo, for their encouragement and support.

ACKNOWLEDGEMENTS

I would like to thank the following people:

- Prof. LF Mushaphi, my supervisor, for her guidance, encouragement, and support throughout the research process.
- Dr. TC Mahopo and Dr. HV Mbhatsani, my co-supervisors, for mentoring, encouragement, and support from the beginning until the end of this study.
- Dr. A Bere, for statistical analysis.
- Ms. TA Nkosi, for training me on milestone development assessment.
- My partner, Ms. K Nemavhundi, for support and understanding.
- My mother, for her support and encouragement.
- My uncle and his family for support and encouragement.
- The Department of Health, Chief Albert Luthuli Sub-district management, for allowing me to collect data without a study leave.
- Field workers for assisting in the data collecting process.
- Thank the principals of ECD centres for permitting me to work with their institutions.
- Caregivers who agreed to participate in the study and answer all the questions.
- ECD center teachers for agreeing to become informants in the study.
- The Mpumalanga Department of Education for financial support.

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ABBREVIATIONS AND ACRONYMS

BAZ - Body Mass Index for Age

CBCCs - Community-Based Child Care Centres

CI - Confidence Intervals

DAYC-2 - Developmental Assessment of Young Children-Second Edition

DDS - Dietary Diversity Score

DHS - Demographic and Health Surveys

ECD - Early Childhood Development

FBDGs - Food Based Dietary Guidelines

GBD - Global Burden of Diseases

GCP - Good Clinical Practice

GDD - Global Development Delays

GDI - General Development Index

HAZ - Height for Age

IYCF - Infant and Young Child Feeding

LMICs - Low and Middle-Income Countries

MAM - Moderate Acute Malnutrition

MUAC - Mid-upper arm circumference

NCDs - Non-Communicable Diseases

NDoHSA - National Department of Health South Africa

NFCS - National Food Consumption Survey

NW-CHILD - North West–Child Health Integrated Learning and Development

PEDS - Parents' Evaluation of Developmental Status

PEDS: DM - Parents' Evaluation of Developmental Status: Developmental Milestones

RtHB - Road to Health Booklet

SADHS - South Africa Demographic and Health Survey

SAM - Severe Acute Malnutrition

SANHANES - South African National Health and Nutrition Examination Survey

SA-PFBDGs - South African Paediatric Food-Based Dietary Guidelines

SD - Standard Deviation

SDG - Sustainable Development Goals

Stats SA - Statistics South Africa

UNICEF - United Nations Children's Fund

WAZ - Weight for Age

WHO - World Health Organisation

WHZ - Weight for Height

ABSTRACT

Introduction: Nutritional status is vital for overall health and development in children. Anthropometry, reflecting health and nutritional status, predicts performance and survival. Children's development follows unique trajectories, with specific milestones achieved universally. This study explores the nutritional status and milestone development of preschoolers.

Methods: A cross-sectional design was employed, clustering the Chief Albert Luthuli municipality into four circuits. Four Early Childhood Development (ECD) centers were randomly chosen from each cluster. Utilising Slovin's formula, the sample size was determined, resulting in 353 participants. Participants were children attending ECD centers, while caregivers and ECD teachers were informants. Data were collected via a questionnaire and three 24-hour recalls assessing dietary diversity. Anthropometric measurements were taken using standard techniques, and developmental screening was conducted using the Developmental Assessment of Young Children-Second Edition (DAYC-2). Inferential statistics determined associations between nutritional status and milestone development.

Results: Regarding household characteristics, the study found varying levels of access to resources such as land for food production and improved water sources. Notably, most households relied on electricity (94%) for cooking, while a portion of households still used wood (62**%**) as the primary cooking fuel, which has implications for indoor air quality and environmental sustainability. Across three visits, most children exhibited high dietary diversity scores (DDS) (63-77%). Commonly consumed food groups included meat and fish (72-78%), milk and dairy products (68-73%), with organ meat (5-8%) and eggs (6-13%) less frequent. The prevalence of stunting, underweight, and wasting varied, with stunting at 17.9%, underweight at 19.9%, and wasting at 23.2%. Approximately 8% showed suspected developmental delays, notably in physical fine motor skills (27%). Positive correlations were found between weight-for-height (wasting) and general development index (GDI) ($p=0.00$) as well as between DDS and GDI ($p=0.00$).

Conclusion: The prevalence of malnutrition varied, with wasting being notably high. Physical fine motor skills showed lower scores in a significant proportion of children. However, most children met the expected milestones across developmental domains. Significant associations were observed between anthropometric indicators, DDS, and milestone development. These findings underscore the importance of addressing nutritional status and milestone development in preschool-aged children for their overall well-being and development.

KEYWORDS: Caregiver, Children, Early childhood development centre, Milestone development, and Nutritional status

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Sufficient nutrition is essential in early childhood to ensure healthy growth, a healthy immune system, proper organ formation, and neurological and cognitive development (Batool et al., 2019). Nutritional status is a condition of the body that is influenced by diet, the levels of nutrients in the body, and the ability of the levels to maintain healthy metabolic integrity (Chawla, 2018). Feeding practices mostly influence the nutritional status of children (Mya, Kyaw, &Tun, 2019). Moreover, childhood malnutrition results in delayed physical growth and compromised motor development, lading to cognitive-developmental disorders.

About millions of children from low and middle-income countries (LMICs) globally fail to reach their full cognitive, language, and social-emotional development, which has implications on their educational attainment and adult functioning (Grantham-McGregor et al., 2014). Data derived from Early Childhood Developmental Status in LMICs: National, Regional, and Global Prevalence Estimate Using Predictive Modelling (2016) suggest that about 80.8 million preschool-aged children in LMICs experience low cognitive and socioemotional development, with a high prevalence of 43.8% found in sub-Saharan Africa, followed by South Asia by 37.7% (McCoy et al., 2016).

As Lee and Manan (2014) reported, poor nutrition has been associated with poor psychomotor development, lower scores on cognitive function tests, and decreased activity levels. Seid et al. (2018) indicated that protein-energy malnutrition and micronutrient deficiencies are associated with inadequate nutrient consumption. Thus, nutrient deficiencies during the early years of childhood have enormous lifetime consequences (Smith, 2016). In Bangladesh, Akram et al. (2018) reported that 36.3% of children were stunted, compared to 17.9% in Ghana (Saaka & Galaa, 2016). Amongst all nutritional indicators, Muhoozi et al. (2016) found that childhood stunting was linked to impaired cognitive, language, and motor development in Uganda. Furthermore, children who lack certain nutrients (such as iron and iodine) or suffer from general malnourishment do not have the same readiness for learning as their healthy and adequately nourished counterparts.

Researchers reported that the best predictor of human capital in adulthood was height-for-age at two years, height directly determined by adequate nutrition (Victora et al.,

2008). Consequently, Bandikolla and Harika (2016) reported an association between children's nutritional status and developmental milestones. As highlighted by Bhutta et al. (2017), underweight, wasting, stunting, and micronutrient deficiencies are a risk factor for poor childhood development. Childhood stunting is one of the most significant impediments to human development, and it is estimated that it affects approximately 162 million children under five years globally (WHO, 2014). In South Africa, a magnitude of 21.6% stunting was documented by Labadarios et al. (2005). The SANHANES (2012) reported a stunting prevalence of 23.1% in Mpumalanga (Shisana et al., 2014).

Childhood undernutrition has adverse effects on childhood developmental milestones and ultimately impacts long-life productivity, which has implications for income and self-sustainability in the long term (Ali & Dhaded, 2014). Children who start their lives at a marked disadvantage of poor nutritional status face learning difficulties in school, earn less as adults, and face barriers to participating in their communities (Muhoozi et al., 2016). This is a result of developmental delays that occur in early childhood. As Van der Linde et al. (2015) indicated, milestone delays affect one or more developmental domains in a lifetime of social-emotional, physical, language, and cognitive development. Different screening tools are used to assess child developmental milestones internationally (Macy, 2012).

The Road to Health Booklet (RtHB) in South Africa is used more than in high-income countries with early detection and intervention strategies (Van der Linde et al., 2015). In addition, numerous benefits are associated with the availability and use of developmental screening tools. At an individual level, screening tools help determine if a child is on track with their development, identify interventions to compensate for any eventual delay and implement early interventions that help improve their health and educational outcomes (Slemming & Saloojee, 2013). Sánchez-Vincitore, Schaettle, and Castro (2019) stated that at the program level, developmental screening tools are used as baseline and outcome variables in impact evaluations to help determine a program’s effectiveness. At the public policy level, the use of screening tools helps guide the development of evidence-based health and education policies.

Through developmental screening tools, South African researchers reported that children with low height-for-age at two years fall substantially behind in motor skills development and cognitive function compared to socioemotional maturity (Casale, Desmond & Richter, 2014). Due to poor nutrition, iron deficiency remains high (10.7%)

among South African children requiring early intervention due to known repercussions on growth and development (Visser & Herselman, 2013). Limited data on the nutritional status of children in Mpumalanga have been reported (Shisana et al., 2014). However, no study has reported children's nutritional status and milestone development in Chief Albert Luthuli Municipality, Mpumalanga Province. Based on the existing body of information and in light of the above, this study aims to investigate children's nutritional status and milestone development in early childhood development centers.

1.2 Problem statement

Child mortality in South Africa has declined, but children are still not reaching their full developmental potential (National Department of Health South Africa, 2018); thus, children need to survive and thrive. Poor nutrition impacts preschool children's health, cognitive function, and educational achievement (Chawla, 2018). Bandikolla and Harika (2016) further revealed that the consequences of poor nutrition on child development affect one in three children in developing countries. Two-thirds of preschool-aged children in South African households live in marginalized areas where it is difficult to access adequate food and reach health facilities (South African Early Childhood Review, 2017). Due to inadequate nutrition, various forms of poor nutrition exist among South African children; therefore, there is a need for regular monitoring of children's growth and development. Growth monitoring and promotion ensure early detection and identification of poor growth and development and timely intervention for various forms of malnutrition (Hirai et al., 2018).

Stunting hinders developmental potential and human capital due to its longer-term impact on cognitive function and adult economic productivity (Prendergast & Humphrey, 2014). Egala and Oldewage-Theronab (2018) at Qwa-Qwa, South Africa, reported a prevalence of wasting, stunting, and underweight to be 19.2, 13.7, and 11.4%, respectively. In a study conducted in Limpopo Province, Motadi et al. (2015) reported a stunting prevalence of 18.6% and 0.3% of underweight among preschool children. A national study highlighted that children in Mpumalanga Province are the most affected, as 23.1% were stunted (Shisana et al., 2014). Integrating early childhood development with health (nutrition) promotes survival, growth, and development (Gelli et al., 2017). An investigation undertaken in Durban found that menus offered to children in ECD centres are nutritionally inadequate to support the necessary growth (Nzama & Napier, 2017). As agreed, other South African researchers report that the nutritional status of children diet, attending ECD centres, is sub-optimal and is

characterized by inadequacies for optimum development with a marked prevalence of stunting, overweight, and low haemoglobin levels (Makanjana & Naicker, 2020). More emphasis has been placed on the importance of nutrition during childhood (NDoHSA, 2018). However, there is limited data on whether the nutritional status of children in ECD centres affects their milestone development. Hence, the researcher saw the need to determine children's nutritional status and developmental milestones in ECD centres.

1.3 Aim of the study

- The study aims to investigate the nutritional status and milestone development of children aged 3 to 5 years attending early childhood development centres at Chief Albert Luthuli Municipality.

1.4 Objectives

- To assess the anthropometric status of children aged 3 to 5 years attending early childhood development centres at Chief Albert Luthuli Municipality
- To determine the dietary intake of children aged 3 to 5 years attending early childhood development centres at Chief Albert Luthuli Municipality
- To determine the milestone development of children aged 3 to 5 years attending early childhood development centres at Chief Albert Luthuli Municipality
- To correlate the nutritional status and milestone development of children aged 3 to 5 years attending early childhood development centres at Chief Albert Luthuli Municipality

1.5 Research question

- What are the nutritional status and milestone development of children aged 3 to 5 years attending early childhood development centres at Chief Albert Luthuli Municipality?

1.6 Significance of the study

Upon completion, the results may be used to improve nutrition intervention services at the ECD centres. The results provide information that could influence appropriate early childhood nutrition policies to protect children's nutrition and developmental

needs. The data obtained may be a foundation for further studies conducted in the related field.

1.7 Structure of the dissertation

- The dissertation is structured into seven chapters to explore the research topic comprehensively. **Chapter 1** serves as the introduction, laying the groundwork by introducing the study's motivations and providing a background context. Within this chapter, the problem statement, aim, objectives, research question, and significance of the study are articulated to guide the reader's understanding.
- **Chapter 2** thoroughly reviews relevant literature to contextualize the study within existing scholarship.
- **Chapter 3** outlines the research methods employed, including study design, sampling procedures, measurement techniques, data collection methods, and data analysis procedures.
- Subsequently, **Chapter 4** presents the results obtained from the study, while **Chapter 5** engages in a detailed discussion and interpretation of these findings. **Chapter 6** draws conclusions based on the study's outcomes and offers recommendations for future research or practice.

1.8 Definition of terms

- **A caregiver** is a person who regularly looks after a child, elderly, sick, or disabled person and is responsible for care and control of behaviour and their health and welfare (Leeb, 2008). In this study, the caregiver refers to a person who looks after the ECD child and will attend the researcher meeting and consent on behalf of the child.
- **Children** are persons experiencing the period of development from infancy to puberty (Rathus, 2013). In this study, children refer to persons aged 3 to 5 years attending early childhood development centres.
- **Early childhood development centres are** any premises regularly used to provide temporary or partial care and early education for children apart from their parents (Child Care Facilities By-Law, 2015). This study refers to registered childcare facilities for the care and development of education for children aged 3 to 5 years.
- **Milestone development** refers to the physical or behavioural changes or the maturation of infants and children. Such developments include cognitive,

physical, communication, and social-emotional development (Singh and Anekar 2018; Bedford, Walton, and Ahn, 2013). This study refers to young children's cognitive, communication, social-emotional, physical, and adaptive behaviour development.

- **Nutritional status** is a condition of the body that is influenced by diet, the levels of nutrients in the body, and the ability of the levels to maintain healthy metabolic integrity. Nutritional status is determined through anthropometric measurements, biochemical assessment, clinical assessment and observation, and dietary intake assessment (Chawla 2018, Poh et al. 2013). In this study, nutritional status refers to children attending ECD centres' anthropometric status and dietary intake.

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview

This section introduces literature that will be used to support the discourses to be made in the study about the nutritional status and milestone development of preschool children. Nutritional status refers to the condition of the body, which is influenced by diet, the levels of nutrients in the body, and the ability of the levels to maintain healthy metabolic integrity (Chawla, 2018). Nutritional status can be determined through anthropometric, biochemical, clinical, and dietary assessment methods (Lee & Nieman, 2013). For this study, only anthropometric and dietary assessments will be discussed. Parental feeding practices influence dietary intake, child eating behaviours, and nutritional status outcomes (Matvienko-Sikar et al., 2018). Developmental milestones are the functional skills or age-specific tasks most children can do at a specific age range (Gadade & Kale, 2019). This chapter will also highlight the relationship between nutritional status and milestone development.

2.2 Nutritional status of children under five years of age

Malnutrition prevails in developing and developed countries as undernutrition and overnutrition (Das & Gulshan, 2017). Good nutrition during preschool age is important as it plays an essential role in adequate growth and development and has long-lasting effects later in life (Grimes et al., 2015). Das and Gulshan (2017) reported that child malnutrition causes critical health and development disorders in developing countries and is responsible for an estimated 13.6 million deaths annually from children under five globally (Boah et al., 2019). Promoting good nutrition ranks among the most effective interventions for improving positive health and development (Liu & Raine, 2017).

Child growth is the most widely used measure of children's nutritional status (Akombi et al., 2017a). South African researchers are using the National Food Consumption Survey (NFCS) and Shisana et al. (2014) to report children's nutritional status. Nutritional status can be assessed by anthropometric, biochemical, clinical, and dietary methods (Lee &Nieman, 2013). Anthropometry reflects health and nutritional status and predicts performance, health, and survival (NDoHSA, 2019). Important nutrition indicators are used in determining the level of growth status from anthropometric measurements. The following indicators are widely used by researchers in South Africa, weight for age (underweight), height for age (stunting), weight for height (wasting), and body mass index for age (wasting).

2.2.1 Anthropometric status of children under five years of age

According to Lee and Nieman (2013:167), “anthropometry is the measurement of body size, weight, and proportions”. Anthropometric measurements are non-invasive quantitative measurements, for example, height, weight, mid-upper arm circumference, head circumference, body density (underwater weighing), air-displacement plethysmography, magnetic resonance imaging, and bioelectrical impedance to estimate the percentage of fat and lean tissue in the body (Lee & Nieman 2013: 3, Casadei and Kiel 2019). The indicators for weight and height are expressed as the weight for age, height for age, weight for height and body mass index for age and are interpreted using Z-scores. The Z-scores system expresses the anthropometric values as several standard or Z-scores below or above the reference mean or median value. Z-scores are gender and age-independent, thus permitting the evaluation of children’s growth status as it is expressed through weight for age (WAZ), height for age (HAZ), weight for height (WHZ), and Body Mass Index for Age (BAZ) (Mushaphi, 2011).

According to WHO (2009) Z-score classifications, WAZ of -1SD to <-2SD is classified as mild underweight, whereas -2SD to <-3SD indicates underweight. A weight for age Z-score of <-3SD means severely underweight. HAZ from -1SD to <-2SD is classified as mild stunting, -2SD to <-3SD as stunted, and <-3SD as severely stunted. A weight for height Z-score of -1SD to <-2SD is classified as mildly wasted, while -2SD to <-3SD is classified as wasted and <-3SD as severely wasted. BAZ of -2SD to <-3SD is classified as wasted and <-3SD is classified as severely wasted. The Z-score classifications are indicated in Table 2.1.

Table 2.1 Z-score classifications

Z-score classifications	Interpretations			
	WAZ	**WHZ**	**HAZ**	**BAZ**
>+3SD	Possible growth problem	Obese	Above normal	Obese
>+2SD to ≤+3SD	Possible growth problem	Overweight	Normal height	Overweight
>+1SD to ≤+2SD	Possible growth problem	Possible risk of overweight	Normal length	Possible risk of overweight
-1SD to +1SD	Normal WAZ	Normal WHZ	Normal length	Normal weight
-1SD to <-2SD	Mild underweight	Mildly wasted	Mildly stunted	Normal
-2SD to <-3SD	Underweight	Wasted	Stunted	Wasted
<-3SD Severely	Severely underweight	Severely wasted	Severely stunted	Severely wasted

Source: (WHO, 2009)

To establish whether the observation of nutritional status is of public health importance, the following classification assessment for the severity of malnutrition by percentage prevalence ranges will be used (Bose et al., 2007), as indicated in Table 2.2.

Table 2.2 Severity of malnutrition classification by % prevalence ranges

Indicator	Severity of malnutrition by prevalence ranges (%)			
	Low	Medium	High	Very high
Stunting	<20	20-29	30-39	≥ 40
Underweight	< 10	10-19	20-29	≥30
Wasting	<5	5-9	10-14	≥ 15

Source: (WHO, 1995)

2.2.2 Weight for age (Underweight)

Underweight is defined as a score of less than -2 weight for age standard deviations from the median of the WHO international growth reference (Tosheno et al., 2017). Being underweight reflects past (chronic) and present (acute) undernutrition (Srivastava et al., 2012). It represents body mass relative to age and is influenced by a child's height and weight, thus a composite of stunting and wasting (Betebo et al., 2017). According to Dukhi (2020), 99 million children under five were underweight globally in 2013. However, underweight children worldwide declined from 25% in 1990 to 15% in 2015 (Akombi et al., 2017b). According to Schienkiewitz et al. (2018), being underweight is not a public health concern in Germany as it affects only 0.5% of preschool-aged children. Results from an economically advanced Southwest country of Asia revealed a low (5.7%) prevalence of underweight among school children (Zayed et al., 2016). A study in Indonesia reported a fluctuating prevalence of underweight from 12.1% in 2007, 11.2% in 2013, and 14.5% in 2016, with a significantly higher number of underweight boys than girls (Syahrul et al., 2016).

About 90% of the underweight children are from Southeast Asia and Sab-Saharan Africa. In Sub-Saharan Africa, the West Africa region accounts for 20.1%, East Africa at 14.4%, Central Africa at 12.8%, and Southern Africa at 10.7% (Akombi et al., 2017b). Moreover, in the same meta-analysis of demographic and health survey (2006-2016) conducted in Sub-Saharan Africa, countries with the highest estimate of underweight in each region were Burundi (28.8%), Niger (36.4%), Chad (28.8%), and Lesotho (13.2%). In South Africa, Labadarios et al. (2005) found that the prevalence of underweight was 10.3% nationally, and 1.4% were severely underweight. The SANHANES-1 reported that the prevalence of underweight decreased from 11% to 6% from 2005 to 2012 (Shisana et al., 2014). The same survey also found that boys were more underweight than girls, with most underweight children from rural areas.

Another study in the Free State Province documented a 7.7% underweight prevalence among children aged zero to five years attending primary healthcare clinics, comparably, a 7.3% prevalence of underweight was recorded in Gauteng and Mpumalanga Provinces while 10.4% underweight prevalence was reported in Mpumalanga Province alone (Shisana et al. 2014, Symington et al. 2016, Koetaan et al. 2018). According to the WHO classifications for the assessment for the severity of malnutrition to be of public health importance indicate that a prevalence of underweight that is less than 10% shows a low prevalence of underweight, while 10 to 19% shows a medium prevalence. In addition, 20 to 29% prevalence shows a high prevalence, and > 30% show a very high prevalence of underweight (WHO, 1995). Therefore, the contrasting available literature regarding Mpumalanga Province, shows that the prevalence of underweight is of medium prevalence significance. This means that there is a need to investigate the prevalence of underweight among children under five years old in the Chief Albert Municipality to apply appropriate preventative and intervention measures.

2.2.3 Height for age (Stunting)

Stunting is manifest when a child's height for age is less than -2 standard deviations of the WHO growth standards median. The child is severely stunted if the WHO growth standards score is less than -3 standard deviations (WHO, 2009). Stunting measures past (chronic) child undernutrition (Srivastava et al., 2012). If children are stunted, they are chronically deprived of their basic nutrition, and it results in delayed development (Bhutta and Salam, 2012). Moreover, the prevalence of stunting is a critical indicator of progress in child survival. Akombi et al. (2017c) reported that 70% of stunting occurs within the first 1000 days of life and the linear growth deficit continues until age five. Focusing on childhood stunting indicates the extent to which children receive the basic nutrition they need for adequate growth and development (Mutisya et al., 2015). Stunting is a major public health problem among children globally, affecting approximately 22% of children under five (Titaley et al., 2019). Furthermore, the consequences of stunting necessitated the setting of global targets to reduce the number of stunted children by 40% by 2025, as supported by SDG 2, target 2 as it states, “By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under five years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.”

UNICEF’s (2021) annual joint global and regional malnutrition estimates reported that stunting affected 22% or 149.2 million children under five years globally 2020. In a different study, De Onis and Branca (2016) said stunting is the most prevalent form of child malnutrition, with an estimated 161 million children worldwide. There’s a declining tendency year after looking at the estimated 178 million children under five years being stunted globally in 2012 (Bhutta and

Salam, 2012). The number of stunted children decreased by 98.5 million globally between 1990 and 2015; however, in Sub-Saharan Africa, the number of stunted children increased by 12.4 million between 1990 and 2015 (Campisi, Cherian & Bhutta, 2017). The prevalence of stunting in children in Latin America has decreased from 23.7% in 1990 to 13.5% in 2010 (Flores-Quispe et al., 2019). Comparably, Montenegro et al. (2022) recorded a reduction in stunting from 23% to 10% between 1990 and 2020 in Latin America and the Caribbean. In addition, South America has a low prevalence rate (9%), while Central America accounts for a 14% prevalence rate. Even though a reduction is notable in the prevalence of stunting, about 5 million children still suffer from stunting in Latin America and the Caribbean. Meanwhile, Betebo et al. (2017) estimated the prevalence of low (1.7%) height about age in Germany.

According to Akram et al. (2018), the prevalence of stunting among preschool-aged children in Bangladesh was 36.3% for males and females respectively. Of the overall prevalence, 30.3% were exposed to moderate stunting (HAZ between -2 SD and -3 SD), and 15% were severely stunted (HAZ < 3 SD). In comparison, no significant difference was observed in the prevalence among male and female children (36.5% and 36.1%). The results of a study conducted in five South Asian countries using Demographic and Health Surveys (DHS) from 2014 – 2018, reported that the prevalence of stunting was high for children aged 24–59 months at 38% and 35% for children aged 0–59 months (Wali, Agho & Renzaho, 2020). African researchers documented a very high prevalence of stunting from a study covering 33 countries in Sub-Saharan Africa. The study found an average prevalence of 41.1% (Quamme & Iversen, 2022).

Stunting increased by one-third in Sub-Saharan Africa between 1990 and 2013, accounting for 39% globally, while about 30.6% of children under five years were reportedly stunted in Southern Africa (Akombi et al., 2017a). Lesotho reported the highest prevalence in Southern Africa at 33.2%. In South Africa, stunting remains one of the nutritional disorders affecting children, with 26.5% of children aged 1 to 3 years affected in 2012 compared to 2005, where 23.4% of children were affected (Shisana et al., 2014). However, a growth-based decline in stunting was notable, where 16.4% of children aged 4 to 6 years were affected in 2005 compared to 11.9% in 2012.

Children living in commercial farms were the most affected, with 30.6% stunted (Labadarios et al., 2005). A gender difference in the highest prevalence of stunting was reported by Shisana et al. (2014). More (23.2%) boys residing in rural informal areas were affected by stunting, whereas girls from informal urban areas had the highest prevalence of stunting at 20.9%. Stunting was below the national prevalence (26.5%) in all provinces. The highest prevalence of stunting among boys was in the Northwest, with 23.7%, and the least stunted

among girls was recorded in Limpopo (9.4%). Nesamvuni (2014) found that about 8.7% of children were stunted in the Limpopo Province, 7.8% were moderately stunted, and 0.9% were severely stunted. A stunting prevalence of 18.6% was recorded by Motadi et al. (2015) among preschool children in the Vhembe district.

The SANHANES-1 (2012) reported a stunting prevalence of 23.1% in Mpumalanga Province (Shisana et al., 2014). Symington et al. (2016) found an 18.2% stunting prevalence in the Mpumalanga Province in another study. The findings of Shisana et al. (2015) and Symington et al. (2016) on stunting concerning Mpumalanga varied by 4.9%. According to the WHO classifications for the assessment of malnutrition to be of public health importance, <20% of stunting is classified as low, and 20-29% as medium prevalence. Furthermore, 30 to 39% show a high prevalence, while more than 40% indicate a very high prevalence of stunting (WHO, 1995). Based on the available literature, the prevalence of stunting in Mpumalanga is of medium public significance.

2.2.4 Weight for height (Wasting)

Wasting is defined as more than 2 standard deviations below the WHO international growth reference weight for height median (Harding, Aguayo, and Webb, 2018). Low weight for height reflects wasting, which is caused by a combination of factors, including poverty, acute inadequate food intake, poor feeding practices, disease, and infections (Ghosh-Jerath et al., 2017). Wasting impairs the functioning of the immune system thus affecting growth and development hence it's a reliable indicator that signals an urgent need for action (Bhutta & Salam, 2012). Globally, in 2013, about 51 million children below five years were wasted, and 17 million were severely wasted, or rather, the global prevalence of wasting in 2013 approximated 8%, of which 3% accounted for severe wasting (Dukhi, 2020). Some data from Harding, Aguayo, and Webb (2018) estimated that in 2016, 52 million children worldwide were wasted and 14.1 million of those were estimated to be from the African Region, with 4.3 million of them being severely wasted. Akombi et al. (2017d) found that the global prevalence of wasting decreased from 9% in 1990 to 8% in 2015. This global decrease was confirmed by UNICEF (2021) findings that the global prevalence of wasting was 6.7% or 45.4 million among children under five years.

On its annual joint global and regional estimates of malnutrition among children under five years, UNICEF (2021) reported a low prevalence of wasting in Brazil and China (1.8% and 1.9%) among children under five years, while 2% was reported in Cuba. The prevalence of child wasting in South Asia is 14.8%, and 4.5% are severely wasted (Torlesse and Le, 2020). However, the prevalence of wasting in India has increased from 19.8% in 2005-2006 to 21%

in 2015-2016 (Madan et al., 2020). Also, Bhutta and Salam (2012) observed very high prevalence rates of waste in Bangladesh (17.5%) and India (20.0%). South Asia is the epicentre of global wasting, with Sab-Saharan Africa being the next highest region. In Africa, 9.4% of children under five years were wasted (Akombi et al., 2017d).

This is supported by the estimated number of 12.1 million children in Africa who are reported to suffer from wasting and 3 million suffering from severe wasting (UNICEF, 2021). According to WHO (2017), wasting in Sub-Saharan Africa ranges from 2% in Swaziland to 22.7% in South Sudan. The following countries are above the 15% of critical public emergency cut-off value; Eritrea (15.3%), Niger (18.7%), and South Sudan (22.7%). All sub-regions in Africa reported poor prevalence for wasting (5–9%) and 17 countries had a wasting rate below 5%. South Africa recorded a 4.7% wasting prevalence (WHO, 2017). The National Food Consumption Survey (NFCS) documented a nationwide wasting prevalence of 3.7% for children aged 1-9 years (Labadarios et al., 2005). Relatively, Shisana et al. (2014) also found a 3.8% prevalence of wasting, while 1.9% of children aged 0-3 years were severely wasted. Whereas for children 4-6 years, 2.6% were wasted and 1.0% were severely wasted. Moreover, wasting was highly prevalent (9.3%) among children residing in informal rural areas and the least in urban informal areas (1.0%).

The Northern Cape (18.5%) and Northwest (8.5%) provinces of South Africa had the highest prevalence of wasting. In comparison, the least was recorded in the Eastern Cape (1.6%) and the Free State (1.7%) provinces, regarded as acceptable rates of wasting in a population (Shisana et al., 2014). Moreover, Madiba, Chelule, and Mokgatle (2019) found a critical public emergency prevalence of 17.2% wasting in one health district in Gauteng Province that serves a diverse population. In Limpopo Province, a wasting prevalence of 1.4% was reported among Vhembe district preschool children (Motadi et al., 2015). In the SANHANES-1 (2012) report, about 2.8% of male and 1.8% of female children were wasted in Mpumalanga, and 1.2% of males and 0.8% of females were severely wasted (Shisana et al., 2014). The WHO (1995) classifications for assessing the severity of malnutrition public importance show that a prevalence of <5% indicates low, and 5-9% indicates a medium prevalence of wasting. Moreover, 10-14 indicates a high prevalence, and >15% indicates a very high prevalence of wasting. Therefore, regarding the present literature, Mpumalanga has a low severity of wasting prevalence.

2.3.4 Body Mass Index for Age (Overweight and Wasting)

Body mass index refers to the weight in kilograms divided by height in meters squared (Woolford et al., 2021). Body Mass Index for Age (BAZ) is not a diagnostic tool, nor the ideal means of identifying obesity in children. However, is it a screening tool to identify children who are at risk of nutritional disorders such as overweight and obesity (Javed et al., 2015). Furthermore, BAZ has high specificity but low sensitivity to detect excess fat deposits, rather aid by using skinfold techniques after identifying high BAZ. BAZ considers age, and gender because as children grow, they develop physically differently by gender; thus, their fat deposit changes. Due to economic and nutrition transitions over the years, the growth patterns of children from the middle and upper socioeconomic classes have changed, and they have normalized overweight and obesity (Khadilkar and Khadilkar, 2015).

According to the Global Burden of Diseases (GBD) 2015 Obesity Collaborators (2017), in 2015, about 107.7 million children were obese globally, based on the BAZ indicator and the prevalence of overweight was 26% for children aged 2 to 5 years in the US between 2015 and 2016. In addition, the prevalence of obesity was 15.5%. The reported prevalence of overweight in Brazil was 8.6% (Miglioli et al., 2015). The results of a study conducted in six Southeast Asian countries reported an 8.9% prevalence of wasting and 2% severe wasting among children 0–59 months using the BAZ indicator (Mutunga et al., 2020). In South Africa, the NFCS reported a prevalence of 23.7% overweight for children aged 1 to 3 years and 15.8% for children 4 to 6 years old (Labadarios et al., 2005). The SANHANES-1 (2012) report revealed a 17.5% prevalence of overweight and 4.4% obesity amongst male children from 2 to 5 years, nationally, whereas 18.9% overweight and 4.9% obesity was recorded amongst females of the same age group (Shisana et al., 2014).

In the Limpopo Province of South Africa, Mushaphi (2011) reported that more than 80% of children had a normal BAZ, while 3% were wasted and 1.5% were severely wasted for the experimental group. In the same province, Nesamvuni (2014) found 6.6% of children below 61 months of age to be moderately wasted, 3% were suffering from severe wasting, while a prevalence of 2.1% overweight and 1.2% obesity was recorded. In Mpumalanga Province, Shisana et al. (2014) reported a prevalence of 10.6% overweight and 6.1% obesity among male children, whereas, among female children, a prevalence of 14.1% overweight and 5.5% obesity was reported. The WHO (1995) classifications for assessing the severity of malnutrition to be of public importance show that a prevalence of <5% indicates low, and 5-9% indicates a medium prevalence of

wasting. In addition, 10-14 indicates a high prevalence, and >15% shows a very high prevalence of wasting. According to the recent statistics by Shisana et al. (2014) regarding Mpumalanga, there is a need to prioritise overweight and obesity in health intervention programs.

2.2.5 Mid-upper arm circumference (MUAC)

MUAC of the left upper arm is measured at the mid-point between the tips of the shoulder and elbow. The participant's left arm should be bent, and then the examiner finds and marks the mid-point. The arm must be hanging straight down, and a nonstretchable MUAC tape be wrapped around the arm at the midpoint mark. MUAC must be measured to the nearest 1mm. MUAC measurements are analysed according to WHO and UNICEF (2009) classifications. MUAC less than 110mm (11.0cm) indicates Severe Acute Malnutrition (SAM). MUAC of 110mm to 125mm indicates Moderate Acute Malnutrition (MAM). A 125mm to 135mm demonstrates that a child is at risk for acute malnutrition. Table 2.3 indicates MUAC classifications for interpretation.

Table 2.3 MUAC classification

Classifications	Interpretations
<115mm(11.5cm)	Severe acute malnutrition
115mm(11.5cm) and 125mm (12.5cm)	Moderate acute malnutrition
125mm (12.5) and 135mm (13.5cm)	Risk of acute malnutrition
>135mm (13.5cm)	Well-nourished

Source: (WHO and UNICEF, 2009)

2.2.5.1 Prevalence of Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) using MUAC

MUAC is used as a rapid screening tool to detect wasting in children aged 6–59 months (Lamsal et al., 2021). According to Abitew et al. (2021), the WHO guidelines recommend the use of only MUAC and oedema as criteria to admit children with MAM and SAM to outpatient therapeutic programs in community-based settings. Using the cutoff points for MUAC among children aged 6-59 months old, 7.0% were considered severely wasted, and none of the children was moderately wasted in Vietnam (Huong et al., 2014). The overall prevalence of wasting based on MUAC cut-offs captured only 0.4% SAM and 2.7% MAM in Nepal (Lamsal et al., 2021). A staggering wasting prevalence of 62.3% and 63.3% was reported among boys and girls in India (Tigga, Sen, and Mondal, 2015). A study from an East African country found an 11.2% prevalence of SAM based on MUAC <11.5 cm and observed a substantial degree of agreement between MUAC and WHZ to diagnose SAM (Abitew et al., 2021).

South African researchers found a mean MUAC of 13.9 cm in a study conducted in three provinces (Western Cape, Free State, and Northern Cape) (Steenkamp, Lategan, and Raubenheimer, 2016). Of the total sample, 29% were moderately wasted, 5% were severely wasted, and no significant difference was observed between the two genders in MUAC nutritional status. Results of a study covering 4 provinces reported the prevalence of MUAC less than 11.5 cm at 41% for children less than five years entering inpatient care, while 25% between 11.5 cm and 12.5 cm, and 21.8% had a MUAC greater than 12.5 cm (Botha, 2021). The same study reported a prevalence of 16.7% of SAM cases among children with the same characteristics in Mpumalanga Province. The present data regarding the prevalence of MAM and SAM in Mpumalanga Province based on MUAC cut-offs show that the province has a very high severity prevalence of wasting.

2.3 Infant feeding practices

Healthy feeding practices in early childhood make long-life-appropriate recommendations that promote a healthy lifestyle and improve public health (Haines et al., 2019). In a systematic review study among children aged 2 to 6 between 2000 and 2012, McPhie et al. (2014) concluded that child feeding practices were linked with child food intake and nutritional status. Inadequate dietary intake is a key determinant of childhood undernourishment and poor growth (Budree et al., 2017). The adverse consequences of poor feeding practices and malnutrition lead to growth failure, cognitive development impairment, and communication challenges within the child's physical and socio-emotional environment (Pantoja-Mendoza et al., 2015).

2.3.1 Dietary intake of children under five years of age

Dietary intake includes overall foods consumed, and individual nutrients, as informed by dietary practices (Rehm et al., 2016). Equally important, Babaeer et al. (2022) state that healthy dietary intake is fundamental to health and well-being across the lifespan. The types of foods children consume, the amounts of the foods consumed, and the food sources of nutrients are important in assessing dietary intake (Korkalo et al., 2019). An optimal dietary pattern is described as containing a wide variety of nutritious foods from different food groups. Appropriate dietary intake is critical during preschool age for forming good eating habits and providing the needed nutrients for growth, long-term health, cognition, and educational achievements (Ochola & Masibo, 2014). Foods consumed at preschool contribute significantly to children's dietary intake (Korkalo et al., 2019). Individuals have different dietary intake requirements according to their age and gender (Mahan, Escott-Stump & Raymond, 2012).

The prudently revised South African Paediatric Food-Based Dietary Guidelines (SA-PFBDGs) are appropriate, and commensurate with optimum physical, behavioural, and mental development (Strydom, Du Plessis & Daniels, 2021). Consuming three main meals a day positively influences overall dietary intake (Shisana et al., 2014).

The dietary recommendations expressed in the Food Based Dietary Guidelines (FBDGs) are nutrient-based recommendations for food to ensure the adoption of adequate diets that meet all nutrient needs and diets that help to prevent the development of deficiencies and non-communicable diseases (NCDs) later in life (Vorster, Badham & Venter, 2013). Macronutrient and micronutrient deficiencies are caused by inadequate dietary intake, disturbed absorption or utilization, and increased requirements due to growth (Shisana et al., 2014). Young children are expected to consume foods from a variety of food groups, with adequate energy and high proteins to prevent malnutrition and illnesses (Galgamuwa et al., 2017). In the US, children's dietary intake is characterized by excessive consumption of calories/food more than what their body needs for healthy functioning resulting in the accumulation of adipose tissue (Sanyaolu et al., 2019). On the contrary, the high prevalence of undernutrition in Sri Lanka reveals that children suffer from acute and chronic malnutrition due to low energy, protein, and micronutrient intake (Galgamuwa et al., 2017). According to the South Africa Demographic and Health Survey (SADHS), the staggering 27% prevalence of stunting in South Africa is an expression of the serious disparities and vulnerabilities of inadequate dietary intake that children under 5 years still face (NDoHSA, 2019). Moreover, according to the survey, only 23% of children were fed a minimum acceptable diet, signalling inadequate dietary intake.

2.3.2 Dietary diversity of children under five years of age

Dietary diversity refers to the number of unique foods or food groups consumed over a given period. It has been considered a potential 'proxy' indicator to reflect nutrient adequacy and adequate intake across a range of key micronutrients (Workicho et al., 2016). Dietary diversity is expressed in categories; minimum dietary diversity means a child consuming foods and beverages from at least five of the eight defined food groups (WHO, 2021). Moreover, high dietary diversity means a child that consumes above six food groups, medium dietary diversity refers to a child who consumes four to five food groups, and low dietary diversity is when a child consumes less than three food groups. Children should be provided with five small meals each day, and their diet be inclusive of protein-rich and starchy foods, milk or milk products, fruits, and vegetables, and hygiene practices. Tea, coffee, sugar drinks, high-sugar, and high-fat salty snacks should be avoided (Möller, Du Plessis, and Daniels, 2021). Dietary diversity is an internationally accepted recommendation for healthy eating (Steyn, 2013). In the South

African dietary guideline position, the FBDG “Enjoy a variety of foods” aims to encourage individuals to consume mixed meals from various food groups, and interchange food preparation methods to yield an adequate intake of essential nutrients. Dietary diversity is calculated using different food groups based on the eating patterns of the population under investigation (WHO, 2021).

Onyango et al. (2014) established that a diversified diet has the potential to prevent stunting. Continuous infant and young child feeding with a poorly diversified diet increases the risk of micronutrient deficiencies, which may affect the child's physical, and cognitive development (Steyn, 2013). Without nutritious foods, minimum dietary diversity, and minimum meal frequency, infants and young children are vulnerable to undernutrition, including stunting and micronutrient deficiencies, and to increased morbidity and mortality (NDoHSA 2019, WHO 2008). High dietary diversity is associated with 31% reduced probabilities of stunting among children aged 24–59 months (Disha et al., 2012). Children need a minimum acceptable diet from diversified food groups for a minimum number of times in a day to get a variety of nutrients useful to sustain ideal nutrition and health (WHO, 2010).

Minimum dietary diversity, minimum meal frequency, and enough milk or milk products constitute a child’s minimum acceptable diet (NDoHSA, 2019). Labadarios et al. (2005) identified the most consumed food items to be maize, brown bread, sugar, tea, margarine, and whole milk among children of all age groups. Foods of high satiety value, like chips, sweets, sugar, and fizzy drinks, are not recommended for children. Homemade foods are good (NDoHSA, 2019). The dataset collected from 6 regions of the world covering 19 countries found that the average dietary diversity of children below five years was 3.22, meaning children ate 3.2 food groups on average out of 10 possible food groups (Niles et al., 2021).

Moreover, dietary diversity ranged from 4.48 in South America to 2.66 in Southeast Africa. Average dietary diversity at the country level ranged from 4.77 in Colombia to 1.80 in Lesotho. The SADHS report indicates that 49% of children met the criteria for minimum dietary diversity and 52% for minimum meal frequency. While only 23% of children were fed a minimum acceptable diet, about 56.2% consumed milk or milk products. The SADHS indicates that 46.7% of preschool-aged children consumed fruits and vegetables rich in vitamin A, 35% consumed sugary foods, and 44% consumed salty snacks (NDoHSA, 2019). Data from the available literature show that most children are not meeting the recommended five out of eight food groups in South Africa.

2.3.3 Eating habits of children under five years of age

Children learn eating habits and social behaviour from their parents, and their beliefs, attitudes, emotions, and cultural relationships with food directly impact their eating habits (WHO, 2021). Infant feeding practices are a significant component that determines the nutritional status of children. Infant and young child feeding practices need to be appropriate, safe, well-nourished, and frequent to provide enough nutrients for rapid growth and development (Mekonnen et al., 2017). The WHO's guiding principle for feeding infants and young children recommends that children be fed a variety of foods to ensure that nutrient needs are met (WHO, 2021). Feeding a diversified diet is a primary requirement for access to essential nutrients; therefore, it's a useful indicator for assessing infant and young child feeding practices (Khamis et al., 2019).

Feeding a diversified diet gives access to macro and micronutrients that may influence growth, cognition, and immune response as reflected by the body's ability to respond to needs dependent on that nutrient (Caulfield et al., 2014). Age-appropriate infant and young child feeding practices prevent chronic malnutrition caused by prolonged food deprivation (stunting), and short-term food deprivation (undernutrition). Thus, Frempong and Annim (2017) suggest that there is a positive correlation between feeding practices and better health outcomes. In a birth cohort study conducted in South Africa, no association was found between the under-consumption of individual food groups or low dietary diversity and indicators of malnutrition such as wasting, stunting, and being underweight for age (Budree et al., 2017). The South African Infant and Young Child Feeding (IYCF) policy aims to implement strategies promoting, supporting, and protecting age-appropriate infant and young child feeding practices that improve child survival, growth, and development (NDoHSA, 2013).

2.4 Milestone development of children under five years of age

Children develop along a continuum unique to each child. However, some typical milestones are achieved universally by most children at a particular age and stage (Press, 2015). Caregivers should conduct developmental screening to indicate whether a child is meeting expected developmental milestones or may have a developmental delay that requires further assessment apart from the broader set of preventive healthcare practices (Johnson-Staub, 2014). According to Wong and Fleer (2013), children are born learners, and the desire to understand their surroundings and operations is common among children as stimulated by the time made available for child-initiated activities. Age-appropriate screening tools are utilised to assess a variety of developmental domains and issues, including physical development,

social-emotional development, cognitive development, as well as communication, and language (Johnson-Staub, 2014).

Determining child development involves measuring abilities and aptitudes and making comparisons with children of the same age to describe children's development in terms of the developmental tasks they can or cannot carry out (Bedford, Walton & Ahn, 2013). Developmental screening tools vary and depend on the child's age, the setting (e.g., home, early childhood development center, paediatrician's office), and the adult's qualifications (Johnson-Staub, 2014). Periodization by Wong and Fleer (2013) suggests that direct emotional contact, manipulation of objects, imaginary play, and then formal learning are the leading activities for the development of infants, in early childhood, preschool children, and early school-age children, respectively.

Each developmental domain is important; nonetheless, children do not function in a single domain at a time while carrying out their daily tasks, rather they work in several or all the domains simultaneously (Press, 2015). Physical development provides a foundation for other developmental domains including socio-emotional, communication, and cognitive domains. As children grow, gross and fine motor skills (physical development domain) continue to develop as young children navigate their environment, engage in daily tasks, and exercise their problem-solving skills while engaging with their immediate environment (Yang et al., 2019). Moreover, children communicate socially using the acceptable means of communication learned from home and school. Through exposure to early childhood learning, children are assigned activities to collaborate with their peers to solve problems. Tasks emphasize pre-schoolers' agency to make a difference in their own world and develop problem-solving and communication skills (Edwards, 2017). Literature suggests a connection between improved nutrition and optimal child growth and development (Nyaradi et al., 2013).

i) Interpretation of milestone development

The Developmental Assessment of Young Children-Second Edition (DAYC-2) is an individually administered, norm-referenced measure of early childhood development for children from birth through age 5 years and 11 months (Voress and Maddox, 2013). It measures five different developmental domains: cognitive, communication, social-emotional, physical, and adaptative behaviour domain. Each domain has developmental items, and starting points for assessment are determined by child age in months because the norms table for DAYC-2 is presented in months. On the items, the examiner scores 1 if the child exhibits the behaviour described most of the time or did when he or she was younger but has outgrown the behaviour and scores 0 if the child does not exhibit the behaviour described or

inconsistently. The scores for items per child are based on observation of child skills in their environment, either at home or school, interviews with caregivers or teachers, and direct assessment of child behaviour.

To start with the assessment, the child's age is determined in months, developmental items per domain are assigned numbers on the assessment tool, and starting points are highlighted in age, therefore the last item to obtain a score of 1 before the ceiling it's the raw score of the child milestone development. A ceiling is when three consecutive items receive a score of 0, and then testing stops. This raw score is converted into normative scores (age equivalent, standard score, percentile rank) using Appendix A, B, and C of the DAYC-2 examiner's guide. The communication and physical domains have two subdomains. The raw score for each subdomain is recorded first and converted into normative scores using the appendices mentioned. Then sum the two subdomain raw scores and the two standard scores. The sum of subdomain raw scores must be converted into the domain age equivalent using Appendix A. The sum of standard scores for the two subdomains is converted to a composite standard score using Appendix D. Appendix C is used to convert the composite standard score to a percentile rank.

Descriptive terms correspond to standard scores as indicated in Table 2.4. After determining each standard score, a descriptive term is recorded for that standard development score, and they range from very poor to very superior. The normative scores for the composite of all five domains are called General Development Index (GDI). It is the sum of all the standard scores of the five domains. The index corresponding to the sum of the standard scores of the domains that make up this composite is found in Appendix E, and descriptive terms corresponding to these scores are the same in Table 2.4 (Voress & Maddox, 2013).

Table 2.4 Descriptive terms for standard scores

Standard score	Descriptive term
>130	Very Superior
121 - 130	Superior
111 – 120	Above average
90 – 110	Average
80 – 89	Below average
70 – 79	Poor
<70	Very poor

Source: (Voress and Maddox, 2013)

2.5.1 Prevalence of Milestone Developmental Status

The growth and development of infants and young children need continuous screening and assessment to help identify children who are significantly below their peers in developmental

milestones, to monitor children's progress in special intervention programs, and for use in research studying the abilities of children (Voress and Maddox, 2013). About 43% of children worldwide under five years are at risk of suboptimal development due to poverty and stunting, mainly living in low- and middle-income countries (Agarwal et al., 2018). In a global study conducted in 35 low- and middle-income countries (LMICs), McCoy et al. (2016) found that 35.8% of the total sample had low cognitive and/or socio-emotional development scores. The estimated percentage of children with delayed cognitive and/or socio-emotional development ranged from 4.4% of children in Botswana to 67% of children in Chad, and in most countries delayed development was more common for boys than girls.

Zhang et al. (2018) observed an overall 35.7% prevalence of suspected developmental delays in rural China, while researchers in Turkey reported 6.4% developmental delays for children aged 3 to 60 months (Demirci and Kartal, 2016). In India, the overall prevalence of developmental delays was 12.2% for children from infancy to 59 months, while for children 24 to 59 months the prevalence was 15.3% (Agarwal et al., 2018). Keyvanfar et al. (2021) reported less than 10% (9%) of developmental delays in all five domains in Tehran. A shocking prevalence of 35.4% of children suffering from developmental delays was recorded in Nigeria (Jimoh, Anyiam, and Yakubu, 2018). A study conducted in South Africa comparing the national developmental checklist to a standardized tool for screening children below five years show that 52% of the sample failed the Parents' Evaluation of Developmental Status: tools (PEDS), 49% failed the Parents' Evaluation of Developmental Status: Developmental Milestones (PEDS: DM), while 17% of the same sample failed the Road to Health Booklet (RtHB) developmental checklist, indicating a high prevalence of developmental delays in the country (Van der Linde et al., 2015).

2.5 Children's nutritional status and milestone development

A healthy diet enhances child development and constricts the development of macro and micronutrient deficiencies and imbalances (Gale et al., 2009). Children's diets reflect parental food habits, and the effects of poor nutrition from gestation through childhood reduce adult productivity by reducing cognitive performance (Cusick and Georgieff, 2016). The study by Olivieri (2020) identifies poor-quality protein as a dietary cause of poor cognitive development as it is associated with a low intake of healthy fats and poor intake of important micronutrients like iron, zinc, and iodine. Rapid child development occurs in the early years, with the brain developing faster than the rest of the body, making it vulnerable to dietary deficiencies (Benton, 2010).

Persistent nutritional deficits such as protein-energy malnutrition in early childhood result in growth and developmental impairments, including stunting (Dewey and Begum, 2011). Malnutrition, poor health, and unstimulating environments detrimentally affect children's cognitive, physical, and social-emotional development (Grantham-McGregor et al., 2007). Moreover, malnourished children have less energy and interest in engaging in learning activities, negatively influencing their development. Burkhalter and Hillman (2011) concluded that being overweight and obese may result in delayed child development. In contrast, Bisset et al. (2013) contradicted that weight status and overweight were not associated with child development outcomes.

2.6 Summary

Even though nutrition-specific interventions are essential for child development, they are insufficient for children to reach their full developmental potential (NDoHSA 2018, Pérez-Escamilla and Moran 2017). To achieve universal child development, special consideration is needed for non-nutrition factors such as the social determinants of health, parenting style, and early childhood stimulation as they affect both nutritional status as well as other dimensions of early childhood development, including psycho-emotional, cognitive, and academic development (Black, Pérez-Escamilla & Fernandez Rao, 2015). In addition to health and nutrition, nurturing care needs to consider responsive parenting, including responsive feeding, learning stimulation, education, and social protection, which provide the essential care for children to survive and thrive (Daelmans et al., 2017).

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This study aimed to investigate the nutritional status and milestone development of children aged three to five years attending early childhood development centres at Chief Albert Luthuli Municipality. This chapter will describe the study design, population and study area, sampling, instrument development, measurements and techniques, and statistical analysis.

3.2 Study design

The cross-sectional study design was used in this study. In a cross-sectional study, the investigator measures the outcome and the exposure of the study participants at the same time (Setia & Panda, 2017). In this study, data was collected from the representative subset at one point in time. In addition, the nutritional status and milestone development of children in ECD centers were described. The nutritional status and milestone development were described as this type of study involved identifying the characteristics of the observed phenomenon and exploring possible correlations among the two variables. Quantitative methods were used during data collection and analysis. Quantifiable measures include weight, height, MUAC, dietary diversity, and milestone development scores. According to Motadi et al. (2015), this type of data can be used to assess the prevalence of acute or chronic conditions in a population.

3.3 Population and Study Area

The target population was children aged 3 to 5 years with their caregivers and ECD teachers in Chief Albert Luthuli Municipality. The accessible population was children aged 3 to 5 years attending ECD centers, caregivers and their ECD teachers. Caregivers and teachers of children were informants. In this study, caregiver refers to a person who looks after the ECD child and will attend the researcher meeting and consent on behalf of the child. For this study, teachers refer to the full-time educators for the children. The target group was selected because children under five years are the most vulnerable group of any community (Ibeanu et al., 2012). Nutrition in the preschool stage plays an essential role in growth and development and has long-lasting effects later in life (Coleman Smith, 2016).

The study was conducted in Chief Albert Luthuli Municipality, which is one of the seven municipalities of the Gert Sibande District. The Chief Albert Luthuli Municipality is divided into four districts: Carolina, Ekulindeni, eMpuluzi, and eManzana. According to

Statistics South Africa (2011), Chief Albert Luthuli municipality had a total population of 186 010. About 57% of this population speaks SiSwati, 34.8% speaks IsiZulu, 2% speaks English, 1.6% speaks Afrikaans, and 4.6% speaks other languages. The municipality had 119 registered ECD centers, with a total enrolment of 4823 children. Figure 3.1 shows the map of Chief Albert Luthuli Municipality in Mpumalanga Province.

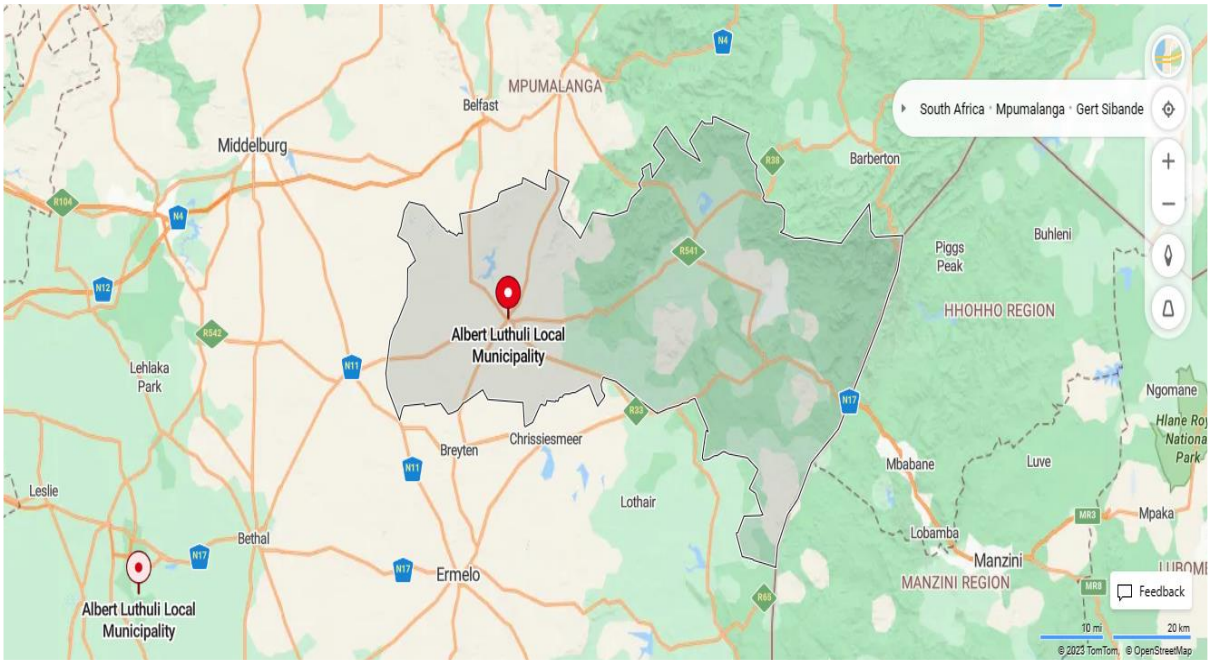

Figure 3.1 Map of Chief Albert Luthuli Municipality Source: (https://www.bing.com/maps?q=gmail&FORM=HDRSC&cp=26.067365~30.11977&lvl=16.0, Accessed 11/10/2023)

3.4 Sampling design and sampling procedure

The Chief Albert Luthuli Municipality was clustered into four districts: Carolina, Ekulindeni, eMpuluzi, and eManzana circuits. Cluster sampling is a procedure where the population is divided into subgroups based on their geographical allocation (Alvi, 2016: 22-24). The Department of Social Development in the Gert Sibande district office obtained a list of ECD centres. From the list, ECD centers were categorised according to their respective circuits. For this study an equal representation of all clusters was four ECD centers, which were purposefully allocated for each cluster. Simple random sampling was used to select ECD centers from the list of each cluster. Each ECD center was assigned a number, and the numbers were placed in a bowl where the researcher mixed them thoroughly. The researcher picked one number at a time from the bowl blind-folded. Each number represented an ECD center. Four ECD centers were selected from each circuit. From Carolina circuit, Sibekezelo Day Care and Creche, Sinethemba Preschool, Vulamehlo Preschool, and Siyaphambili Preschool were

selected. Meanwhile, Vusithemba Preschool, Sifisokuhle Preschool, Wesley Creche, and Vulindlela Preschool were selected in Ekulindeni circuit. The selected ECD centers under eMpuluzi circuit were Joy Christian Preschool, Zamani Day Care and Preschool, Thuthukani Preschool, and Masithandane Preschool. The following ECD centers were randomly selected under eManzana circuit; Under His Wings Preschool, Nonkululeko Preschool, Izithandani Preschool, and Sunduza Preschool. The same research design (simple random sampling) was used to select participants for the study within the selected ECD centers. Teachers were conveniently sampled according to the ECD center they were working in.

Slovin's formula was used to determine the sample size of the participants for this study. The following formula whereby n= N/ (1 + (N X e2)) where n represents sample size, N is the total number of preschool children, and e is the accepted error level.

n=N/ (1+ (N X e2))

n=4823 / (1 + (4823x0.0025))

n=4823/13.06

n=369

The formula yielded a total of 369 participants. This number of participants did not warrant ECD centers the same number of participants from all four circuits. Twenty-four participants were randomly selected from chosen ECD centers using the bowl technique, and a sample of 384 was achieved for attrition. Some selected ECDs did not have the twenty-four children. For these reasons, an equal number not above or less than 10% from the number of participants yielded by the formula had to be chosen to avoid deviating from the original sample. Therefore, 384 children were achieved from sixteen ECD centers as stated above. The participant's number was ideal so it could replace children who were sick or absent during data collection, but at the end, the number of children who participated in this study did not deviate from the original sample and 353 children participated in the study. Table 3.1 shows the names of ECD centers per circuit and number of children accessed on each ECD. Figure 3.1 below illustrates a sampling procedure and the number of ECD centers in each circuit.

Table 3.1 Names of ECD centers and number of children selected per ECD center

Carolina circuit	**Ekulindeni circuit**	**eMpuluzi circuit**	**eManzana circuit**
Sibekezelo Day Care and Creche (21)	Vusithemba Preschool (24)	Joy Christian Preschool and Preschool (24)	Under His Wings Preschool (20)
Sinethemba Preschool (24)	Sifisokuhle Preschool (21)	Zamani Day Care (24)	Nonkululeko Preschool (24)
Vulamehlo Preschool (23)	Wesley Creche (22)	Thuthukani Preschool (24)	Izithandani Preschool (17)
Siyaphambili Preschool (13)	Vulindlela Preschool (24)	Masithandane Preschool (24)	Sunduza Preschool (24)

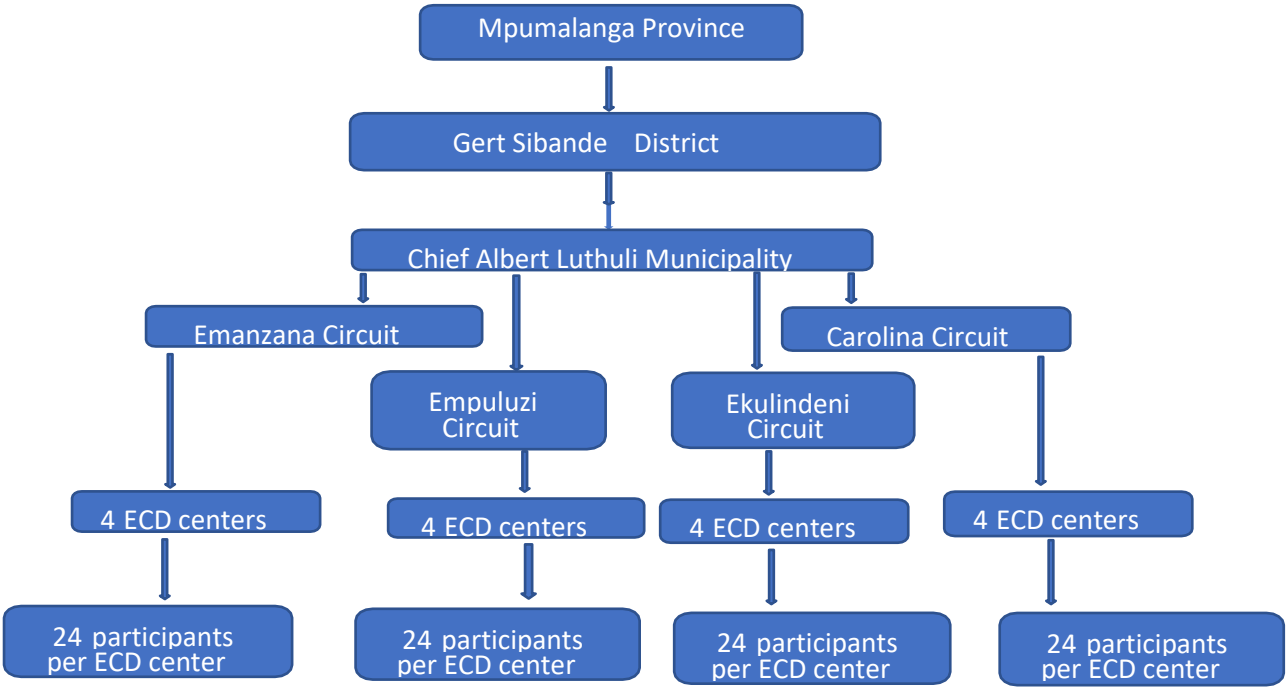

Figure 3.2 Sampling design and sampling procedure

3.5 Inclusion and exclusion criteria

3.5.1 Inclusion criteria

Children who were attending ECD centers full-time, and their parents signed an informed consent form in Chief Albert Luthuli municipality were included in the study.

3.5.2 Exclusion criteria

Children who were sick, living with a disability, and/or had immune suppression disease were excluded from the study. The exclusion was because the researcher realised it would be difficult to get accurate anthropometric measurements and assess their developmental milestones.

3.6 Subject recruitment

Subject recruitment was done as follows:

- **First Visit**

Permission to conduct the study was sought from the principals of ECD centres. The research aims, objectives, and procedures were explained to them. In addition, they were requested to organise caregivers' (parents') meetings and brief ECD centre teachers.

- **Second Visit**

The researcher met with caregivers and teachers to explain the study's procedure, aim, and objectives. Caregivers and teachers were allowed to ask questions for clarification. Information sheets (Appendix F) and consent forms (Appendix G) were distributed to caregivers to sign if they agreed that their children be included in the study. Teachers were given the same information sheet as caregivers but a separate consent form (Appendix H) if they agreed to participate in milestone development screening (Section D of the questionnaire).

- **Third visit**

The researcher gave more verbal explanations to caregivers and teachers who needed clarity before they could give consent for children to participate in the study. On this day, data collection commenced. Each child was requested for verbal assent before he/she participated in the study. The assent form, in which the child had to put his/her thumbprint, was also issued after a child nodded with his/her head to show assent (Appendix I).

3.7 Instrument development

The researcher developed the questionnaire in English following the study's objectives and relevant literature (Stats SA 2011, Lee and Nieman 2013, Voress and Maddox 2013, SADHS 2016). It was translated into SiSwati by an expert in the Linguistics Department at the University of Venda and back into English. The questionnaire consisted of four sections. The sections were as follows: socio-demographic information, dietary assessments, anthropometric measurements, and milestone development screening (Appendix J).

Section A (socio-demographic data) was adopted from Statistics South Africa's (2011) household questionnaire and the South Africa Demographic and Health Survey (2016).

It covered child age, gender, and maternal characteristics such as age, marital status, and level of education. Also, household characteristics such as the availability of a vegetable garden, livestock, source of drinking water, and dumping hole or garbage availability were included.

Section B (dietary assessments) determined the frequency of meals per day, and type of foods usually given to the child. Three 24-hour recalls were used to get food groups consumed by children and determine dietary diversity scores.

Section C (anthropometric measurements) weight, height, and mid-upper arm circumference (MUAC) of children were taken to determine the physical body size and proportions as they reflect the health and nutritional status and predict performance, health, and survival (NDoHSA, 2019).

Section D (milestone development screening) - The milestone development screening tool was adopted from the Developmental Assessment of Young Children-Second Edition (DAYC-2) (Voress and Maddox, 2013). Children's cognitive, communication, social-emotional, physical, and adaptative behaviour development were assessed. The scores for all five domains, the General Development Index (GDI), were also determined. The study supervisors and a qualified Occupational Therapist were consulted to check the completeness of the questionnaire.

3.8 Data collection procedure

Data collection was done using a questionnaire. All variables highlighted in Section 3.6 above were carried out on the first day of data collection. The other two 24-hour recalls were done on separate days telephonically. The researcher and three fieldworkers conducted all interviews with caregivers and teachers in a private room using SiSwati and children's measurements were taken. The following measurements and techniques for all these variables are explained in the subsequent sections.

3.8.1 Measurements and Techniques

3.8.1.1 Anthropometric measurements

Anthropometric measurements were taken more than once for weight, height, and MUAC. Weight, height, and MUAC were measured following the standard procedure described by Lee and Nieman (2003: 164-165). The researcher and fieldworkers were responsible for taking the anthropometric measurements on the day of data collection.

3.8.1.1.1 Weight

A Seca solar scale model 0213 was used for weighing children. The scale was placed on a flat, hard surface. The scale was zeroed and calibrated using a known weight of 3kg. The scale was zeroed each time before measuring a child. Children were weighed without shoes and wearing light clothes, standing still in the middle of the scale platform without touching anything so that the body weight was equally distributed on both feet. An average of two weights was recorded numerically to the nearest 0.01kg on the comparison, and if the current values appeared unusual, the measurements were repeated (Lee and Nieman, 2013: 170).

3.8.1.1.2 Height

Height was measured using a Seca 0123 portable stadiometer. The participants were barefooted, standing with heels, arms to the side, legs straight, knees together, and wearing minimal clothing. The participants stood with their shoulders relaxed and looking straight ahead in a Frankfurt position. Heels, buttocks, scapular (shoulder blade), and back of the head were against the vertical surface of the scale. Height was recorded in centimetres to the nearest 0.1 cm. The subject was instructed to maintain an erect posture while the headboard was lowered on the highest point of the head with enough pressure to compress the hair. Hair ornamentation was removed if it interfered with the measurement. The eye was level with the headboard to read measurements (Lee and Nieman, 2013: 168-169).

(i) Interpretation of weight and height

Anthropometric measurements (weight, height) were analysed using the World Health Organization Anthroplus computer software (WHO, 2011). Weight-for-age, height-for-age, weight-for-height, and Body Mass Index for Age were interpreted using Z-scores. The Z-scores system expresses the anthropometric values as several standard or Z-scores below or above the reference mean or median value. Z-scores, which are gender and age-independent, thus permitting the evaluation of children's growth status, were determined by weight for age (WAZ), height for age (HAZ), weight for height (WHZ), and Body Mass Index for Age (BAZ).

WAZ of -1SD to <-2SD is classified as mild underweight, whereas -2SD to <-3SD is underweight. <-3SD classified as severely underweight. HAZ from -1SD to <-2SD is

classified as mild stunted, while -2SD to <-3SD is stunted, and <-3SD is severely stunted. The Z-score classifications are indicated in Table 3.2.

Table 3.2 Z-score classifications

Z-score classifications	Interpretations			
	WAZ	**WHZ**	**HAZ**	**BAZ**
>+3SD	Possible growth problem	Obese	Above normal	Obese
>+2SD to ≤+3SD	Possible growth problem	Overweight	Normal height	Overweight
>+1SD to ≤+2SD	Possible growth problem	Possible risk of overweight	Normal length	Possible risk of overweight
-1SD to +1SD	Normal WAZ	Normal WHZ	Normal length	Normal weight
-1SD to <-2SD	Mild underweight	Mildly wasted	Mild stunted	Normal
-2SD to <-3SD	Underweight	Wasted	Stunted	Wasted
<-3SD Severely	Severely underweight	Severely wasted	Severely stunted	Severely wasted

Source: (WHO, 2009)

3.8.1.1.3 Mid-upper arm circumference (MUAC)

MUAC of the left upper arm at mid-point between the tip of the shoulder and elbow was measured using a no-stretchable children's MUAC tape. The participant's left arm was bent, and then the researcher identified and marked the mid-point. The arm was allowed to hang straight down, and a MUAC tape was wrapped around the arm at the midpoint mark. MUAC was measured to the nearest 1mm.

(i) Interpretation of MUAC indicators

MUAC was analysed according to the WHO and UNICEF (2009) classifications. MUAC less than 110mm (11.0cm) indicates Severe Acute Malnutrition (SAM). MUAC of 110mm to 125mm indicates Moderate Acute Malnutrition (MAM). A 125mm to 135mm indicates a child is at risk for acute malnutrition. Table 3.3 shows MUAC classification for interpretation.

Table 3.3 MUAC classification

Classifications	Interpretations
<110mm(11.0cm)	Severe acute malnutrition
110mm(11.0cm) and 125mm (12.5cm)	Moderate acute malnutrition
125mm (12.5) and 135mm (13.5cm)	Risk of acute malnutrition
>135mm (13.5cm)	Well-nourished

Source: (WHO and UNICEF, 2009)

3.8.2 Dietary assessments

The dietary practices of children were measured using a quantifiable questionnaire. Dietary intake was measured using three 24-hour recalls, further used to get the food groups and determine the dietary diversity score (DDS). The researcher and fieldworkers were responsible for all dietary assessments measured.

3.8.2.1 Dietary Practices Questionnaire

Dietary practices are central to the kind of nutrients children need and consume. Caregivers were informants; this information was collected on the first day of data collection. Dietary practice questions were included to determine the frame the child normally eats at home to validate the information from the 24-hour recall. Children under five years are the most vulnerable to nutrient deficiencies in low and middle-income countries (Chege, Kimiywe & Ndungu, 2015).

3.8.2.2 24-hour recall

Three 24-hour recalls were collected on different days, one being a weekend. The researcher and fieldworkers asked caregivers to recall in detail all the foods and beverages consumed by their child in the last 24 hours for the three different days. A list of foods eaten the previous day was compiled. The caregiver was asked to clarify each food item's description and preparation methods. For example, if a child was reported to have eaten cereal during breakfast, the researcher asked whether milk was included and, if so, what kind of milk and how much was used. Lastly, the researcher probed for additional eating occasions the caregiver would have missed recalling. For example, asking whether there were any snacks or fruits the child would have consumed. Portion sizes were estimated using household utensils.

(i) Interpretation of 24-hour recall

The 24-hour recall was analysed according to the indicators for assessing infant and young child feeding practices, definitions and measurement methods (WHO, 2021). Foods consumed were classified according to eight food groups: starchy staples, dark green leafy vegetables, vitamin A-rich fruits and vegetables, organ meat, meat and fish, eggs, legumes, nuts and seeds, and milk and milk products. These classifications were done for all three visits. Food groups were used to determine the diversity of food groups consumed daily and determine dietary diversity scores. Children who consume ≤3 food groups are classified as having a low dietary diversity score, from 4-5 food groups with a medium dietary diversity

score, and ≥ six food groups with a high dietary diversity score. The dietary diversity scores for the three days were used to determine the average dietary diversity score. Table 3.4 indicates the dietary diversity score classifications.

Table 3.4 Dietary diversity score classification

Classification	Interpretation
≤3 food groups	Low dietary diversity score
4-5 food groups	Medium dietary diversity score
≥6 food groups	High dietary diversity score

Source: (WHO, 2021)

3.8.3 Milestone Development Screening

Four steps were followed when conducting children's milestone development screening as adopted from the Developmental Assessment of Young Children-Second Edition (DAYC-2) (Voress and Maddox, 2013: 5). The researcher and fieldworkers were responsible for milestone development screening. Below are the steps that were applied:

3.8.3.1 Method of administration

The scores for the developmental items were based on any one or all three sources, though applying all three sources avoided under and over-scoring. The following three sources per the examiner's manual were applied to conduct milestone development screening:

- Observation of the child in their school environment.
- Structured interviews with caregivers and teachers.
- Direct assessment of the child (Voress and Maddox, 2013: 5).

3.8.3.2 Testing time

Testing time was not limited as it depended on the child's age. For example, the information needed to complete the DACY-2 for younger children was obtained using structured interviews with the caregiver and teachers. In such cases, the time required to assess a domain was relatively shorter. Additional direct assessments were needed for older children, and more items were required to establish a ceiling and basal (Voress and Maddox, 2013: 6).

3.8.3.3 Entry points, basals, and ceilings

Entry points, basals, and ceilings were used to shorten testing time. For each domain, administration began at the appropriate entry point. On the Domain Scoring Form (Appendix J, Section D), entry points for each domain were determined by the child's chronological age and varied from domain to domain. According to Voress and Maddox (2013: 7-12), the entry points were determined by selecting the points at which typically developing children would likely be successful on the first few items. Entry points/starting items are shown in Table 3.5 and are highlighted on each Domain Scoring Form. The items for DAYC-2 were scored either "passed" or "not passed". Passed items earned 1 point; items not passed scored 0. The basal was established when the child scored 1 on three items in a row. Testing began on the entry point item. If the child didn't score 1 on each of the first three items administered and received a 0 on any of the first three items administered starting from the entry point, testing went backwards until the child scored 1 on three items in a row. All items below the basal were scored 1.

A ceiling occurred when three consecutive items received a score of 0. If the child didn't receive a 0 on three items in succession during the establishment of the basal, the researcher/fieldworker returned to the highest item number scored and continued testing until a ceiling was established. An actual ceiling was the set of three items scored 0 that was closest to the basal. Since we (researcher/fieldworker) may have used interview, observation, and direct assessment to collect data, establishing basals and ceilings may not have proceeded directly as stated above. Typically, we would interview caregivers as the first option for gathering information to complete the DAYC-2 assessment, focusing on skills near the child's entry point. Since the child was present during data collection, we would simultaneously observe the child and recorded scores as the skills were observed and discussed in the interview. In most cases, that was not in the same order as the items are listed on the Domain Scoring Form. Because items were not scored sequentially, it was important to record scores for all skills observed in case they were needed to determine a ceiling or basal.

Table 3.5 Starting items for the DAYC-2 based on the child's age

Age (months)	Cognitive	Receptive language	Expressive language	Social-emotional	Gross motor	Fine motor	Adaptative behaviour
Birth–11	1	1	1	1	1	1	1
12-23	19	8	8	16	27	13	14
24-35	29	16	16	28	37	17	23
36-47	40	23	24	38	40	19	34
48-59	53	27	30	46	43	22	44
>60	65	31	34	51	47	26	50

Source: (Voress and Maddox, 2013)

3.8.3.4 Specific administration and scoring instructions for the domains

Each domain and subdomain had developmental items, and starting points for assessment were determined by the child's age because the Domain Scoring Form for DAYC-2 was presented in months. On the items based on child age, we scored 1 if the child did exhibit the behaviour described most of the time or did when they were younger but has outgrown the behaviour. We scored a 0 if the child did not exhibit the behaviour described or was inconsistent. To start with the assessment, the child's age was determined in months since developmental items per domain were assigned numbers on the Domain Scoring Form, and entry points were highlighted with a star sign.

The assessment started from the entry point, then the last item to obtain a score of 1 before the ceiling, which was the raw score of the child milestone development for that domain under assessment. The raw scores were converted into normative scores (age equivalent, standard score, percentile rank) using Appendix A, B, and C of the DAYC-2 examiner's guide. The communication and physical domains had two subdomains. The raw score for each subdomain was recorded first and converted into normative scores using the abovementioned appendices. The two subdomains raw scores and the two subdomain standard scores were summed up. The sum of subdomain raw scores was converted into the domain age equivalent using Appendix A. The sum of the standard scores for the two subdomains were converted into composite standard score using Appendix D. Appendix C was used to convert the composite standard score into a percentile rank. After determining each standard score, a descriptive term was recorded for that standard development score, and they ranged from very poor to very superior (Table 3.6). The standard scores for all five domains were summed up to determine the General Development Index (GDI) composite standard score. The standard score index that corresponds with the sum of all the five standard scores (GDI) were found in Appendix E (Voress & Maddox, 2013: 12-22).

Table 3.6 Descriptive terms for standard scores

Standard score	Descriptive term
>130	Very Superior
121 - 130	Superior
111 – 120	Above average
90 – 110	Average
80 – 89	Below average
70 – 79	Poor
<70	Very poor

Source: (Voress and Maddox, 2013)

3.8.3.5 Summary of variables measured

Table 3.7 illustrates the summary of each variable that was measured, the source of information for that variable and the responsible person for measuring that variable.

Table 3.7 Summary of variables measured

Variable measured	Subject/source	Person responsible
Socio-demographic information	Caregiver	Researcher Fieldworkers
Dietary assessments	Child Caregiver	Researcher Fieldworkers
Anthropometric measurements	Child	Researcher Fieldworkers
Milestone development	Child Caregiver Teacher	Researcher Fieldworkers

3.9 Validity and reliability

3.9.1 Validity

Validity is the extent to which an instrument measures what it is intended to measure (Polit & Hungler, 2009). To ensure content validity in the study, the data collection tool included socio-demographic questions as information may link with variables of interest (Olser & Heitmann, 1996: 1024). To improve content validity, the study supervisors and a qualified Occupational Therapist were always consulted to ensure the data collection instrument covered all the aspects of the study's aim and objectives. Child feeding practices were also assessed as it is integral to nutritional status. The local language (SiSwati) was used to ensure construct validity during interviews. Scales were calibrated before anthropometric measurements were taken to determine nutritional status by measuring body dimensions. The DAYC-2 tool for assessing milestone development was adopted by Voress and Maddox (2013).

3.9.2 Reliability

Reliability is the extent to which results are consistent over time and accurately represent the actual situation under investigation and if the results can be reproduced under the same circumstances (Pandey, 2014). Repeated measures of anthropometric assessment were taken to confirm stability and ensure reliability. If the values appeared unusual, the measurements were repeated until a typical value was obtained. Household utensils were used to ensure accurate portion sizes. The researcher randomly selected two ECD centres, and supervisors came to ensure the study

procedures were properly followed and that the questionnaire was producing the same results consistently.

3.10 Pilot study

The advanced questionnaire testing was done on a small scale to evaluate the practicality, time, and adverse events to predict an appropriate approach and improve the study design before starting the research project (Njati, 2015*)*. The researcher conveniently selected one ECD centre from the eManzana circuit at Badplaas community because it was accessible to the researcher considering resource management. Twenty-four children were randomly selected from the ECD center to participate, according to inclusion and exclusion criteria. After the pilot study and identifying shortcomings in the data collection tool, inputs were affected before the actual study. The researcher and two fieldworkers were responsible for data collection during piloting. The Occupational Therapist was responsible for mentoring and support for milestone development screening. Based on the outcomes of the pilot study, the researcher organised a meeting with the team (Occupational Therapist & fieldworkers) and identified that the time taken to complete a questionnaire was, on average, 40 minutes. This observation prompted a decision to add one more fieldworker to assist in data collection looking at the magnitude of the work. The additional fieldworker was a Registered Nutritionist and had undergone the same training as the other fieldworkers before data collection. Data from the pilot study was not included on the final sample.

3.11 Training of the researcher

The researcher was trained for a week in milestone development assessment by a qualified Occupational Therapist using the Developmental Assessment of Young Children-Second Edition (DAYC-2) examiner's manual. The Occupational Therapist prepared the training manual (Appendix K).

3.12 Selection and training of fieldworkers

Fieldworkers were recruited and trained by the researcher. Two professional nurses who could speak and write in SiSwati were available and willing to participate in the study and assisted in data collection. The appointment of these fieldworkers was based on their relevant experience in growth monitoring and promotion and developmental screening as "Mother and Child" nurses to adhere to good general practice. The training manual (Appendix L) compiled by the researcher was used in the training process. The fieldworkers were trained to ensure that methods of data collection were standardised. They were trained in interview techniques,

taking anthropometric measurements, dietary assessments, and assessing milestone development.

Moreover, informed consent, confidentiality, and child assent. The training was done for one week. Practices on conducting interviews, techniques for anthropometric measurements, dietary assessments, and assessing milestone development were conducted at Thembela Preschool for two days of the training week. The researcher offered refresher training after four (four out of sixteen) ECD centers were completed during the data collection.

(i) Responsibilities of the researcher

The researcher was responsible for:

- Training field workers in data collection procedures (ensuring consent forms were complete, verbal assent and thumbprint were done, and conducting an interview).
- Developing the questionnaire, information sheet, consent form and assent form.
- Collecting data with fieldworkers.
- Supervising the data collection process.
- After pilot study, the researcher organised a meeting with fieldworkers to discuss challenges and remedial actions.
- The researcher checked all the questionnaires at the end of each day of data collection to ensure completeness and correct coding of the questionnaires.

(ii) Responsibilities of the fieldworkers

The fieldworkers were responsible for:

- Clarifying participants on any unclear matter on the data collection procedures.
- Ensuring informed consent forms were complete and conducted assent with the child.
- Precise collection and recording of data.
- After each data collection day, ensure the questionnaires' completeness before submitting them to the researcher to double-check.

3.13 Statistical analysis

Data was captured in Excel and analysed using the R and RStudio version 3.6.2. Descriptive statistics were used to interpret data. Frequency distributions were determined to describe demographic data. For normally distributed, means and standard deviations were used. Normally distributed, medians and interquartile ranges were used. Inferential statistics (bivariate and multiple regression) were used to

determine associations between nutritional status and milestone development. Parametric and non-parametric statistical tests were used for inferential statistics tests. These inferential statistical tests were applied as data may or may not normally be distributed normally. If the p-value was >0.05, a parametric statistical test was used, and if the p-value is <0.05, a non-parametric test was used.

3.14 Institutional approval

The research proposal was submitted to the University of Venda's Research Ethics Committee for approval. The approval letter dated 2020 December 02 was granted with an ethical clearance certificate number (SHS/20/NUT/22/0212) (Appendix M). Approval to conduct the research from the ECD centres was sought from the Mpumalanga Provincial Department of Social Development (DSD). The researcher used the university institutional approval letter (Appendix M) and DSD approval letter (Appendix N) to request permission to collect data from the ECD centre principals.

3.15 Ethical considerations

No participants were enrolled in the study until the protocol, subject information sheet, and recruitment material, including the consent form, had been approved in writing by the University of Venda's Research Ethics Committee. The study was conducted following the principles of the Declaration of Helsinki (2008), Good Clinical Practice (GCP), and the laws of South Africa. The following ethical issues were applied:

i. Informed Consent Form

Consent forms (Appendix G) were provided to obtain written confirmation from the caregivers for participation in the study. Consent forms were written in SiSwati. The forms included a section that explained in detail the purpose and methods of the study as presented during the caregivers' meeting. Consent forms (Appendix H) were also provided for teachers to inform caregivers collaboratively during milestone development assessment. The decisions of the caregivers and teachers on whether to participate or not in the study were respected. Caregivers and teachers who wished to pull out of the study were told they would be released without intimidation. Assent forms for children (Appendix I) were also administered upon verbally explaining the study using lay language. Permission was confirmed by nodding the head and thumbprints.

ii. Harm and risk

In case participants were diagnosed with a particular nutrition-related health risk, they were not informed rather, they were referred to the appropriate health professional(s) to address the diagnosed risk or disease.

iii. Participants' confidentiality

A private or consultation room in the ECD centres was used during data collection to ensure privacy and confidentiality. Data generated from the study was stored in a Microsoft Excel 2019 version computer database with a secret password until the final dissertation was submitted and the University of Venda Research Ethics Committee accepted the article. Participants' confidentiality will be further ensured in any handling and publication of the data.

iv. Anonymity

The anonymity of participants was ensured by using codes instead of names of participants during data collection.

3.16 Quality assurance and data management

To ensure quality outcomes, socio-demographic data was collected following Stats SA (2011) household questionnaire and the South African Demographic and Health Survey (2016), selecting questions considering the study's objectives. Anthropometric measurements adhered to the standard procedures Lee and Nieman (2013) enshrined. Anthropometric measurements were captured and analysed using the WHO Anthro Plus computer software. When measuring diet, the Nutritional Assessment textbook by Lee and Nieman (2013) was applied to the dietary assessment questions and 24-hour recall. The DAYC-2 tool was adopted to measure children's milestone development (Voress & Maddox, 2013). The researcher was trained (see training manual in Appendix K) by a qualified Occupational Therapist using the standardized norm-referenced DAYC-2 assessment tool. Milestone development data was collected through observations of the child in their school environment, structured interviews with caregivers and teachers, and direct assessment of the child following the entry points, basals, and ceiling rule when scoring children's development. The Occupational Therapist was present during the pilot study to mentor and support milestone development assessment. The researcher trained all fieldworkers on the data collection procedures. A Qualified Statistician, a Senior Lecturer under the Department of

Mathematical and Computational Sciences at the University of Venda, analysed the data collected. Regulatory authorities and University Higher Degree Committee members may be allowed access to participant data under strict confidentiality for data verification. All data from the study will be stored in OneDrive for five years by the researcher and the supervisors. Questionnaires will be stored in a locked cupboard by the supervisor.

3.17 Dissemination of results

Once the final dissertation has been approved and accepted by the University Higher Degree Committee exams section, the results will be shared with other researchers interested in the same field through the publication of an article. These results will also be shared with the Mpumalanga Provincial Department of Social Development as an interested stakeholder in the final report (Appendix N). Where accessible or invited, the results will be presented at scientific or academic conferences. The researcher will request to present these findings with nutritionists and dietitians' colleagues within the Chief Albert Luthuli Municipality and Gert Sibande District to share a practice-based research report.

3.18 Summary

This study aimed to investigate the nutritional status and milestone development of children aged 3 to 5 years attending early childhood development centres at Chief Albert Luthuli Municipality. A cross-sectional study design was adopted, using quantitative methods to collect and analyse data. A questionnaire was utilised as the main data collection tool to conduct interviews, record anthropometric measurements, and record milestone development of the skills that the child could exhibit or could not exhibit. The participants were 353 children who were randomly recruited from their respective ECD centres. The data was analysed using the R and RStudio version 3.6.2. The study followed the ethical guidelines of the University of Venda Research Ethics Committee and obtained informed consent and verbal permission from all participants. The study adhered to the principles of the Declaration of Helsinki (2008), Good Clinical Practice (GCP), and the laws of South Africa. The limitation of the study was that randomly selected ECD centres did not have the same number of children. Thus, the researcher did not achieve the total sample that was calculated using Slovin's formula.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents the study findings from a sample of 353 ECD-enrolled children between the ages of three and five from Chief Albert Luthuli Municipality. The findings cover socio-demographic characteristics, dietary assessment, anthropometric measurements, developmental milestones, and the associations between dietary diversity score and developmental milestones in children.

4.2 Socio-demographic characteristics of the participants

The results of the children's age and gender distribution, mothers' age distribution, mothers' socio-demographic characteristics, and participant households' characteristics are described in this section.

4.2.1 Age and gender of the children

The children's age and gender are reported in Table 4.1. According to the findings, more than half (53.8%) of the children were between the ages of 48 and 59 months (4 years), and 31.2% were between the ages of 36 and 47 months (3 years). In addition, the study highlights that there were more girls (53.0%).

Table 4.1 Age and gender of children

Characteristics	Frequency (n)=353	Percentage (%)
Child age (months/years)		
36 - 47 (3)	110	31.2
48 – 59 (4)	190	53.8
60 – 71 (5)	53	15.0
Gender	**n=353**	**%**
Male	166	47.0
Female	187	53.0

4.2.2 Mothers age distribution

Table 4.2 reports on the age of mothers. The findings report that most of the mothers in the study were between the ages 20-25 (28.6%) and 26-30 (28.9%) while very few mothers (4.5%) were of age 41 to 45 years.

Table 4.2 Age ranges of the mothers

Age range (years)	Frequency (n)	Percentage (%)
20 – 25	101	28.6
26 – 30	102	28.9
31 – 35	87	24.6
36 – 40	47	13.3
41 – 45	16	4.5

4.2.3 Socio-demographic characteristics of the mothers

Table 4.3 reports the socio-demographic characteristics of the mothers. Two-thirds of mothers were single (66.6%), while 21.2% were married. The results indicate that very few mothers had primary education (1.4%) and 0.6% never attended school, while almost three quarter (71.7%) had grade 12. About 40.5% of the mothers were the sole providers compared to 27.8% of the fathers. Only 10.5% of households had both parents as breadwinners, and very few (2.3%) households where the breadwinners were others (e.g. family members like aunt/uncle/sibling, civil and religious organisations). Over one-third (35%) of breadwinners were engaged in sales and services, 22% were involved in skilled manual work, and 16% worked unskilled manual jobs. Equally, about 10% of breadwinners were domestic services workers and 10% worked in the agricultural sector.

Almost all study participants (95.5%) were receivers of social grants. Of those who receive social grants, 93.5% depend on child support grants and 5.9% on old-age pension grants. The study also reported that, on average, 29.5% of the households receive an average income range of R4001 to R7000. Very few (0.6%) households had more than R33 000 monthly income.

Table 4.3 Socio-demographic characteristics of the mother/caregiver

Characteristics	Frequency (n)=353	Percentage (%)
Marital status		
Single	235	66.6
Married	75	21.2
Living together	37	10.5
Divorced	3	0.8
Widowed	3	0.8
Level of education	**n=353**	**%**
No education	2	0.6
Grade 1 – 4	2	0.6

Grade 5 – 7	3	0.8
Grade 8 – 10	16	4.5
Grade 11 – 12	41	11.6
Passed grade 12	253	71.7
Tertiary education, specify	36	10.2
Breadwinner	**n=353**	**%**
Mother	143	40.5
Father	98	27.8
Mother and Father	37	10.5
Grandparents	112	31.7
Other, (specify)	8	2.3
Type of employment of breadwinner	**n=353**	**%**
Professionals	26	7
Sales and services	124	35
Skilled manual	77	22
Unskilled manual	54	16
Domestic services	35	10
Agriculture	37	10
Type of employment of breadwinner (in case of two breadwinners)	**n=78**	**%**
Professionals	5	6.4
Sales and services	17	21.8
Skilled manual	19	24.3
Unskilled manual Other (specify)	17	21.8
Agriculture	10	12.8
Domestic services	10	12.8
Social grant support	**n=353**	**%**
Yes	337	95.5
No	16	4.5
Type of social grant	**n=337**	**%**
Child support	315	93.5
Old age	20	5.9
Disability	2	0.6
Household income per month	**n=353**	**%**
<R2000	29	8.2
R2001 – R4000	121	34.3

R4001 – 7000	104	29.5
R7001 – R12000	58	16.4
R12001 – R20000	30	8.5
R20001 – R33000	9	2.5
>R33001 – R50000	2	0.6

4.2.4 Household characteristics

Table 4.4 shows the characteristics of households. More than half of the survey participants (53%) had livestock. Of those who had livestock, 98% owned chicken, whereas 14% and 1.1% had cattle and sheep, respectively. Approximately 63% of households possessed land for food production, with 94.2% cultivating vegetable gardens and 30.4% cultivating fruit gardens. Only 6.3% of households engaged in subsistence farming on available land. Very few, 2.5% of households reported using river water for domestic purposes such as drinking and cooking. Improved water was recorded in at least 84% of households that accessed water from home taps, while others accessed water via community taps (11%), and borehole water access (1.4%). Most of the dwellings were bricks (85.3%), with only 6.8% still using traditional buildings. Only 1.1% of the households possessed townhouses, 0.3% were tenants, 3.4% paid for a flat or rented room, whereas 3.1% lived in an unofficial abode.

According to the study, most families (85%) utilised their garbage dump/pit for sanitary purposes, while 8.5% used a community refuse dump. However, only 0.6% of households had no waste disposal facility, and the municipality aided 5.9% of households once a week with garbage removal. According to the survey, 83% of homes still use pit toilets, with only 12% and 4.2% having access to flush toilets connected to sewage and a septic tank, respectively. Only 1% of the families had no toilet in their yard. The study's primary energy source was electricity (94%), followed by wood (62%). About 11% of the homes reported using coal as a source of energy, while the rest used gas (2%) and paraffin (4.2%). Healthcare staff were the most common source of nutrition information (100%), followed by electronic media (television = 22.1%; radio = 21%), mom-connect and social media (16.7%), and periodicals (3.7%).

Table 4.4 Household Characteristics

Characteristics	Frequency (n)=353	Percentage (%)
Availability of livestock at home		
Yes	187	53
No	166	47
Types of livestock	**n=187**	**%**
Cattle	26	13.9
Goats	15	8
Sheep	2	1.1
Pigs	9	4.8
Chicken	183	97.9
Other (specify)	2	1.1
Availability of land for food production	**n=353**	**%**
Yes	224	63
No	129	37
Types of land for food production	**n=224**	**%**
Vegetable garden	211	94.2
Fruit garden or orchard	68	30.4
Subsistence field for ploughing maize/sorghum, etc.	14	6.3
Other (specify)	2	0.9
Source of drinking water	**n=353**	**%**
Home tap water	295	83.6
Communal tap water	39	11
Borehole	5	1.4
River	9	2.5
Well	3	0.9
Water tanker	2	0.6
Type of dwelling	**n=353**	**%**
Brick/concrete house	301	85.3
Traditional dwelling/hut/structure made of traditional material	24	6.8
Flat or apartment	2	0.6
Town house	4	1.1
House/room in the backyard	1	0.3
Informal dwelling/shack	11	3.1
Rented room/flatlet	10	2.8
Dumping garbage in the household	**n=353**	**%**

Removed by municipality/private	21	5.9
Communal refuse dump	30	8.5
Own refuse dump/pit	300	85
No rubbish disposal	2	0.6
Toilet facility used by the household	**n=353**	**%**
Flush toilet connected with sewerage system	41	11.6
Flush toilet with septic tank	15	4.2
Pit toilet	293	83
No toilet	4	1.1
Source of energy/fuel for cooking	**n=353**	**%**
Electricity	331	93.8
Gas	7	2
Paraffin	15	4.2
Wood	217	61.5
Coal	39	11
Sources of nutrition information	**n=353**	**%**
Health care worker	353	100
Momconnect	23	6.5
Television	78	22.1
Radio	74	21
Social media	36	10.2
Magazine	13	3.7
Other (specify)	8	2.3

4.3 Dietary assessment

The frequency of consuming different food groups, types of food commonly consumed by children, and dietary diversity food groups and dietary scores are explained in this section.

4.3.1 Frequency of meal consumption

Table 4.5 reports the frequency of consuming different food groups for children in the study. The findings highlight that more than half of the children were given meals more than three times a day, while 3.1% could only be given meals twice a day. Daily consumption of vegetables was not typical as only 34.6% consumed vegetables, while 48.7% consumed 3 to 5 times per week. Almost all children (99.4%) were given milk and milk products, with 50%

given daily. Regarding snacks, more than half of the children (57.8%) ate daily and only 38.8% consumed 3 to 5 times per week. Daily consumption of fruits was reported in 61.2% of children, while 37.1% reported 3 to 5 times per week.

Table 4.5 Frequency of meal consumption

Characteristics	Frequency (n)=353	Percentage (%)
How often do you give your child meals per day		
Twice a day	11	3.1
Three times a day	137	38.8
Four times a day	108	30.6
More than four times a day	97	27.5
How often do you give your child vegetables	**n=353**	**%**
Everyday	122	34.6
3 – 5 times per week	172	48.7
Less than 3 times per week	54	15.3
Not sure/once in a while	5	1.4
Do you give your child milk and milk product	**n=353**	**%**
Yes	351	99.4
No	2	0.6
How often do you give your child milk and milk products	**n=351**	**%**
Everyday	180	51.3
3 – 5 times per week	156	44.4
Less than 3 times per week	13	3.7
Not sure/once in a while	2	0.6
How often do you give your child snacks	**n=353**	**%**
Everyday	204	57.8
3 - 5 times per week	137	38.8
Less than 3 times per week	7	2
Not sure/once in a while	5	1.4
How often do you give your child fruits	**n=353**	**%**
Everyday	216	61.2
3-5 times per week	131	37.1
Less than 3 times per week	6	1.7

4.3.2 Food commonly consumed by children.

Table 4.6 presents the types of food commonly consumed by children. The commonly consumed vegetables reported in the study were spinach (98.6%), *tinstanga* (pumpkin leaves) (97.7%), *likhabishi* (cabbage) (98.3%), lettuce (93.2%), *ligusha* (okra) (91.2%), *injujela* (tomatoes) (99.2%), sweet potato (91.5%), beans (100%), and potatoes (100%). All children were given yoghurt (100%). Fresh milk (99.1%), emasi (96%), and cheese (66.4%) were the most popular milk and dairy products. In this study, unhealthy snacks such as sweets (94.5%) and soft drinks (97.2%) were also prevalent. The findings also noted that children were provided with bananas and apples while other fruits provided included fruits such as oranges (98.9%), avocados (96.6%), guava (94.3%), pears (90.1%), and *magumence* (blackberry) (60.9%). This study reported a very low consumption of indigenous fruits and vegetables among children, with less than 30% of children indicating that they were provided with indigenous fruits and vegetables. Such food provided to children were *mantulwa* (matorana fruit) (17.8%), *manumbela* (bequia fruit) (17.3%), and *tincozi* (miraculous berry) (21.2%) among the least given fruits.

Table 4.6 Food items commonly consumed by children

Characteristics	Frequency (n)=353	Percentage (%)
Vegetables you usually give your child		
Spinach	348	98.6
Tinstanga/pumpkin leaves	345	97.7
Mabhontjisi/beans	353	100
Likhabishi/cabbage	347	98.3
Lidlekedleke/sweet potato leaves	16	4.5
Inkaka	173	49
Tinhlumaya/lentils	51	14.4
Chuchuza/blackjack	209	59.2
Lettuce	329	93.2
Ligusha/okra/Corchus hirstirus	322	91.2
Injujela/tamatisi/tomato relish	350	99.2
Potatoes	353	100
Sweet potato	323	91.5
Other vegetables	62	17.6
Milk and milk products you usually give your	**n=351**	**%**
Fresh milk	348	99.1

Emasi	337	96
Yoghurt	351	100
Cheese	226	64.4
Dairy-based ice-cream	199	56.7
Other milk and milk products	14	4
Snacks you usually give your child	**n=353**	**%**
Simba chips	351	99.4
Sweets	334	94.6
Cold drink	343	97.2
Biscuits	335	94.9
Squash	335	94.9
Other snacks	28	7.9
Fruits you usually give to your child	**n=353**	**%**
Mantulwa/matorana fruit	63	17.8
Manumbela/bequia fruit	61	17.3
Tincozi/miraculous berry	75	21.2
Magumence/blackberry	215	60.9
Banana	353	100
Orange	349	98.9
Apple	353	100
Pear	318	90.1
Guava	333	94.3
Avocado	341	96.6
Other fruits	51	14.4

4.3.3 Dietary diversity food groups and dietary diversity scores (DDS)

Table 4.7 summarises the dietary diversity of food groups and the diversity score of children over a week. All three visits' dietary diversity scores showed that most children had high dietary diversity scores (63-77%). About a quarter of children had low dietary diversity at visit three. In this study, all three dietary diversity food group measures revealed that starchy staples are children's most-eaten food groups. The findings show that children in the study are not getting enough dark green leafy vegetables and vitamin A fruits and vegetables. Other fruits and vegetables, on the other hand, were offered on the first visit (96%), and consumption fell during the second (29%) and third (27%) visit. Meat and fish (72-78%) and milk and products (68-73%) were the most common food groups in all three visits, with less organ meat food groups.

Furthermore, in all three visits, children were infrequently given eggs (6-13%) and legumes, nuts, and seeds (22-26%).

Table 4.8 shows the average dietary diversity scores of children over three days. Most children had good dietary diversity on day one and day three, with mean scores of 4.20 and 4.98, respectively. There was an increase in diversity from day two to, day three, with the highest score of 4.98 on day three.

Table 4.7 Dietary Diversity food groups and dietary diversity scores

Dietary diversity food groups	1st Visit (n-353)		2nd Visit (n=272)		3rd Visit (n=261)	
Food groups	N	%	n	%	N	%
Starchy staples	353	100	234	86	232	89
Dark Green leafy Vegetables	67	19	54	20	44	17
Vit A rich fruits and Vegetables	50	14	27	10	20	8
Organ meat	19	5	17	6	20	8
Meat and fish	276	78	196	72	193	74
Eggs	45	13	15	6	30	11
Legumes, Nuts and seeds	78	22	61	22	67	26
Milk and milk products	256	73	185	68	182	70
Dietary diversity scores						
Low (≤ 3 food groups)	19	5	5	2	65	25
Medium (4-5 food groups)	63	18	96	35	12	5
High (≥6 food groups)	271	77	171	63	184	70

Table 4.8 Mean Dietary Diversity Scores

	1st Visit (n=353)	2nd Visit (n=272)	3rd Visit (n=261)
Mean Dietary Diversity scores	4.20	3.80	4.98

4.4 Anthropometric measurements

Anthropometric measurements of children will be described and presented in terms of height for age Z-score (HAZ), weight for age Z-score (WAZ), weight for height Z-score (WHZ), Body Mass Index for Age (BAZ), and Mid-Upper Arm Circumference (MUACZ).

4.4.1 Descriptive statistics for anthropometric measures

Table 4.9 shows the descriptive data for males and females in terms of wasting (WHZ), stunting (HAZ), underweight (WAZ), Body Mass Index for Age (BAZ), and Mid-Upper Arm Circumference (MUACZ). Children had a mean WHZ score of -0.26(1.25SD), a mean HAZ score of 0(1.23SD), a mean WAZ score of -0.16(1.03SD), a mean BAZ z-score of -0.21(1.28SD), and a mean MUACZ of 0.06 (0.85SD).

Table 4.9 Descriptive statistics for anthropometric measures

"Indicator"	"number"	"mean"	"standard deviation"	"median"	"trimmed"	"minimum"	"maximum"	"range"	"skew"	"kurtosis"
"Weight for height (WHZ)_	353	-0.26	1.25	-0.25	-0.23	-5.18	3.83	9.01	-0.43	1.78
"Height for age (HAZ)_	353	0	1.23	0.02	0.03	-5	2.99	7.99	-0.3	0.3
"Weight for age Z-score (WAZ) "	353	-0.16	1.03	-0.09	-0.12	-3.16	3.65	6.81	-0.22	0.43
"Body Mass Index for Age (BAZ)	353	-0.21	1.28	-0.17	-0.16	-5.4	4.25	9.65	-0.58	2.29
"Mid-Upper Arm Circumference (MUACZ)	353	0.06	0.85	0.02	0.02	-1.75	3.86	5.61	0.58	0.94

4.4.2 Height for age

Table 4.10 shows that when using the WHO (2009) z-score classification, above 60% of children in the study had normal HAZ (± 1SD). More females (>63.1%) had normal height for age (+1SD to ≤+ 3) than males (>57.8%). About 17.9% of children were stunted (-1SD to <-3SD), with more stunted males (21%) than females (15%). More than one-tenth of males (12%) were mildly stunted, while 9.1% females were mildly stunted (-1 to <-2SD). About 7.8% of males were stunted (-2 to <-3SD) compared to 5.9% of females. Only males (1.2%) were severely stunted (<-3SD).

Table 4.10 Height for age of children by gender

Height for age of children by gender							
Interpretation of Z score classifications		Gender				Total	
		Males		Females			
		N	%	N	%	N	%
>+3SD	Above normal	0	0	0	0	0	0
>+2 to ≤+ 3	Normal height	6	3.6	7	3.7	13	3.7
>+1 to ≤+2	Normal height	29	17.5	34	18.2	63	17.8
± 1 SD	Normal height	96	57.8	118	63.1	214	60.6
-1 to <-2 SD	Mildly stunted	20	12.0	17	9.1	37	10.5
-2 to <-3SD	Stunted	13	7.8	11	5.9	24	6.8
<-3SD	Severely stunted	2	1.2	0	0.0	2	0.6
Total		166	100.0	187	100.0	353	100.0

4.4.3 Weight for age

Most of the children had normal (68.3%) WAZ (±1SD) for males and females. About 11.9% children were classified as having possible growth problems (>+1 to >+3SD) and females (12.9%) were dominating. These findings show that 14.2% of children were mildly underweight (-1 to <-2SD), while more males (7.8%) were mostly affected by underweight (-2 to <-3SD) compared to their female counterparts (3.7%). Table 4.11 summarises the weight for age Z-score classification.

Table 4.11 Weight for Age Z-scores of children by gender

Weight for Age Z scores of children by gender							
		Gender				Total	
		Males		Females			
Classification		N	%	N	%	N	%
>+3SD	Possible growth problem	1	0.6	0	0.0	1	0.3
>+2 to ≤+ 3	Possible growth problem	0	0.0	2	1.1	2	0.6
>+1 to ≤+2	Possible growth problem	17	10.2	22	11.8	39	11.0
± 1 SD	Normal WAZ	112	67.5	129	69.0	241	68.3
-1 to <-2 SD	Mild underweight	23	13.9	27	14.4	50	14.2
-2 to <-3SD	Underweight	12	7.2	7	3.7	19	5.4
<-3SD	Severely underweight	1	0.6	0	0.0	1	0.3
Total		166	100.0	187	100.0	353	100.0

4.4.4 Weight for height

According to the WHO (2009) z-score classification, most of the children had normal (63.2%) WHZ (±1SD), while 2.5% were overweight (>+2 to >+3SD), and slightly more females (2.6%) were overweight than males (2.4%). Mild wasting (-1 to <-2 SD) was affecting 16.1% children, and wasting (-2 to <-3SD) was more prevalent among female children (7.5%) compared to males (6.6%) as shown in Table 4.12.

Table 4.12 Weight for Height Z-scores of children by gender

Weight for Height Z-scores of children by gender							
		Gender				Total	
		Males		Females			
Classification		N	%	N	%	N	%
>+3SD	Obese	2	1.2	1	0.5	3	0.8
>+2 to ≤+ 3	Overweight	2	1.2	4	2.1	6	1.7
>+1 to ≤+2	Possible risk of overweight	17	10.2	22	11.8	39	11.0
± 1 SD	Normal WHZ	103	62.0	120	64.2	223	63.2
-1 to <-2 SD	Mildly wasted	31	18.7	26	13.9	57	16.1
-2 to <-3SD	Wasted	9	5.4	8	4.3	17	4.8
<-3SD	Severely wasted	2	1.2	6	3.2	8	2.3
Total		166	100.0	187	100.0	353	100.0

4.4.5 Body mass index for age

Most children had normal (76.7%) BAZ (± 1SD to <-2 SD), 14.2% were at possible risk of being overweight (>+1 to ≤+2SD), and more males (2.4%) were overweight (>+2 to >+3SD) than female children (1.6%) when using the WHO (2009) z-score classification. Wasting (-2 to <-3SD) was discovered in 4.5% of children, and 2.5% were severely wasted (<-3SD). More males (4.8%) were wasted (-2 to <-3SD), while more females (3.2%) were severely wasted (<-3SD), as presented in Table 4.13.

Table 4.13 Body mass index for age of children by gender

Body mass index for age of children by gender							
		Gender				Total	
		Males		Females			
Classifications		N	%	N	%	N	%
>+3SD	Obese	2	1.2	1	0.5	3	0.8
>+2 to ≤+ 3	Overweight	2	1.2	2	1.1	4	1.1
>+1 to ≤+2	Possible risk of overweight	21	12.7	29	15.5	50	14.2
± 1 SD	Normal weight	102	61.4	118	63.1	220	62.3
-1 to <-2 SD	Normal	28	16.9	23	12.3	51	14.4
-2 to <-3SD	Wasted	8	4.8	8	4.3	16	4.5
<-3SD	Severely wasted	3	1.8	6	3.2	9	2.5
Total		166	100.0	187	100.0	353	100.0

4.4.6 Mid-Upper Arm Circumference (MUAC)

According to the WHO and UNICEF (2009) MUAC classification, most children (90.6%) in the study were well-nourished (>13.5cm). Children at risk of acute malnutrition (>12.5 to <13.5 cm) were 3.7%. The overall prevalence of moderate acute malnutrition was 3.7%, and the prevalence of severe acute malnutrition was 2%. Moderate acute malnutrition (>11.5 to <12.5 cm) was detected in 4.3% of female children and 3% of males, while 2.1% of female children were suffering from severe acute malnutrition, compared to 1.8% of male children. Table 4.14 summarises the Mid-Upper Arm Circumference classifications.

Table 4.14 Mid-Upper Arm Circumference (MUAC)

Mid-Upper Arm Circumference of children by gender							
		Gender				Total	
		Males		Females			
Classification		N	%	N	%	N	%
>13.5 cm	Well-nourished	155	93.4	165	88.2%	320	90.6%
>12.5 to <13.5 cm	Risk of acute malnutrition	3	1.8	10	5.3%	13	3.7%
>11.5 to <12.5 cm	Moderate acute malnutrition	5	3	8	4.3%	13	3.7%
<11.5 cm	Severe acute malnutrition	3	1.8	4	2.1%	7	2%
Total		166	100.0	187	100.0%	353	100.0%

4.4.7 Child age when first MUAC was recorded on the Road to Health Booklet

Table 4.15 reports the child's age when the first MUAC was recorded. The results indicate that only 30.9% of children's MUAC was taken in the first six months. About 14.7% was taken between 7 – 9 months, and 30.6% of children's first MUAC was recorded when children were 18 months and more.

Table 4.15 Child age when first MUAC was recorded

Characteristics	Frequency (n)=353	Percentage (%)
Child age when first MUAC was recorded		
6 months	109	30.9
7 – 9 months	52	14.7
10 – 12 months	35	10
13 – 15 months	28	7.9
16 – 18 months	21	5.9
> 18 months	108	30.6

4.4.8 Comparing anthropometric measurements for males and females

Table 4.16 compares anthropometric measurements for males and females, including estimates of the mean values in each group, statistical t-values, p-values, and 95% confidence intervals (CI). The results indicate that, in most cases, there are no statistically significant differences in the means of these measurements between the two groups. The mean weight-for-height z-score (WHZ) is slightly lower in males (-0.25) compared to females (-0.28). However, the t-test statistic (0.23) and the p-value (0.82) indicate that this difference is insignificant. The 95% confidence interval suggests that the mean difference falls from -0.23 to 0.29. However, a noticeable difference was observed in height-for-age z-score (HAZ), but the p-value (0.13) indicates that the difference is not statistically significant at a conventional significance level. The results further highlight that the mean weight-for-age z-score (WAZ) is slightly lower in males (-0.20) compared to females (-0.12). The t-test statistic (-1.53) and the p-value (0.45) suggest this difference is insignificant. The 95% confidence interval ranges from -0.30 to 0.13. The mean body-mass-index-for-age z-score (BAZ) is slightly lower in males (-0.19) compared to females (-0.22). However, the t-test statistic (0.22) and the p-value (0.82) suggest this difference is insignificant. The 95% confidence interval ranges from -0.24 to 0.30. The mean mid-upper-arm-circumference-for-age z-score (MUACZ) is slightly higher in males (0.07) compared to females (0.04). Figure 4.1 illustrates box plots comparing the distributions of anthropometric measurements for males and females.

Table 4.16 Comparing anthropometric measurements for males and females

Anthropometric Indicator	Estimate. mean in group Male	Estimate. mean in group Female	Statistical t-values	p.value	95% Confidence intervals (CI)	
					Lower	Upper
Weight-for-height(WHZ)	-0.25	-0.28	0.23	0.82	-0.23	0.29
Height-for-age (HAZ)	-0.11	0.09	-1.53	0.13	-0.46	0.06
Weight-for-age (WAZ)	-0.2	-0.12	-1.53	0.45	-0.3	0.13
Body-mass-index-for-age(BAZ)	-0.19	-0.22	0.22	0.82	-0.24	0.3
Mid-upper-arm-circumference-for-age(MUACZ)	0.07	0.04	0.3	0.77	-0.15	0.21

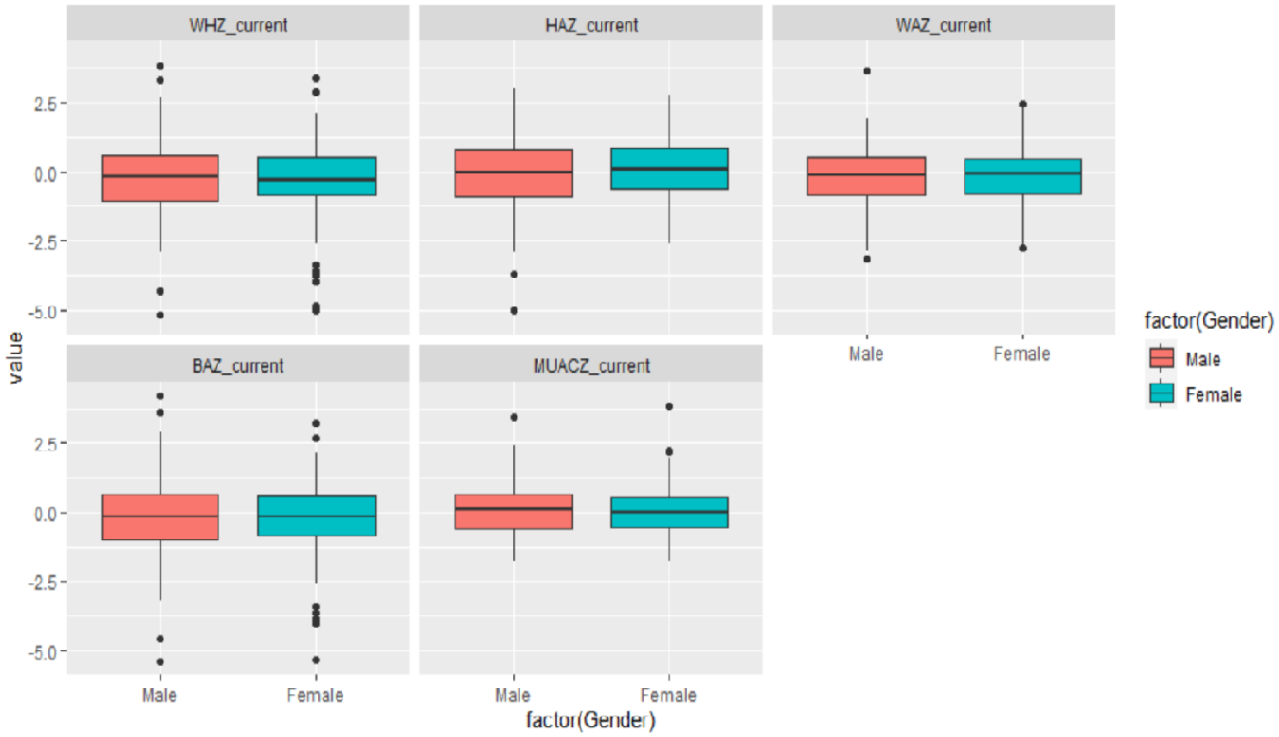

Figure 4.1 Box plots comparing the distributions of anthropometric measurements for males and females

4.5 Milestone development

According to the results obtained through the Developmental Assessment of Young Children - Second Edition (DAYC-2), a comprehensive assessment tool for child development, approximately 8% of the children in the study exhibited suspected developmental delays in their General Development Index (GDI). Notably, none of the children demonstrated "very poor" development and a minimal 1% of children were categorised as "poor" in terms of their physical fine motor development. However, a significant portion, precisely 27%, of the children

displayed physical fine motor skills issues, while 5% were considered "below average" in physical gross motor skills. In overall physical development, 10% of the children were rated as "below average," and only 2% demonstrated "below average" cognitive development. The data further revealed that over 25% of the children scored below the expected standard scores for physical fine motor development, indicating that many children did not reach the anticipated levels of fine motor development for their age within this study. These scores placed them below the bottom 25% of children in the test's normative sample. In contrast, most children fell within the "normal" or "average" range for their milestone development across all domains and subdomains, with percentages ranging from 70% to 87%.

In the case of the General Development Index (GDI), more than 90% of the children achieved overall developmental levels aligned with their age expectations, placing them among the top 75% of children included in the test's normative sample. Additionally, nearly 20% of the children were found to be "developing above average" in communication (16%) and social-emotional development (15%), while 6% were classified as "developing superior" in terms of their GDI. Table 4.17 summarises the children’s milestone development classifications.

Table 4.17 Milestone development

	Very Poor (%)	Poor (%)	Below Average (%)	Average (%)	Above Average (%)	Superior (%)
Cognitive Development	0 (0)	0 (0)	7 (2)	286 (81)	45 (13)	15 (4)
Receptive Communication	0 (0)	0 (0)	2 (1)	306 (87)	45 (13)	0 (0)
Expressive Communication	0 (0)	0 (0)	1 (0)	308 (87)	44 (12)	0 (0)
Communication development	0 (0)	0 (0)	7 (2)	290 (82)	56 (16)	0 (0)
Social-emotional	0 (0)	0 (0)	2 (1)	299 (85)	52 (15)	0 (0)
Physical Gross Motor	0 (0)	0 (0)	16 (5)	288 (82)	49 (14)	0 (0)
Physical Fine Motor	0 (0)	2 (1)	95 (27)	246 (70)	10 (3)	0 (0)
Physical development	0 (0)	0 (0)	36 (10)	275 (78)	42 (12)	0 (0)
Adaptative Behaviour	0 (0)	0 (0)	7 (2)	296 (84)	50 (14)	0 (0)
General Development Index	0 (0)	0 (0)	28 (8)	258 (73)	47 (13)	20 (6)

4.6 Relationship between nutritional status and child milestone development

This section reports the relationship between children's anthropometric measurements and milestone development and the associations between dietary diversity score and child milestone development.

4.6.1 Relationship between anthropometric measurements and child milestone development

The results in Tables 4.18 to 4.22 report the relationship between anthropometric indicators and child milestone development. The statistical analysis highlights significant associations between anthropometric indicators and child development in all domains examined.

The results highlighted a positive correlation between weight-for-height (WHZ) and overall physical development (p=0.03) and the General Development Index (p=0.00). A significant correlation was also observed between height-for-age (HAZ) and physical gross motor (p=0.00), as well as physical fine motor development (p=0.02). The weight-for-age (WAZ) indicator positively correlated with cognitive development (p=0.00). Moreover, positive correlations were established between WAZ and other communication development domains, including communication receptive language (p=0.02), communication expressive language (p=0.02), and overall communication development domain (p=0.01). These results indicate that the WAZ indicator is associated with physical fine motor (p=0.00) and adaptative behaviour development (p=0.03). A positive correlation was observed between body mass index for age (BAZ) and cognitive development (p=0.04).

A significant association was observed between Mid-upper arm circumference (MUAC) and cognitive (p=0.03), communication receptive language (p=0.00), overall communication (p=0.005), and social-emotional development (p=0.04). Moreover, a positive correlation was also observed between MUAC and physical fine motor development (p=0.00). Associations made between anthropometric indicators and children's milestone development are exemplified in Figures 4.2 to 4.3, as statistically expressed in Tables 4.18 to 4.22. Figures 4.2 to 4.3 unpack the percentage of children falling into various milestone development categories within each anthropometric indicator. This study found a positive correlation between weight-for-height (WHZ) and overall physical development (p=0.0351) and the General Development Index (p=0.0027).

Therefore, the general finding deduced from these results is that a higher WHZ is associated with above-average physical development. In this case, Figure 4.2 shows that 19% of children with a possible risk of being overweight achieved above average, 12% of normal children, and 7% of

wasted children achieved above average. Furthermore, the percentage of children that scored below average in the General Development Index (Figure 4.3) decreased from 18% wasted children to 5% normal children, and only 4% scored below average among children at risk of being overweight. These results are consistent in various anthropometric indicators and milestone development domains, as shown in Tables 4.18 to 4.22. These findings highlight the importance of maintaining a normal anthropometric/nutritional status to prevent delayed development in children.

Table 4.18 Correlation between WHZ and child milestone development

Developmental domain	X-squared	Df/	p-value
Cognitive development	2.5935	NA	0.6278
Receptive communication	1.2596	NA	0.9421
Expressive Communication	5.2829	NA	0.2876
Communication development	2.7954	NA	0.5925
Social-emotional	3.2559	NA	0.4848
Physical gross motor	6.6558	NA	0.1415
Physical Fine motor	3.686	NA	0.454
Physical development	10.195	NA	0.0351
Adaptative Behaviour	3.3094	NA	0.4998
General Development Index	16.187	NA	0.0027

Table 4.19 Correlation between HAZ and child milestone development

Developmental domain	X-squared	Df	p-value
Cognitive development Receptive	9.5375	NA	0.0474
communication	3.0445	NA	0.5192
Expressive Communication	4.9963	NA	0.3322
Communication development	5.391	NA	0.2392
Social-emotional	4.5323	NA	0.2888
Physical gross motor	19.797	NA	0.0006999
Physical Fine motor	11.682	NA	0.0218
Physical development	23.904	NA	0.304
Adaptative Behaviour	4.6208	NA	0.318
General Development Index	23.592	NA	0.304

Table 4.20 Correlation between WAZ and child milestone development

Developmental domain	X-squared	Df	p-value
Cognitive development	17.775	NA	0.0024
Receptive communication	11.997	NA	0.0269
Expressive Communication	11.521	NA	0.0224
Communication development	13.367	NA	0.0117
Social-emotional	4.554	NA	0.3095
Physical gross motor	36.382	NA	9.99905
Physical Fine motor	15.092	NA	0.006499
Physical development	33.979	NA	9.999
Adaptative Behaviour	10.951	NA	0.0319
General Development Index	48.494	NA	9.99905

Table 4.21 Correlation between BMI/AZ and child milestone development

Developmental domain	X-squared	Df	p-value
Cognitive development Receptive	9.7711	NA	0.0448
communication	4.59	NA	0.2841
Expressive Communication	3.9398	NA	0.4184
Communication development	6.1506	NA	0.1741
Social-emotional	5.9095	NA	0.1705
Physical gross motor	25.489	NA	0.204
Physical Fine motor	8.3033	NA	0.08129
Physical development	34.266	NA	9.99905
Adaptative Behaviour	5.2208	NA	0.2515
General Development Index	25.021	NA	0.34

Table 4.22 Correlation between MUAC and child milestone development (MUAC)

Developmental domain	X-squared	Df	p-value
Cognitive development Receptive	10.124	NA	0.0399
communication	20.946	NA	0.0016
Expressive Communication	11.354	NA	0.0377
Communication development	16.658	NA	0.003
Social-emotional	10.912	NA	0.0448
Physical gross motor	29.973	NA	9.999
Physical Fine motor	16.446	NA	0.005099
Physical development	29.842	NA	9.999
Adaptative Behaviour	8.3381	NA	0.08079
General Development Index	39.756	NA	9.99905

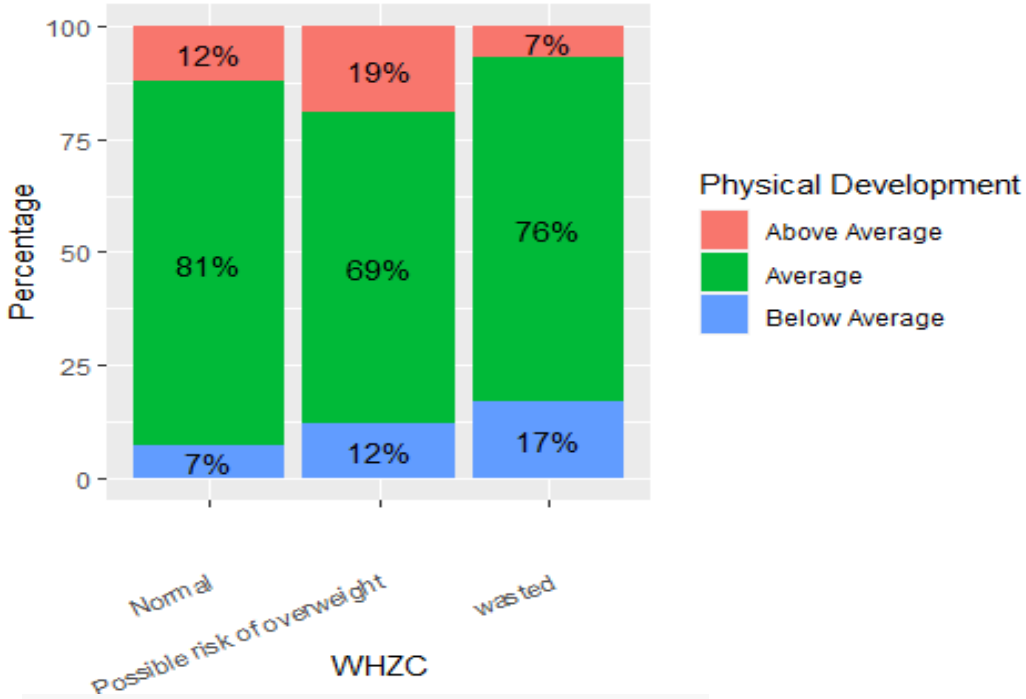

Figure 4.2 Weight-for-height vs. physical development

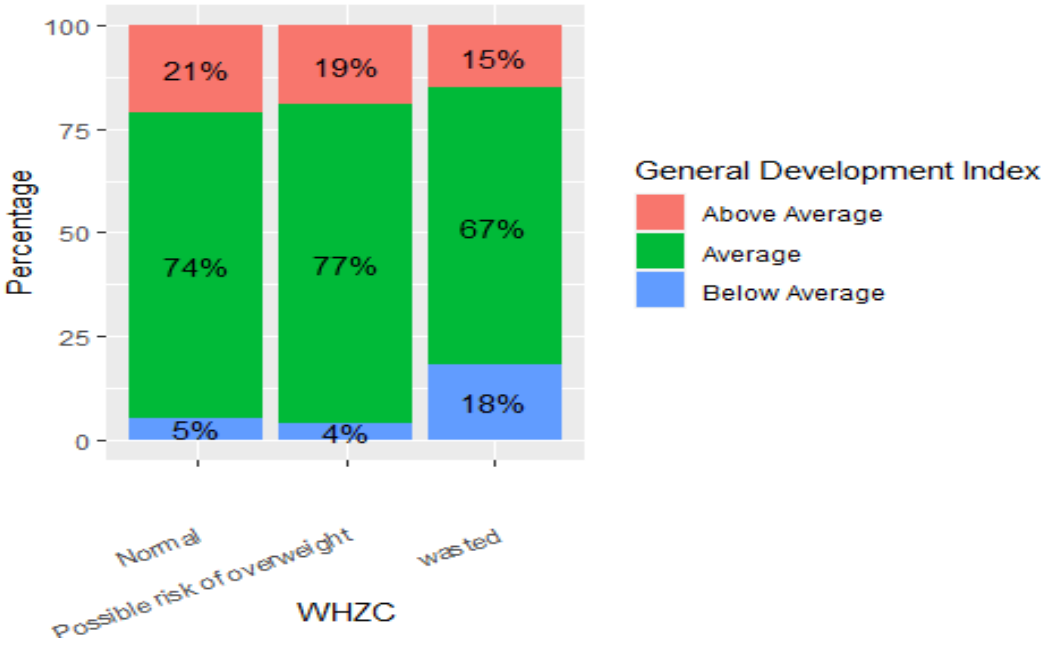

Figure 4.3 Weight-for-height vs. General Development Index

4.6.2 Relationship between dietary diversity score and child milestone development

The findings presented in Table 4.23 reveal a compelling relationship between dietary diversity scores and child milestone development in various domains. The statistical analysis indicates noteworthy correlations between dietary diversity scores and specific aspects of child development.

A significant correlation was observed between dietary diversity score and child cognitive development (p=0.00). This suggests that the diversity of their diet influences a child's cognitive development. Moreover, positive correlations were found between dietary diversity scores and various physical development domains, including physical gross motor (p=0.00), physical fine motor (p=0.01), and overall physical development (p=0.00). These findings indicate that a more diverse diet is associated with better physical development. The General Development Index also demonstrated a statistically significant correlation with dietary diversity scores (p=0.00), highlighting the overall impact of dietary diversity on a child's development. To visually represent these relationships, figures were created for DDS and domains with correlations. These figures illustrate the nature of the association between food group scores and milestone development. Specifically, Figures 4.4 to 4.8 break down the percentage of children falling into different developmental categories (very poor, poor, below-average, average, above average, and superior) within each food group score category.

The general finding drawn from these results is that higher dietary diversity scores are linked to superior milestone development scores. For instance, Figure 4.4 highlights that only 3% of children with poor dietary diversity scores and just 4% of those with medium diversity scores achieved superior cognitive development. In contrast, approximately 25% of children with high dietary diversity scores demonstrated superior cognitive development. Moreover, the percentage of children with below-average cognitive development decreased from 11% for those with low dietary diversity scores to 0% for those with high dietary diversity scores. This pattern of results is consistent across multiple domains, including physical gross motor, physical fine motor, physical development, and the general development index (as shown in Figures 4.5, 4.6, 4.7, and 4.8). In all these cases, a higher dietary diversity score corresponds to a lower percentage of children performing poorly or below average in their developmental milestones. However, it's important to note that no associations were observed between the dietary diversity score and the level of development in receptive communication, expressive communication, communication development, social-emotional, and adaptative behaviour development. These findings emphasise the critical role of dietary diversity in child development, particularly in cognitive and physical domains, underscoring the importance of a well-balanced and diverse diet for optimal developmental outcomes.

Table 4.23 Correlation between dietary diversity score and child milestone development

Developmental domain	Çhi-square	d.f	p-value
Cognitive development	26.13	6	0.0002106
Receptive communication	1.5495	4	0.8178
Expressive Communication	4.9153	4	0.2961
Communication development	1.5358	4	0.8203
Social-emotional	6.982	4	0.1368
Physical gross motor	19.978	4	0.0005045
Physical Fine motor	15.252	6	0.01839
Physical development	34.873	4	0.0000004933
Adaptative Behaviour	5.575	4	0.2332
General Development Index	31.953	6	0.00001666

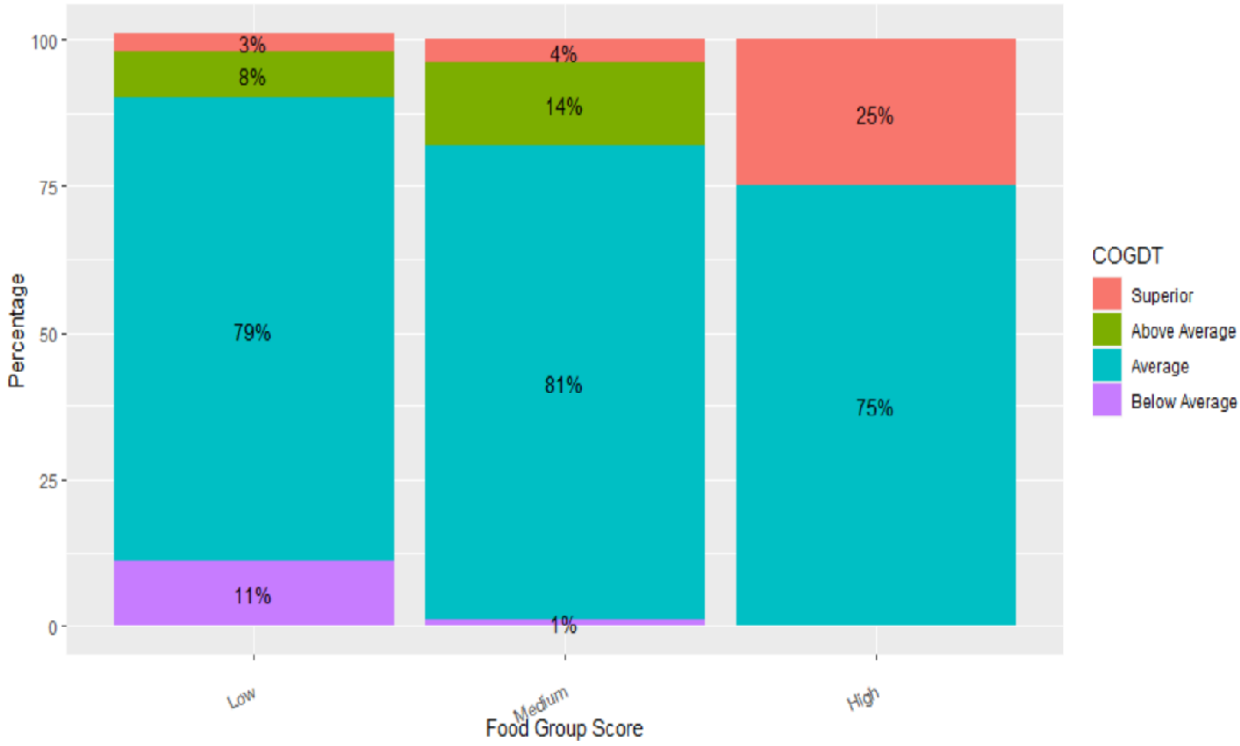

Figure 4.4 Cognitive development vs. dietary diversity score

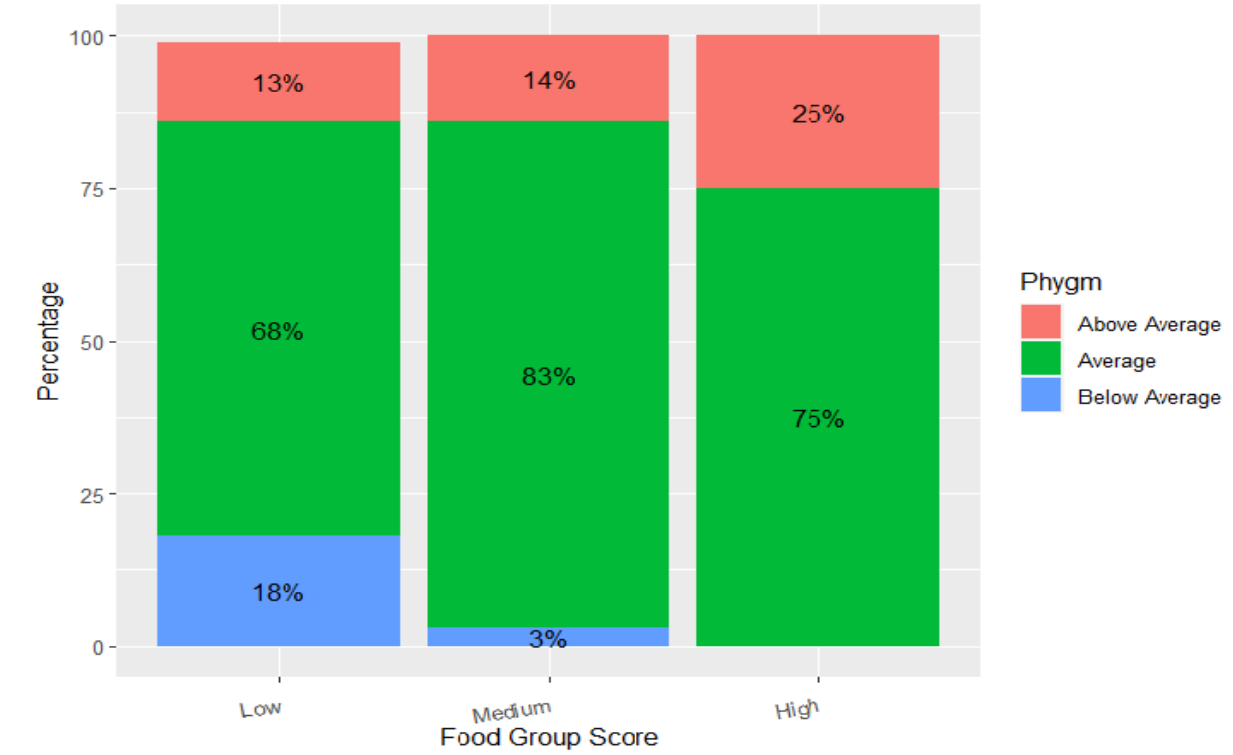

Figure 4.5 Physical gross motor vs. dietary diversity score

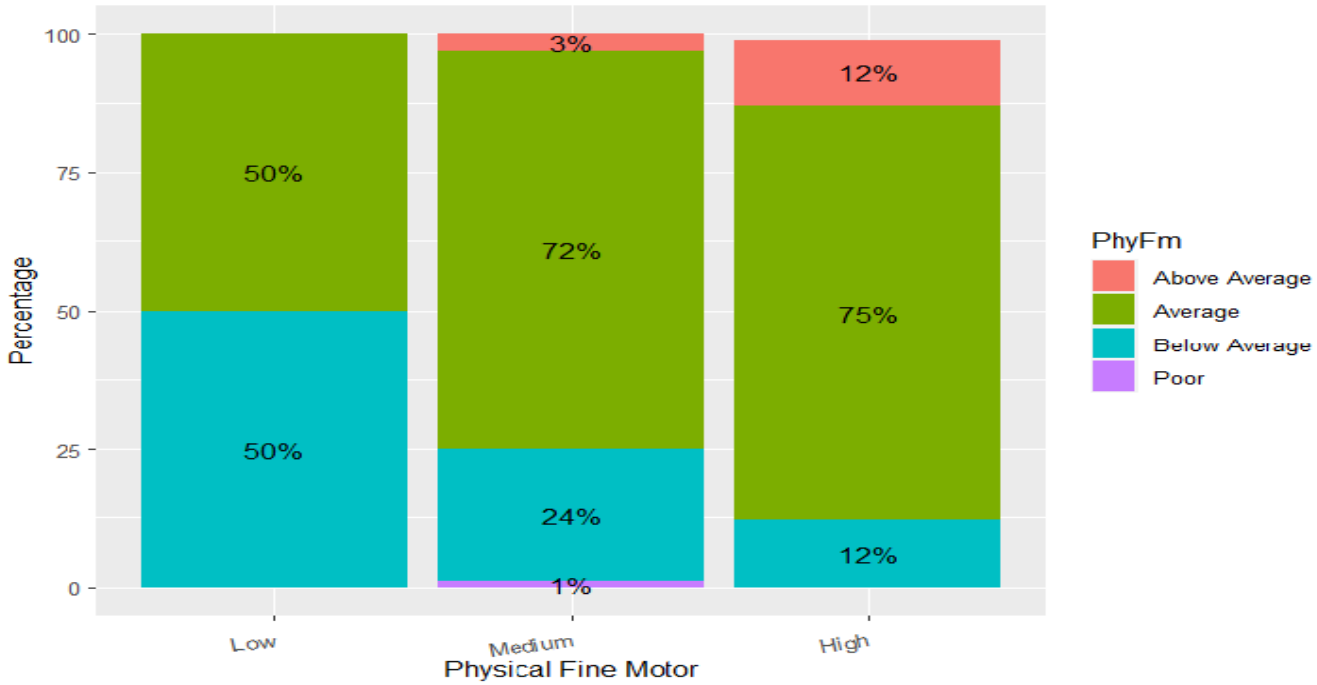

Figure 4.6 Physical fine motor vs. dietary diversity score

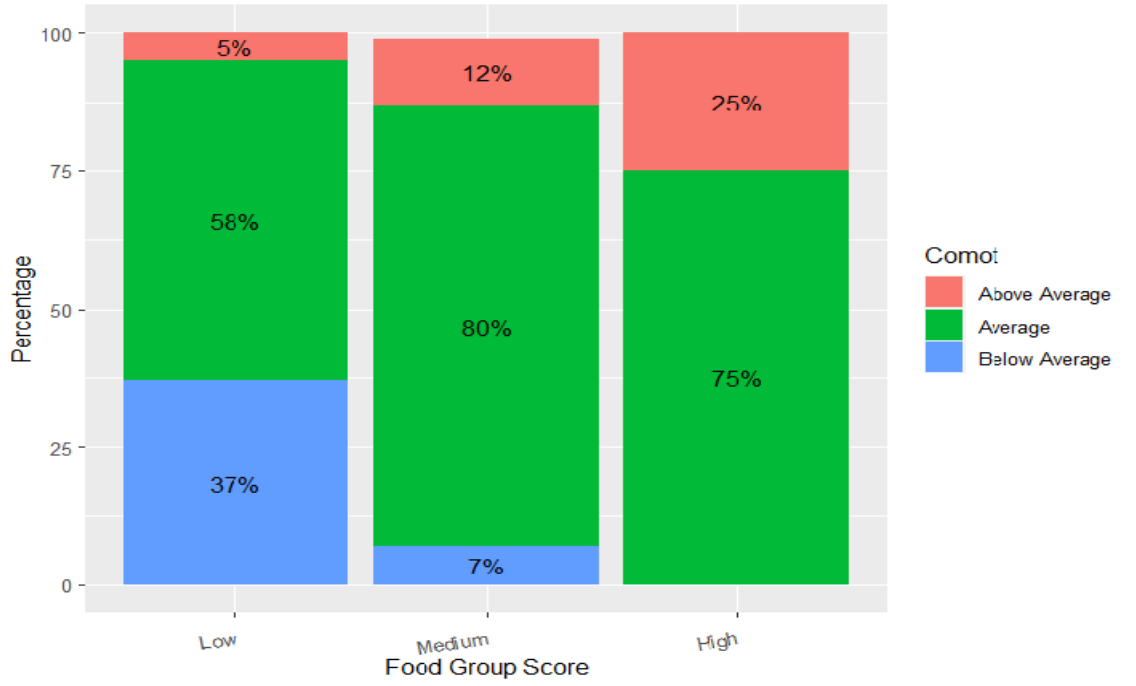

Figure 4.7 Physical development vs. dietary diversity score

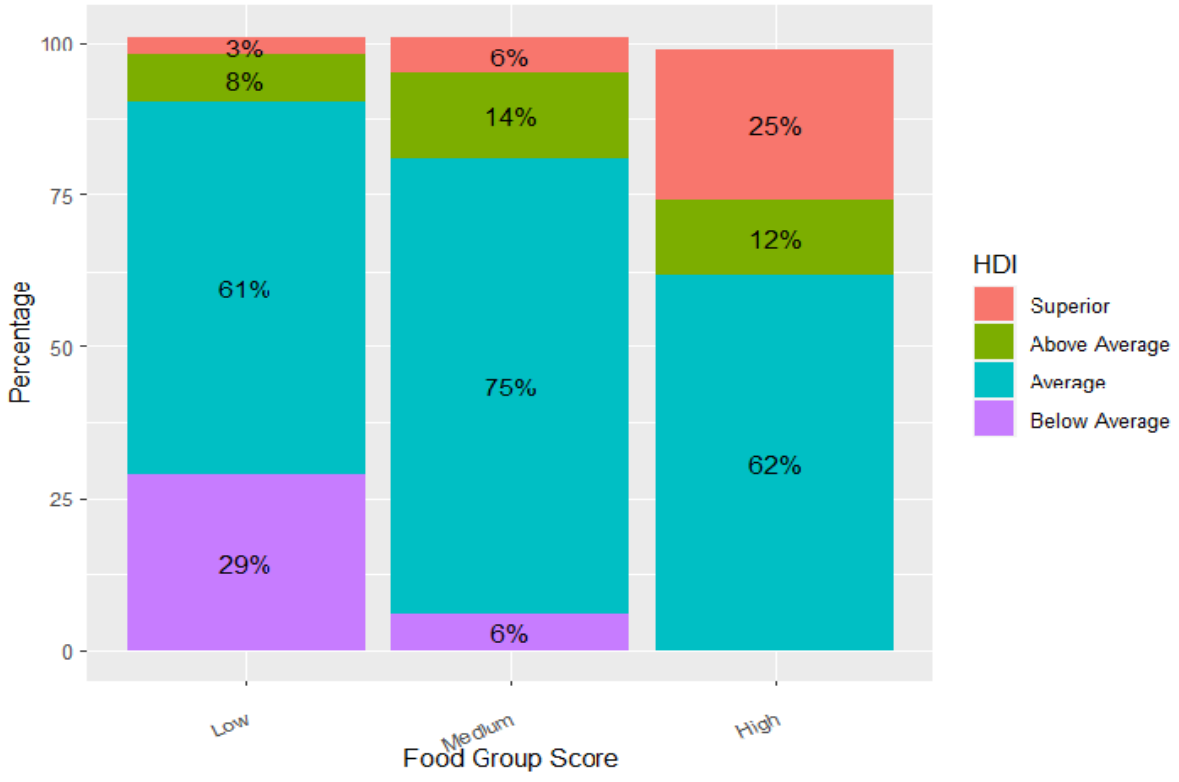

Figure 4.8 General Development Index vs. dietary diversity score

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 Introduction

The research on the nutritional status and developmental milestones of three to five-year-olds attending Early Childhood Development (ECD) centres in Chief Albert Luthuli Municipality is covered in this chapter. The study first described the study participants' socio-demographic characteristics, nutritional assessment, anthropometric measurements, and developmental milestones to attain this goal. The observations on the relationship between the dietary diversity score and a child's developmental milestones are also presented. Whenever possible, the results will be contrasted with those of other studies.

5.2 Socio-demographic Characteristics of the Participants

According to the current study, most participants were 48 to 59 months (4 years), while 31.2% were between 36 and 47 months (3 years). This observation aligns with previous research conducted by Kang et al. (2018) in Pakistan, where children aged 36 to 47 months were involved, and the current study's comparable age group of 48 to 59 months accounted for 48.4%. Similarly, Modjadji, Molokwane, and Ukegbu (2020) noted the participation of children aged three to five years in a North-West provincial study, with a predominant age group of 48 to 59 months. Additionally, consistent with the current study, girls comprised 52% of the participants. This finding resonates with the work of Munthali, Mvula, and Silo (2014) in Malawi, who reported a higher enrolment of girls than boys in community-based childcare centres (CBCCs) among children aged 3-5 years. Similar trends in age and gender distribution were observed by Sacolo-Gwebu, Chimbari, and Kalinda (2019) in rural KwaZulu-Natal, where a majority of children attending Early Childhood Development (ECD) centres were aged 3-5 years, with females constituting the majority. These consistent findings across studies suggest a prevailing pattern wherein most children attending ECD centres are aged 3-5 years, with females outnumbering males.

The current study reveals that the age distribution of participating mothers was mainly below the age of 30, with a notable proportion falling between 26 and 30 years (28.9%), while a significant portion was below 25 years (28.6%). This pattern mirrors a study conducted in the North West, where the mean maternal age was 31 ± 7 years, with 25% of mothers aged less than 25 years (Modjadji, Molokwane, & Ukegbu, 2020). Consistent with national trends, the South African Demographic and Health Survey (SADHS) of 2016 and Modjadji, Molokwane, and Ukegbu (2020) reported that around a third of mothers were under 25. Specifically, the SADHS (2016) noted that 33% of women were aged between 15 and 24 years, 33% were

between 25 and 34, and 34% were between 35 and 49 years old (NDoHSA, 2019). These findings suggest a consistent trend across studies, indicating that a significant proportion of mothers of preschool children in South Africa are below 35 years old. Furthermore, in line with the SADHS (2016) report, the current study observed that most mothers were single, with only a small fraction living with their partners. Specifically, two-thirds of mothers were single, 21.2% were married, and 10.5% lived with a partner. Similarly, Modjadji, Molokwane, and Ukegbu (2020) reported a high percentage (80%) of single marital status among mothers in the North-West Province. These consistent findings underscore the prevalence of single motherhood among participants in studies focusing on preschool children in South Africa.

In many African countries, including South Africa, access to education remains a significant challenge (Stober, 2019). While efforts have been made to improve access to primary education, secondary and tertiary education may still be limited in many areas (Du Plessis and Mestry, 2019). The results of the current study revealed that 71.7% of mothers had completed grade 12. This contrasts with findings from Nesamvuni (2014), where only 36.4% of mothers had completed grade 12, and the South African Demographic and Health Survey (SADHS) of 2016, which found that 28% of women had completed secondary school (NDoHSA, 2019). Additionally, the South African National Health and Nutrition Examination Survey (SANHANES-1) of 2012 reported that 20.2% had completed matric and 32.8% had completed high school (Shisana et al., 2014). The study results further indicate that 10.2% of mothers had tertiary education, 1.4% had primary education, and 0.6% had no schooling. These findings are consistent with the SADHS (2016), which reported that 12% of mothers had completed tertiary education, with 2% having no formal education (NDoHSA, 2019). Conversely, South African researchers reported a high proportion of mothers who had completed primary school (33.6%) and were illiterate (6%). However, 7.5% had completed tertiary education, which aligns with the present findings (Shisana et al., 2014). In a study conducted in Limpopo Province among 3 to 5 years old children, Nesamvuni (2014) documented different findings, where 17.6% of mothers had completed primary school, and 11% had no schooling, which is relatively consistent with the current study's results on tertiary education (6.3%).

The current study echoes findings from various reports indicating a significant role of women in household economic activity despite men being more likely to be employed (NDoHSA, 2019). Similarly, the present results highlight that the majority of primary breadwinners were mothers (40.5%), surpassing fathers (27.8%) and households where both parents contributed (10.5%). This trend aligns with Mundy's (2013) observation that women increasingly become family primary earners. Occupation-wise, the study reveals that a considerable proportion of

breadwinners were engaged in sales and services (35%), skilled manual work (22%), and unskilled manual jobs (16%), with domestic services and the agricultural sector representing smaller percentages (10% each). These findings are comparable to those reported by NDoHSA (2019), which documented various occupations among employed individuals, with sales and services, skilled manual work, and unskilled manual jobs being prevalent. Notably, domestic and agricultural workers constituted smaller proportions, consistent with the current study's findings. Despite differences in sample demographics, such as age range and inclusion of grandparents as breadwinners, the present study's results remain consistent with broader literature regarding household breadwinners, indicating the relevance and generalizability of these findings.

The findings of the current survey underscore a high prevalence of social grant recipients among participants, with 95.5% receiving some form of social assistance. Specifically, 93.5% of recipients received a child grant, 5.9% received an old-age pension grant, and a small percentage (0.6%) received a disability grant. This aligns with observations made by Fanta et al. (2017) in South Africa, where most grant beneficiaries were registered for child support grants out of 17 million recipients. Similarly, the South African Demographic and Health Survey (NDoHSA, 2019) identified child support grants as the most common grant type. Moreover, the current study revealed that 99.4% of children were social grant recipients, consistent with findings from previous research by Fanta et al. (2017) and NDoHSA (2019), highlighting the prevalence of child support grants in South Africa.

Regarding household income, most households in the present study reported incomes ranging from R4001 to R7000 (29.5%), with 8.2% surviving on incomes below R2000. This mirrors findings from a study in the North-West Province by Modjadji, Molokwane, and Ukegbu (2020), where a substantial proportion (70%) of households lived on monthly incomes of less than R5000. A similar trend was observed in Limpopo Province, where Nesamvuni (2014) found that 20.6% of households had monthly incomes above R3000. These consistent findings highlight the prevalence of social grant reliance and low household incomes among participants, underscoring the socio-economic challenges many households in South Africa face.

5.2.1 Household characteristics

The current study reveals that a majority of households (53%) owned livestock, with chickens being the most common type of livestock (98%), followed by cattle (14%) and sheep (1.1%). This contrasts with findings from Nesamvuni (2014), which reported a lower prevalence of livestock ownership among households at 30.2%. A study by Mushaphi (2011) with experimental and control groups found that chickens were the predominant livestock in most households (E= 44.6%; C=43.3%). Meanwhile, goats and cattle were also commonly kept at varying frequencies between the groups. Regarding land use for food production, approximately 63% of households in the current study had land available, with the majority (94.2%) using it for vegetable garden production and a smaller proportion (30.4%) for fruit garden production. Surprisingly, only 6.3% of households utilized the available land for subsistence farming. This aligns with Nesamvuni's (2014) findings, where a high percentage (98.8%) of households engaged in home gardening, while a smaller proportion (41.8%) practised subsistence cultivation. Similarly, Mkhawani et al. (2016) noted that approximately 50% of households in the Mopani District had land for subsistence food production, indicating variability in land use patterns among different regions and populations.

The South African Demographic and Health Survey (SADHS) of 2016 highlighted that 8% of households relied on river water or unimproved water sources for household activities (NDoHSA, 2019). Similarly, in a study by Mushaphi (2011), nearly a third of households (E=32.3%; C=31.7%) used river water for household activities. However, there appears to be a declining trend over the years, as the current study observed a lower proportion (2.5%) of households using river water for activities like drinking and cooking. Instead, most households (84%) in the present study accessed improved water sources, primarily from home taps, with smaller percentages relying on communal taps (11%) and borehole water (1.4%). This trend aligns with national data, as NDoHSA (2019) reported, which indicated that approximately 78% of South African households had tap water on their premises, while 14% relied on communal taps and 3% used borehole pumps. However, contrary to these findings, Edokpayi et al. (2018) and Mushaphi (2011) reported communal tap water as the most used source for household activities, highlighting discrepancies in water source utilization across different studies and populations.

In the current study, a substantial majority of households (85.3%) resided in brick houses, traditional dwellings, or modern townhouses, echoing findings from the South African Demographic and Health Survey (SADHS) of 2016, where 79.5% of families lived in brick and cement houses, 7% in traditional houses, and 12.8% in informal residences. However, a

notable disparity was observed in the North-West Province, where approximately 64% of respondents lived in non-brick houses (Modjadji, Molokwane, and Ukegbu, 2020). Despite recommendations for garbage disposal sites to be located outside residential areas to mitigate pest and disease proliferation (Suleman, Darko, and Agyemang-Duah, 2015), only a small proportion (5.9%) of households in the current study had access to municipal aid for weekly garbage removal. Nevertheless, most households demonstrated interest in sanitation and hygiene, utilising their refuse dumps (85.3%) or communal dumping sites, albeit a few had no rubbish disposal facility (0.6%). Conversely, national data from NDoHSA (2019) revealed that 57% of South African households had their refuse removed weekly, while 11% had their refuse dumps, and 20% resorted to burning their refuse. Similarly, a study in North Sumatra reported that 98.2% of households had their garbage removed weekly, with only 0.5% lacking any rubbish disposal facility (Niawaroh & Santosa, 2018), mirroring the 0.6% figure from the present study. Despite a national decline in households without proper toilet facilities from 12.3% to 4.9% between 2002 and 2016, the current study revealed that 83% of households still utilized pit toilets, with only 16% having flush toilets. This contrasts with reports from 2016 indicating improved use of toilet facilities (62.3%) (Hemson, 2016), suggesting disparities in sanitation infrastructure across different regions and populations.

Recent studies in South Africa consistently highlight electricity as the primary source of energy for cooking, with 90% of households, according to the South African Demographic and Health Survey (NDoHSA, 2019), and 89% according to Modjadji, Molokwane, and Ukegbu (2020). The present study aligns with this trend, reporting that 94% of households utilise electricity for cooking. Additionally, wood emerges as another commonly used energy source for cooking, with 62% of households relying on it, alongside coal, gas, and paraffin. This reliance on wood for cooking is also evident in Limpopo Province, where Mushaphi (2011) found that over 90% of households used firewood as their primary cooking fuel. Similarly, a study conducted across 52 developing countries revealed a high prevalence of wood usage for cooking, particularly in Eswatini, where 62% of households relied on wood compared to 27% using electricity. This contrasts with trends observed in Vietnam, where about 55% of households use gas for cooking, and Cameroon, where 16% utilize gas (Kojima, 2021). These findings underscore the diverse energy consumption patterns for cooking across different regions and countries, influenced by factors such as access to infrastructure, availability of energy sources, and socio-economic conditions.

The dissemination of nutrition information to mothers is crucial for fostering healthy dietary behaviours and choices in children as they grow (Perera et al., 2015). In the current survey, all caregivers expressed trust in healthcare workers as their primary source of nutrition

information, with additional utilisation of electronic media (43.1%), mom-connect, social media (16.7%), and periodicals. This preference for healthcare workers aligns with findings from Skeens et al. (2016), where 80% of mothers with infants preferred healthcare workers as their source of child health information. Similarly, Australian researchers found that verbal communication from healthcare professionals was the most trusted source (69%) among mothers, with some supplementing this information using internet/social media networks (15.3%) to make it relevant to their lives (Lobo et al., 2020). Furthermore, in the Accra Region of Ghana, healthcare workers (92.7%) and electronic media (58.3%) were identified as the most popular sources of nutrition information (Quaidoo, Ohemeng, and Amankwah-Poku, 2018). These findings underscore the consistency across literature, indicating that healthcare workers are mothers' preferred and trusted sources of nutrition information, followed by electronic media, reinforcing the importance of effective communication channels in promoting healthy dietary practices among caregivers.

5.3 Dietary assessment

In this section, the findings of the frequency of meal consumption, types of food commonly consumed by children, and dietary diversity food groups and dietary scores will be discussed and compared with other studies.

5.3.1 Frequency of meal consumption

The World Health Organization (WHO) recommends that children ideally should be given at least five meals a day (Sunguya et al., 2014). However, the current study deviates from this recommendation, as almost all children (96.9%) were fed more than three times daily, with only 3.1% receiving two meals daily. This contrasts with findings from Mushaphi (2011), where 41% of children from the experimental group and 34% from the control group were given meals more than three times daily. Similarly, a study by Litterbach, Campbell, and Spence (2017) found that 82% of Australian preschool-aged children were given three meals a day and a snack, which does not align with the WHO recommendation. Brazilian researchers also observed a deviation from typical vegetable consumption patterns, with children consuming vegetables between one to four times a week (Mello, Barros & Morais, 2016). However, in line with the current findings, 34.6% of children in the present study consumed vegetables daily, while 48.7% consumed them 3 to 5 times per week. Furthermore, the report by Soldateli, Vigo & Giugliani (2016) found that 45% of preschool children consumed vegetables five or more times a week, consistent with the present study's findings. These discrepancies underscore variations in feeding practices and dietary habits among children across different populations

and regions, emphasising the importance of promoting nutritionally adequate meal frequencies and vegetable consumption in early childhood.

Guideline 10 of the South African Paediatric Food-Based Dietary Guidelines (SA-PFBDGs) emphasises the importance of providing children with milk, maas, or yoghurt every day (Vorster, Badham &Venter, 2013; Strydom, Du Plessis, and Daniels, 2021). However, the current study's findings reveal a deviation from this guideline, as almost all children (99.4%) were given milk, with only 50% receiving it daily. This contrasts with findings from Mello, Barros, and Morais (2016), which confirmed milk as the most consumed food by Brazilian preschool children, with 76.9% consuming it daily. Moreover, a survey conducted in low- and middle-income countries demonstrated that milk consumption among children aged 6 to 59 months was associated with improved weight-for-age and height-for-age z-scores and reduced probabilities of being underweight or stunted (Herber et al., 2020). These findings emphasise the importance of aligning child feeding practices with Guideline 10 of the SA-PFBDGs to ensure optimal nutrition and growth outcomes. Therefore, efforts should be made to promote daily milk consumption among children in adherence to the SA-PFBDGs.

In this study, more than half of the children (57.8%) were found to consume unhealthy snacks daily, with 38.8% consuming them 3 to 5 times per week. Unhealthy snacks in this context refer to sugary drinks, sugary snacks, and salty snacks, as defined by the South African Demographic and Health Survey (SADHS, 2016). This trend mirrors findings from South African researchers in the uThungulu District of KwaZulu-Natal Province, where a high daily consumption rate (87%) of unhealthy snacks was reported among preschool children (Zungu et al., 2020). However, these results contrast with data from Brazilian preschoolers, where over 70% consumed unhealthy snacks at least once a week (Mello, Barros& Morais, 2016).

On the other hand, the South African Paediatric Food-Based Dietary Guidelines (SA-PFBDGs) recommend daily consumption of fruits (Strydom, Du Plessis & Daniels, 2021). In the current study, 61.2% of children consumed fruits daily, with an additional 37.1% consuming them 3 to 5 times per week. These findings align with similar studies conducted in the North-West Province, where over 50% of preschool children consumed fruits daily (Modjadji, Molokwane & Ukegbu, 2020). Additionally, Andrusaityte, Grazuleviciene, and Petraviciene (2017) found that 83.3% of children were consuming fresh fruits at least three times per week. Therefore, the results of the current study regarding the consumption of certain foods are consistent with findings from other literature, indicating the prevalence of unhealthy snacks alongside regular consumption of fruits among preschool children in various regions.

5.3.2 Types of food commonly consumed by children.

The findings of a repeated cross-sectional study conducted in the KwaZulu-Natal Province among children aged 2 to 5 years old revealed that the consumption of dark-green leafy vegetables significantly contributed to the total nutrient intake of children, including essential micronutrients such as calcium, iron, vitamin A, and riboflavin (Faber, Van Jaarsveld & Laubscher, 2007). Notably, spinach, *tinstanga* (pumpkin leaves), *mabhontjisi* (beans), *likhabishi* (cabbage), lettuce, *ligusha* (okra), *injujela* (tomatoes), and sweet potato emerged as the most consumed vegetables in the current study, with high-consumption rates ranging from 91.2% to 100%.

These findings resonate with previous studies conducted in KwaZulu-Natal Province, where cabbage, pumpkin, and spinach were identified as the most regularly consumed vegetables, often cultivated in household gardens (Faber, Laubscher & Laurie, 2013). Additionally, research from the Eastern Cape Province highlighted cabbage, spinach, potatoes, and carrots as commonly consumed vegetables (Chakona, 2020). Similarly, findings from Limpopo Province by Mushaphi et al. (2017) indicated high consumption rates among children of *ligusha* (okra), beans, and pumpkin leaves.

Aligning with Guideline 54 of the proposed South African Paediatric Food-Based Dietary Guidelines (SA-PFBDGs) (Strydom, Du Plessis, and Daniels, 2021), which emphasizes the importance of vegetables as significant sources of vitamins and minerals crucial for children's growth and development, these studies underscore the nutritional value and importance of incorporating diverse vegetables into children's diets. Thus, promoting the consumption of dark-green leafy vegetables can be pivotal in addressing nutrient deficiencies and supporting optimal growth and development among young children.

Milk and dairy products are widely recognised for their nutritional value, providing children with essential energy, proteins, micronutrients, macronutrients, calcium, and the growth-promoting insulin-like growth factor-1 (Herber et al., 2020). Our current study observed that all children (100%) were provided with yoghurt, indicating the widespread inclusion of dairy products in their diets. Among the milk and dairy products consumed, fresh milk (99.1%), *emasi* (a traditional fermented milk product) (96%), and cheese (66.4%) emerged as the most commonly consumed items. These findings are consistent with previous research, such as the study conducted by Mello, Barros, and Morais (2016), which also identified fresh milk as the primary form of milk consumption (76.9%).

A notable trend observed in our study was the post-test increase in the consumption of milk (54.8%) and yoghurt (34.8%) in the experimental group, as documented by Mushaphi (2011). This shift suggests the potential efficacy of interventions or educational initiatives aimed at promoting the consumption of these dairy products among children. By encouraging the intake of milk and dairy products, caregivers and health professionals can improve children's overall nutritional intake and promote healthy growth and development. Furthermore, the observed increase in yoghurt consumption among children aged 2 to 5 years (46.9%) in our study mirrors the findings of a study by Vatanparast et al. (2019) across five age groups, indicating the consistent popularity of yoghurt across different age ranges. These consistent findings underscore the significance of fresh milk and yoghurt in children's diets as valuable sources of nutrition.

The current study noted that unhealthy snacks like sweets were consumed by a substantial proportion of participants (94.5%), with soft drinks also being quite common (97.2%). While there were some percentage differences, recent research in South Africa reveals a consistent pattern regarding the consumption of unhealthy snacks. For example, a recent survey in South Africa found that soft drinks (40.5%), fried foods (39.4%), salty snacks (39.4%), and sweets (37.8%) were commonly consumed types of snacks among preschoolers (Bortolini, Gubert, and Santos, 2012). Moreover, a study by Zungu et al. (2020) reported that savoury snacks were consumed by 73% of participants, and 43% consumed sugary snacks, further emphasizing the prevalent consumption of unhealthy snacks in our study population. These findings highlight the importance of promoting healthier snack options and limiting the intake of unhealthy snacks among young children to support their overall health and well-being.

Data from the South African Demographic and Health Survey (SADHS) in 2016 provided insights into children's dietary habits in South Africa, revealing that 18% consumed sugary drinks, 35% consumed sugary foods, and 44% consumed salty snacks. These statistics further confirm the widespread consumption of unhealthy snacks among children in the country. Additionally, during the field-testing of the revised South African Paediatric Food-Based Dietary Guidelines (SA-PFBDGs) among caregivers of children aged 3 to 5 years in the Western Cape Province, caregivers frequently reported providing their children with cool drinks, juice, sweets, and even money, which the children used to purchase sweets (Strydom, Du Plessis, and Daniels, 2021). This underscores the continued prevalence of unhealthy snacks and drinks in the diet of South African children, highlighting the need for ongoing efforts to promote healthier dietary choices and reduce the consumption of these less nutritious options to improve the overall health and well-being of children in the country.

In the current study, it was observed that all children had access to bananas and apples, while a variety of other fruits were also provided, including oranges (98.9%), avocados (96.6%), guava (94.3%), pears (90.1%), and *magumence* (blackberry) (60.9%). These findings are consistent with other studies conducted in South Africa, indicating a commonality in fruit consumption patterns. For example, a study on food consumption changes in South Africa by Ronquest-Ross, Vink, and Sigge (2015) identified commonly consumed fruits such as bananas, apples, oranges, pears, and grapes, aligning with our observations in the present study. Furthermore, an experimental and control group design study conducted in the Limpopo Province by Mushaphi et al. (2017) indicated that all children (100%) were typically given guavas, highlighting the significance of guavas in the diet of South African children.

Though there are slight variations, researchers from KwaZulu Natal Province, as reported by Faber, Laubscher, and Laurie (2013), noted that commonly consumed fruits included avocados (66%), bananas (61%), papaya (56%), and guava (29%). These differences could be attributed to regional preferences and availability. Additionally, our study documented the consumption of Indigenous fruits, such as *mantulwa* (17.8%), *manumbela* (17.3%), and *tincozi* (21.2%), among the least provided fruits. However, it is worth noting that in contrast to our findings, Mushaphi et al. (2017) reported a higher consumption of indigenous fruits, with *manumbela* being consumed by over 72% in both control and experimental groups. This discrepancy might reflect regional disparities and cultural preferences. Providing diverse fruits in children's diets reflects efforts to promote nutritional diversity and support their overall health and well-being.

5.3.3 Dietary diversity

In a study examining dietary diversity across multiple visits, it becomes evident that food consumption patterns vary across different food groups and over time (Kearney, 2010). This current study comprehensively understands these dietary shifts and their implications for public health and nutrition interventions.

Starchy staples, meat and fish, and milk products emerged as the most consumed food groups across all visits, indicating their significant presence in the diets of the surveyed population. This aligns with previous research findings from an exploratory analysis of meal composition that starchy staples, meat/poultry/fish, and dairy were the most consumed food groups among preschool-aged children (Sui, Raubenheimer & Rangan, 2017). This underscores the staple nature of these food groups for this population as the present findings are consistent with a study on dietary diversity and nutritional status of preschool children conducted in North West Province (Modjadji, Molokwane, & Ukegbu, 2020). In contrast, consuming dark green leafy

vegetables, vitamin A-rich fruits and vegetables, and organ meat demonstrated a decreasing trend across the visits. These findings suggest potential dietary transitions away from these nutrient-dense food groups, which may affect overall nutrition and health (Mensah et al., 2021). However, the available literature suggests that the consumption of food groups varies from region to region based on socio-economic access, availability, and season. For instance, a study by Kebede et al. (2022) in sub-Saharan Africa documented that vitamin A-rich fruits and vegetables were among the most consumed in rural areas primarily due to consistent subsistence farming practices, while meat and dairy foods were prevalent in urban settings. Therefore, it is worth noting that there is a need to promote adequate intake of animal and plant-based vitamin A food groups across the population to prevent nutrition implications coming with poor intake.

5.3.3.1 Dietary Diversity Scores

The current study revealed fluctuations in dietary diversity across the three visits, indicating potential changes in participants' dietary habits over time. While the second visit showed a slight decrease in diversity, the dietary diversity score rebounded significantly by the third visit, surpassing even the initial level of diversity observed during the first visit. These findings underscore the dynamic nature of dietary patterns among the study population, with potential implications for nutritional status and health outcomes.

Notably, more than half of the children in our study exhibited a low dietary diversity score, according to the Food and Agriculture Organization scoring system for children (Motadi et al., 2023). This aligns with findings from another study among preschool children in the North West Province, which reported a Mean Dietary Diversity Score (DDS) of 4.39 ± 1.55 out of 12 food groups, with a prevalence of 61% and 39% for low and medium DDS, respectively. These results suggest a prevalent issue of inadequate dietary diversity among children in the region, which can harm their nutritional status.

Comparisons with studies conducted in other regions further highlight the significance of our findings. For instance, in a study conducted by Traoré in Côte d'Ivoire, it was noted that most children (60%) had a medium dietary diversity score (DDS), which differs from the current study's findings. These disparities could be attributed to variations in dietary patterns, cultural practices, and socio-economic factors across different populations. Nonetheless, the common thread across these studies is the association between dietary diversity and nutritional status, emphasizing the importance of promoting diverse and nutritious diets among children to mitigate the risk of malnutrition and associated health complications. It is crucial for public

health initiatives to address potential shifts in dietary habits and access to nutritious foods to ensure a well-balanced diet (Browne, 2021). Targeted efforts may be needed to promote the consumption of nutrient-rich foods, especially those on the decline (Troesch et al., 2015). Thus, the current study's findings shed light on the dynamic nature of dietary diversity and food group consumption over time. Such insights are vital for designing effective strategies to improve the nutritional status and health of the population under study.

5.4 Anthropometric measurements

5.4.1 Descriptive statistics for anthropometric measures

In this study, children had a mean WHZ score of -0.26(1.25SD), a mean HAZ score of 0(1.23SD), a mean WAZ score of -0.16(1.03SD), a mean BAZ z-score of -0.21(1.28SD), and a mean MUACZ of 0.06 (0.85SD). Similar findings were reported in a study on nutritional and developmental status among preschool children in southwestern Uganda where the mean SD of WAZ, HAZ, and WHZ was -0.67(1.1SD), 1.14(1.2SD), and -0.13(1.2SD), respectively (Muhoozi et al., 2016). This means most children were normal for all indicators, comparable to the present study.

5.4.2 Height for age (Stunting)

Most children in the current study were classified as normal for the Height-for-Age (HAZ) indicator according to the WHO (2009) z-score classification, while 17.9% were found to be stunted (-1 to <-3SD). These findings align with similar studies conducted in South Africa, indicating a prevalence of stunting below 20% according to the WHO (1995) severity of malnutrition classification. For instance, Symington et al. (2016) reported a stunting prevalence of 18.2% in Mpumalanga Province, while Motadi et al. (2015) found a prevalence of 18.6% among preschool children aged 3 to 5 years in the Vhembe district. These figures are consistent with a review study on factors associated with the nutritional status of children under five years of age from 2010 to 2019, which revealed stunting prevalence ranging from 11.88% in Gauteng Province to 16.83% in North-West Province (Mkhize and Sibanda, 2020).

Furthermore, the current study noted a higher prevalence of stunting in males (21%) compared to females (15%). This observation is supported by previous research in South Africa, where studies by Makanjana and Naicker (2021) and Modjadji and Madiba (2019a) also found stunting to be more prevalent in boys than girls, with percentages ranging from 14% to 20% for girls and 15% to 25% for boys across different studies. These findings suggest a consistent pattern of gender-based disparities in stunting prevalence among children in South Africa, highlighting the need for targeted interventions to address this issue.

5.4.3 Weight for age (Underweight)

The prevalence of underweight among preschool-aged children in the present study was found to be 19.9%, and it was classified as medium (10-19%) according to the WHO (1995) classifications for the assessment of malnutrition. This finding is consistent with the prevalence of underweight among preschool learners reported in other studies conducted in South Africa, which ranged from low to very high. For instance, in the North West Province, Modjadji, Molokwane, and Ukegbu (2020) found a medium prevalence of underweight (13%) among preschool learners, while Otitoola, Oldewage-Theron, and Egal (2021) reported a low prevalence of underweight (5.6%) in the Eastern Cape Province. Conversely, studies conducted in Limpopo Province revealed varying prevalence rates of underweight, with Motadi et al. (2015) reporting a very low prevalence of 0.3%, while Mkhize and Sibanda (2020) found a very high prevalence of 69.90%.

Gender differences in the prevalence of underweight were observed in the current study, with a higher prevalence among males (21.7%) compared to females (18.1%). This finding is consistent with some studies, such as Modjadji and Madiba (2019a), which found a higher prevalence of underweight among boys (28%) compared to girls (27%). However, there are conflicting findings in other studies, such as Otitoola, Oldewage-Theron, and Egal (2021), who reported a higher prevalence of underweight among males (2%) compared to females (1.8%) in the Eastern Cape Province. While there is variation in the prevalence of underweight among preschool-aged children in South Africa, the present study adds to the body of evidence highlighting the importance of addressing this issue to improve the health and well-being of children in the country.

5.4.4 Weight for height (Wasting)

The prevalence of wasting, a condition characterized by low weight for height, was found to be 7.1% in the present study, falling within the medium (5-9%) classification according to the WHO classifications for the assessment of malnutrition. This prevalence is higher than some previous reports in South Africa, such as the low prevalence of 1.4% reported among Limpopo preschoolers by Motadi et al. (2015). However, it is lower than the very high prevalence of 22.2% reported in the Northern Cape Province by Mkhize and Sibanda (2020).

The observed prevalence of wasting in the present study is also higher than the national prevalence reported between 2008 and 2017, which declined from 5.2% to 3.8% nationally

(Sartorius et al., 2020). Additionally, the global prevalence of wasting reported by Ssentongo et al. (2021) was 6.3%, with a lower prevalence of 2.4% reported in South Africa.

Gender differences were observed in the prevalence of wasting, with a higher prevalence among girls (7.5%) than boys (6.6%) in the present study. This contrasts with the findings of the SANHANES-1 report, which found a higher prevalence of wasting among boys (4%) compared to girls (2.6%) in Mpumalanga Province (Shisana et al., 2014).

In contrast, the prevalence of overweight among preschool-aged children in the present study was 13.5%, with a higher prevalence among female children (14.4%) than male children (12.6%). These findings are consistent with previous studies conducted in South Africa, which have also reported a commonality in the prevalence of overweight among preschool-aged children, with some variations across different regions.

Overall, the findings highlight the coexistence of both wasting and overweight among preschool-aged children in South Africa, underscoring the importance of ongoing efforts to address malnutrition and promote healthy nutritional practices in this population.

5.4.5 Body mass index for age (Overweight and Wasting)

The present study found a prevalence of overweight of 1.1% and obesity of 0.8% among preschool-aged children based on the body mass index for age indicator. These findings are consistent with some previous studies conducted in South Africa, such as Nesamvuni (2014), which reported a prevalence of overweight of 1.2% and obesity of 0.9% among children aged 3 to 5 years in Limpopo. However, there are variations in the prevalence of overweight and obesity reported in different studies, as evidenced by the NW-CHILD study in the North-West Province, which reported higher prevalence rates of 12.7% overweight and 8.2% obesity at baseline in 2010 (Pienaar, 2015). Similarly, the study by Negash et al. (2017) reported higher combined prevalence rates of overweight (15.6%) and obesity (7.3%) among preschool children in South Africa.

The observed gender differences in overweight and obesity prevalence in the present study, with higher rates among males, are consistent with some previous studies but diverge from others. For instance, McKersie and Baard (2014) found higher rates of overweight and obesity among female children in Port Elizabeth. Similarly, the SANHANES-1 report showed higher prevalence rates of overweight and obesity among female children nationally and in Mpumalanga Province. These discrepancies underscore the need for tailored interventions to

address overweight and obesity among preschool-aged children, considering both gender-specific and regional factors.

Regarding wasting, the present study found a prevalence of 4.5%, with 2.5% classified as severely wasted. These findings are comparable to those of Nesamvuni (2014), who reported in Limpopo Province. However, there are differences in wasting prevalence reported in other studies, such as the SANHANES-1 report, which showed lower prevalence rates among male and female children nationally. The findings highlight the importance of monitoring and addressing nutritional disorders such as overweight, obesity, and wasting among preschool-aged children in South Africa through targeted interventions aimed at promoting healthy nutrition and lifestyle behaviours from an early age.

5.4.6 Mid-Upper Arm Circumference

The present study found a prevalence of moderate acute malnutrition (MAM) of 3.7% and severe acute malnutrition (SAM) of 2% based on mid-upper arm circumference (MUAC) cutoff points. These findings are consistent with previous studies, such as the study by Dukhi, Sartorius, and Taylor (2017), which reported an overall prevalence of 6.6% of wasting using similar MUAC cutoff points. Similarly, Mandla, Mackay, and Mda (2022) found a prevalence of 10.2% wasting in Port Elizabeth, Eastern Cape, using MUAC cutoffs for SAM.

However, differences in wasting prevalence have been reported in other studies using MUAC cutoff points. For instance, Steenkamp, Lategan, and Raubenheimer (2016) found a mean MUAC of 13.9cm in a study conducted in three South African provinces, with 29% moderately wasted and 5% severely wasted, but no significant difference was observed between genders. In Vietnam, Huong et al. (2014) reported a higher prevalence of severe wasting (7.0%) but no moderate wasting among children aged 6-59 months. Conversely, a study in Nepal by Lamsal et al. (2021) found lower prevalence rates of severe wasting (0.4%) and moderate wasting (2.7%) based on MUAC cutoffs. The prevalence of wasting based on MUAC cutoffs in the present study suggests a medium severity level, indicating the need for intervention measures to improve the nutritional status of children. However, the variation in prevalence rates across studies necessitates considering contextual factors and using standardized methodologies when interpreting and comparing findings related to wasting among children.

5.4.7 Child age when first MUAC was recorded

MUAC is a rapid screening tool to detect wasting in children aged 6–59 months (Lamsal et al., 2021). The current WHO guidelines for community screening for malnutrition recommend a MUAC of <115 mm to identify SAM. Very few children's MUAC assessments are done outside of six months, posing a risk of not determining children's susceptibility to malnutrition (Laillou et al., 2014). The present study's findings confirm that 30.6% of children's first MUAC was recorded when they were 18 months and older. Low MUAC is considered a proxy for low fat-free mass, which is necessary because accurate measurement of fat-free mass in children is usually impractical in both clinical and resource-poor settings (Reilly, 2017).

5.5 Milestone development

In a study investigating the milestone development of children, five developmental domains and the overall five developmental domains called the General Development Index (GDI) are examined (Voress & Maddox, 2013). The present study discusses the suspected developmental delays from all domains, a general developmental description of the population under study, and possible interventions.

5.5.1 Suspected Developmental Delays

Approximately 8% of the children in the study exhibited suspected developmental delays in their General Development Index (GDI). This is a significant finding as it underscores the importance of early identification and intervention for children facing developmental challenges. Identifying these delays early can enable targeted support and intervention strategies to help these children catch up with their peers. It has been reported that the survey on the estimated prevalence of disability and developmental delays among preschool children in rural Malawi documented a 10.2% prevalence of global development delays (GDD) among 2 to 4-year-olds (Murphy et al., 2020). Comparably, Egyptian investigators on the national prevalence and profile of single and multiple developmental delays among children attending early childhood centres recorded a 6.7% overall prevalence of developmental delays (Metwally et al., 2022). The prevalence of overall developmental delays determined by the current study is comparable with other literature. This is confirmed by Agarwal et al. (2018), who found that in India, the total prevalence of developmental delays was 12.2% for children aged birth to 59 months and 15.3% for children aged 24 to 59 months. Furthermore, Keyvanfar et al. (2021) discovered that 9% of preschool children in Tehran had developmental deficits in all five domains.

5.5.2 Low Incidence of "Very Poor" Development

This positive indicator suggests that the study population has not demonstrated extreme developmental deficits. It is reassuring that most children appear to function within a reasonable developmental range. The DAYC-2 manual indicates that entry points were determined by selecting the points at which typically developing children would likely succeed on the first few items. Therefore, numerous circumstances can cause a child's standard score to be very poor, such that children may exhibit delays in one domain or more areas of development. Possible conditions that can cause a child to score very poorly on the DAYC-2 include lack of opportunity to observe or practice various skills, neglect or abuse, poor nutrition, complications of pregnancy and birth, low intelligence, vision problems, hearing loss, exposure to harmful toxins, genetic causes, and various syndromes (e.g., foetal alcohol syndrome). To avoid incorrect measurements, the current study criteria of participation excluded children who were sick, living with a disability, and with immune suppression disease (Voress & Maddox, 2013). Thus, the present results of the low incidence of ''Very Poor'' development are aligned with the exclusion criteria of this study and the DAYC-2 approach, in which entry points were determined by selecting the points at which typically developing children would likely be successful. This means every child at that specific age has a fair chance to exhibit simple behaviours and avoid very poor classification unless the above circumstances prevail.

5.5.3 Challenges in Physical Fine Motor Development

The data reveals a considerable challenge in physical fine motor development, with more than a quarter of children (27%) experiencing difficulties in this subdomain. Additionally, over 25% of children scored below the expected standard scores for physical fine motor development, indicating that many children did not meet their age's anticipated acceptable fine motor development levels. This highlights an area that may require focused attention and intervention, as fine motor skills are essential for activities such as writing and manipulative tasks. However, researchers report a fluctuating prevalence of fine motor skills development. For instance, Metwally et al. (2022) found a 1% prevalence of fine motor delay during a national prevalence and profile of single and multiple developmental delays among children in Egypt. On the other hand, Tuyisenge et al. (2023), who studied screening for developmental delay in urban Rwandan preschool children, identified an 8.4% prevalence of fine motor delays. The findings of Zhang et al. (2018) discovered a different trend where 20.6% of preschool children from rural China were suffering from delayed fine motor development.

5.5.4 The majority are within the Normal or Average Range.

A positive aspect of the findings is that most children were within the "normal" or "average" range for their milestone development across various domains and subdomains, with percentages ranging from 70% to 87%. This suggests that a significant proportion of the study population is achieving age-appropriate developmental milestones, demonstrating that many children are progressing as expected. Most children were also developing normally for their age based on information from multiple domains in a cross-sectional survey conducted in Argentina, India, South Africa, and Turkey (Ertem et al., 2018). The study by Sheldrick et al. (2019) confirmed that most children rate within the normal range even when using two milestone development measurement tools. In the Boston study about establishing new norms for developmental milestones, the Survey of Well-being of Young Children developmental questions and Centers for Disease Control and Prevention guidelines for critical milestones revealed that many children reported passing milestones by age. These findings provide important insights into the developmental status of the study population. They highlight the need for continued efforts to identify and address developmental delays, particularly in domains such as physical fine motor skills, while acknowledging and nurturing the strengths of children excelling in communication and social-emotional development. These insights can inform educational and support strategies to ensure that all children receive the guidance and assistance they need to reach their full developmental potential.

5.5.5 Relationship between nutritional status and child milestone development

Globally, over 250 million children under 5 years do not reach their developmental potential due to several causes, including poor nutritional status (Van Beekum et al., 2022). Nutritional status refers to the condition of the body, which is influenced by diet, the levels of nutrients in the body, and the ability of the levels to maintain healthy metabolic integrity (Chawla, 2018). Anthropometry reflects health and nutritional status and predicts performance, health, and survival (NDoHSA, 2019). The present study discusses the associations between children's anthropometric measurements and milestone development, dietary diversity score and children's milestone development.

5.5.5.1 Relationship between anthropometric measurements and child milestone development

The results of the present study highlight a positive correlation between weight-for-height (WHZ) and overall physical development (p=0.03), and the General Development Index (p=0.00). In a survey on household socioeconomic status, nutritional status and development

of children aged 12 to 59 months in Comoros, weight for height (wasting) was significantly associated (p=0.001) with motor development (Li et al., 2020). The WHZ of the Indian children from birth to 59 months showed a positive correlation (p=0.005) to their overall development (Agarwal et al., 2018). Low WHZ reflects wasting, which is caused by a combination of factors, including poverty, acute inadequate food intake, poor feeding practices, disease, and infections, which impairs the functioning of the immune system and thus affect the overall growth and development of children (Bhutta and Salam 2012, Ghosh-Jerath et al. 2017). When examining nutrition-related factors associated with motor and language development among children in Haiti, the height for age Z score significantly predicted all motor outcomes (p=0.001) (Lannotti et al., 2016). This is aligned with the observations of the present study that height-for-age (HAZ) positively correlates with physical gross motor (p=0.00), and physical fine motor development (p=0.02). Similar findings were reported by Van Beekum et al. (2022) in the survey on associations between stunting and wasting and developmental milestones delays among Cambodian children, where stunting was strongly associated with delays in gross motor development (p=0.001).

The research on ‘’Malnutrition matters: Association of stunting and underweight with early childhood development indicators in Nepal for children aged 36 to 59 months of age’’ observed significant correlations between weight for age Z score (underweight) and literacy-numeracy (p= 0.01), physical development (p= 0.01), and learning development (p= 0.01) on the early childhood development index that had four domains (literacy-numeracy, physical, social-emotional and learning development) (Shrestha et al., 2022). Comparably, in the present study, WAZ is associated with cognitive (p=0.00), communication receptive language (p=0.02), communication expressive language (p=0.02), overall communication (p=0.01), physical fine motor (p=0.00) and adaptative behaviour development (p=0.03). Muhoozi et al. (2016) results are consistent with the present study, which found that WAZ predicted cognitive domain and all communication outcomes. It is worth noting that WAZ is associated with more than one domain. This underscores the need to add ECD interventions, such as responsive and stimulating caregiving, with nutrition programmes to improve child development outcomes.

The current results show a positive correlation between body mass index for age (BAZ) and cognitive development. The available literature indicates conflicting findings on the association between BAZ and cognitive development. For instance, Van Beekum et al. (2022) reported a positive correlation between BAZ and cognitive milestones. On the other hand, Muhoozi et al. (2016) found the association between BAZ and cognitive domain insignificant. Mid-upper arm circumference (MUAC) is a rapid screening tool to detect wasting in children aged 6 to 59

months (Lamsal et al., 2021). The current study observed positive correlations between MUAC and cognitive (p=0.03), communication (p=0.005), social-emotional (p=0.04), and physical fine motor development (p=0.00). Investigators from India documented somewhat similar findings in their survey on the impact of protein-energy malnutrition on development in children, where MUAC outcomes were significantly associated with cognitive (p=0.01), gross motor (p=0.00), fine motor (0.00), and social development (p=0.04). In contrast, language development was statistically insignificant (p=0.07) (Patel and Issac, 2019).

5.5.5.2 Relationship between dietary diversity score and child milestone development

Dietary diversity is a proxy indicator that reflects nutrient adequacy and adequate intake across a range of key nutrients (Workicho et al., 2016). According to Larson et al. (2017), a more diversified diet correlates with mental development (p=0.05) and motor development scores (p=0.01). This aligns with the current study's findings that observed positive correlations between dietary diversity score, child cognitive development (p=0.00), and various physical development domains (p=0.00). These associations were emphasised by a study on the predictors and pathways of cognitive, language and motor development in four prospective cohorts of young children in Ghana, Malawi, and Burkina Faso, where higher mental developmental and higher motor scores were associated with greater dietary diversity (Prado et al., 2017). The present study also demonstrated a statistically significant correlation between dietary diversity scores and the general development index (p=0.00). Similar findings were reported in a survey on dietary diversity and child development in the far west of Nepal, where a more diversified diet was associated with lower odds of delayed child development (Thorne-Lyman et al., 2019). The study on the relationships between dietary diversity and early childhood developmental outcomes in rural China by Zhao et al. (2021) reported a significant association between minimum dietary diversity and reduced likelihood of developmental delays in gross motor, fine motor, problem-solving and personal social subscales. In contrast, minimum meal frequency was only associated with a lower risk of developmental delays in the gross motor subscale. This underscores the importance of dietary diversity on overall child development.

5.6 Conclusion

Child development delay is a public health concern, and it is strongly associated with stunting, underweight, undiversified dietary consumption, and suboptimal infant and young child feeding practices (Oumer et al., 2022). Adding ECD interventions, such as responsive and

stimulating caregiving, within nutrition programmes among children who are stunted and underweight could improve child development outcomes.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents conclusions and recommendations regarding the results obtained from the study. In concluding this study, this chapter provides a comprehensive overview of the socio-demographic characteristics of participants, including details on household characteristics and sources of nutrition information. This study aimed to investigate the nutritional status and milestone development of children aged 3-5 years attending early childhood development centres at Chief Albert Luthuli Municipality in Mpumalanga province. The findings shed light on three- to five-year-olds attending Early Childhood Development (ECD) centres in Chief Albert Luthuli Municipality, including their nutritional status, anthropometric measurements, and developmental milestones.

6.2 Conclusions

6.2.1 Socio-demographic characteristics of study participants

The study highlights significant socio-demographic trends, including mothers' age and educational levels, household characteristics, and sources of nutrition information. These findings provide valuable insights into the context in which children are growing and developing. The study reveals that most participants were between three and five years old, with females comprising the larger proportion. Moreover, a significant proportion of mothers were below 35, and a substantial number were single, which aligns with trends observed in other surveys (Shisana et al., 2014). In terms of education, while a significant proportion of mothers had attained grade 12 or higher, there were still notable percentages with lower levels of education, indicating the need for targeted educational interventions.

Regarding household characteristics, the study found varying levels of access to resources such as land for food production and improved water sources. Notably, most households relied on electricity (94%) for cooking, while some households still used wood (62**%**) as the primary cooking fuel, which has implications for indoor air quality and environmental sustainability. Furthermore, the study highlights the importance of healthcare workers as trusted sources of nutrition information for caregivers, emphasizing the need for effective communication strategies in promoting healthy dietary behaviours among young children.

6.2.2 Dietary habits

The study reveals that most children in the sample were fed more than three times daily, aligning with WHO recommendations (WHO, 2011). However, there were variations in the

consumption of specific food groups, such as vegetables, fruits, milk, and unhealthy snacks. Children in this study were given various foods, including vegetables, milk and dairy products, and fruits. Most children in the study had access to and consumed nutritious foods such as dark-green leafy vegetables, fresh milk, and various fruits. Similar findings in dietary practices among preschool-aged children in South Africa (82%) and other developing countries (Van Beekum et al., 2022). However, alongside these positive findings, there are also concerning trends, notably the high consumption of unhealthy snacks like sugary drinks and sweets. Furthermore, while some children met the recommended daily intake of certain foods, others fell short, highlighting potential gaps in dietary diversity and nutritional adequacy within the studied population. Variations in the prevalence of unhealthy snacks consumption suggest possible cultural or regional differences in dietary habits.

6.2.3 Food Groups and Dietary Diversity

Understanding dietary diversity is crucial for assessing overall nutritional adequacy and identifying potential gaps in dietary intake among children. This study highlights the food group consumption and shifts in dietary diversity scores observed over multiple visits, providing insights into the dynamic nature of dietary habits among preschool-aged children. The findings indicated that all visits included starchy staples, meat and fish, and milk products as the most consumed food groups. These findings are consistent with previous research (Kearney, 2010) in SA and other countries (Solomon, Aderaw & Tegegne, 2017), emphasizing the staple nature of these food groups in the diets of preschool-aged children. A concerning trend was observed with the decreasing consumption of dark green leafy vegetables, vitamin A-rich fruits and vegetables, and organ meat over time. This shift away from nutrient-dense foods may have implications for overall nutrition and health, underscoring the need for interventions to promote adequate intake of these essential nutrients.

The study also highlighted shifts in dietary diversity scores, with a notable decrease observed in the third visit. This decline in dietary diversity raises concerns about potential changes in dietary habits or limited access to various food groups during this period. Such shifts can adversely affect nutritional status, increasing the risk of deficiencies and compromising overall health. Continuous monitoring of dietary diversity scores is essential for early detection of nutritional inadequacies and timely intervention.

6.2.4 Anthropometric status of children

The study presents descriptive statistics for anthropometric measures among children, including weight-for-height z-score (WHZ), height-for-age z-score (HAZ), weight-for-age z-

score (WAZ), body mass index-for-age z-score (BAZ), and mid-upper arm circumference z-score (MUACZ). These measures provided insights into the nutritional status of children. The anthropometric measurements provide valuable insights into the nutritional status of preschool-aged children, highlighting areas of concern such as stunting, underweight, wasting, and overweight/obesity. Gender-specific differences underscore the importance of tailored interventions to address these nutritional challenges effectively.

6.2.5 Height for Age (Stunting)

Stunting prevalence, measured by height-for-age z-scores (HAZ), indicates that (23.3%) of children in the study were stunted. These findings were comparisons with other similar studies conducted in South Africa, highlighting chronic malnutrition prevalent among children below five years, suggesting a persistent issue of stunting among preschool-aged children across different regions. Boys were stunted, suggesting a need for targeted interventions.

6.2.6 Weight for Age (Underweight)

The prevalence of underweight among children in the study highlights another nutritional concern. This is confirmed by variations observed across different provinces in South Africa. Gender-specific differences in underweight prevalence warrant attention, although findings from various studies show inconsistencies in these disparities.

6.2.7 Weight for Height (Wasting)

Wasting prevalence, a measure of low weight-for-height, is another area of concern, with the study indicating a medium prevalence based (WHO, 2009) on WHO classifications. Gender-specific differences in wasting prevalence are noted.

6.2.8 Body Mass Index for Age (Overweight and Obesity)

Prevalence rates of overweight and obesity among preschool-aged children are highlighted, with gender disparities noted in some studies. While prevalence rates vary across different settings, the overall concern regarding overweight and obesity as public health issues remains consistent. The discrepancies in prevalence rates underscore the need for tailored interventions targeting healthy lifestyle behaviours among children.

6.2.6 Mid-Upper Arm Circumference (MUAC)

MUAC measurements provide insights into the prevalence of moderate and severe acute malnutrition, indicating areas of concern for nutritional interventions. Findings from the study

align with previous research, highlighting the need for targeted measures to address malnutrition among preschool-aged children.

6.3 Milestone Development of children

Milestone development showed suspected developmental delays in a minority of children, particularly in physical fine motor skills, but the majority demonstrated normal development across various domains, suggesting overall positive progress. Approximately 8% of children in the study exhibited suspected developmental delays in their General Development Index (GDI). This finding emphasizes the importance of early identification and intervention for children facing developmental challenges. Comparable prevalence rates from other studies (Agarwal et al., 2018) underscore the significance of addressing developmental delays across different settings, highlighting the need for targeted support strategies.

This study highlights a low incidence of "Very poor" development, indicating that most children in the study were within a reasonable developmental range. Exclusion criteria and assessment methodologies contributed to this positive indicator, ensuring that typically developing children have a fair chance to demonstrate their abilities. This underscores the reliability of the study's findings and assessment approach.

However, physical fine motor development challenges are evident, with more than a quarter of children experiencing difficulties in this domain. This highlights the importance of addressing fine motor skill development, which is essential for writing and manipulative tasks. Varied prevalence rates from other studies (Ertem et al., 2018) emphasize the need for tailored interventions to address fine motor skill challenges. Moreover, the current study reports that most children are within the "normal" or "average" range for milestone development across various domains. This indicates that a significant proportion of the study population is achieving age-appropriate developmental milestones, suggesting overall positive developmental progress. Similar findings from other studies further support the normalcy of milestone development among preschool-aged children.

6.4 Relationship between Nutritional Status and Child Milestone Development

6.4.1 Relationship between Anthropometric Indicators and Child Milestone Development

The present study reveals significant correlations between anthropometric measurements and various domains of child milestone development. Weight-for-height (WHZ) positively correlates with overall physical development ($p=0.03$). At the same time, height-for-age (HAZ) correlates positively with physical gross motor ($p=0.00$) and fine motor development ($p=0.00$),

and weight-for-age (WAZ) is associated with cognitive (p=0.02), communication (p=0.00), and adaptive behaviour development (p=0.00). These findings are consistent with previous research (Agarwal et al., 2018) indicating the impact of nutritional status on different aspects of child development. This study adds to the existing literature that stunting has been linked to delays in gross motor development while being underweight is associated with cognitive and language development delays. Similarly, wasting reflects acute malnutrition, affecting physical growth and overall development. These associations underline the importance of addressing nutritional status to promote optimal child development across multiple domains.

6.4.2 Relationship between Dietary Diversity Score and Child Milestone Development

Dietary diversity score, reflecting nutrient adequacy and intake, significantly correlates with various domains of child milestone development. A more diversified diet is positively associated with cognitive development, physical development, and the general development index. This aligns with previous research indicating that higher dietary diversity is linked to better children's mental and motor development outcomes. Furthermore, studies (Sui, Raubenheimer, and Rangan, 2017) have shown that minimum dietary diversity is associated with a reduced likelihood of developmental delays, emphasizing the importance of a varied diet in promoting overall child development. These findings highlight the critical role of dietary diversity in supporting optimal growth and development during early childhood.

Overall, the associations between nutritional status, dietary diversity, and child milestone development underscore the importance of holistic approaches to child health and well-being. Addressing dietary deficiencies and promoting diverse diets can significantly enhance child development outcomes, emphasizing the need for integrated interventions targeting nutritional and developmental needs during early childhood.

6.5 Recommendations

Based on these findings, several recommendations can be made:

- Given the proportion of mothers with lower levels of education, targeted programs should be developed to enhance parental knowledge and skills related to child nutrition and development.
- Efforts should be made to improve access to resources such as improved water sources and proper sanitation facilities, particularly in households with lower income levels.

- Initiatives promoting clean cooking technologies should be implemented to reduce reliance on wood and other traditional cooking fuels, thereby improving indoor air quality and reducing environmental impact.
- Healthcare workers should continue to be leveraged as trusted sources of nutrition information. However, efforts should also be made to utilise electronic media and other innovative channels to disseminate relevant information to caregivers.
- Community-based interventions should be developed to address specific nutritional needs and developmental milestones of children attending ECD centres, considering the socio-demographic characteristics and resource constraints observed in the study area.
- Overall, by addressing these recommendations, stakeholders can work towards improving the nutritional status and developmental outcomes of young children attending ECD centres in Chief Albert Luthuli Municipality and similar settings.
- In summary, the dietary assessment section provides insights into the frequency of meal consumption and types of foods commonly consumed by children aged three to five years attending Early Childhood Development (ECD) centres in Chief Albert Luthuli Municipality. The findings are compared with other studies to provide context and identify trends in dietary practices.
- Interventions are warranted to increase the consumption of nutritious foods and reduce the intake of unhealthy snacks. Additionally, efforts should be made to address barriers to accessing and consuming healthy foods, such as cost and availability.
- Public health initiatives should focus on improving access to diverse and nutritious foods, addressing socio-economic barriers, and promoting healthy dietary behaviours from an early age. By addressing these factors, we can work towards ensuring a well-balanced diet and optimal nutrition for preschool-aged children, thereby supporting their growth, development, and overall health.

6.6 Strengths and limitations of the research

6.6.1 Strengths

The research was conducted ethically, applying standard protocols. The questionnaire was developed from credible sources in all sections. The South African Demographic Health Survey and Statistics South Africa was applied to gather sociodemographic data from participants. The Nutritional Assessment textbook guided the measurement of dietary and anthropometric data. A norm-referenced measure of early childhood development for children from birth through age 5 years and 11 months was used for milestone development screening.

6.6.2 Limitations

Caregivers not available for the second and third dietary data collection schedule for 24hour recall. This second and third dietary data collection was done telephonically, so some caregiver's phones were not available and some did not receive their phones. On the first day of data collection, 353 children's 24hour recalls were completed, on the second day 272 24hour recalls were telephonically recorded, while 261 caregivers were available for the final data collection.

REFERENCES

Abitew, D.B., Yalew, A.W., Bezabih, A.M. and Bazzano, A.N., 2021. Comparison of mid-upper-arm circumference and weight-for-height Z-Score in Identifying severe acute malnutrition among children aged 6‑59 months in South Gondar Zone, Ethiopia. *Journal of nutrition and metabolism*, 2021.

Agarwal, D., Chaudhary, S.S., Sachdeva, S., Misra, S.K. and Agarwal, P., 2018. Prevalence of developmental delay and factors affecting the development status among under 5 children in an urban slum of Agra city. *National Journal of Community Medicine,* 9(07), pp.474-479.

Akombi, B.J., Agho, K.E., Hall, J.J., Wali, N., Renzaho, A. and Merom, D., 2017. Stunting, wasting and underweight in sub-Saharan Africa: a systematic review. *International journal of environmental research and public health*, 14(8), p.863. (a)

Akombi, B.J., Agho, K.E., Merom, D., Renzaho, A.M. and Hall, J.J., 2017. Child malnutrition in sub-Saharan Africa: A meta-analysis of demographic and health surveys (2006-2016). *PloS one*, 12(5), p.e0177338. (b)

Akombi, B.J., Agho, K.E., Hall, J.J., Merom, D., Astell-Burt, T. and Renzaho, A.M., 2017. Stunting and severe stunting among children under-5 years in Nigeria: A multilevel analysis. *BMC pediatrics*, 17(1), pp.1-16. (c)

Akombi, B.J., Agho, K.E., Merom, D., Hall, J.J. and Renzaho, A.M., 2017. Multilevel analysis of factors associated with wasting and underweight among children under-five years in Nigeria. *Nutrients,* 9(1), p.44. (d)

Akram, R., Sultana, M., Ali, N., Sheikh, N. and Sarker, A.R., 2018. Prevalence and determinants of stunting among preschool children and its urban–rural disparities in Bangladesh. *Food and nutrition bulletin*, 39(4), pp.521-535.

Andrusaityte, S., Grazuleviciene, R. and Petraviciene, I., 2017. Effect of diet and maternal education on allergies among preschool children: a case-control study. *Environmental research*, 159, pp.374-380.

Babaeer, L., Stylianou, M., Walker, J.L. and Gomersall, S., 2022. Dietary intake and educational outcomes among Australian university students: Cross-sectional and longitudinal associations. *Public Health Nutrition*, pp.1-37.

Bedford, H., Walton, S. and Ahn, J., 2013. Measures of child development: A review.

Benton, D., 2010. Neurodevelopment and neurodegeneration: are there critical stages for nutritional intervention? *Nutrition reviews*, 68(suppl_1), pp.S6-S10.

Betebo, B., Ejajo, T., Alemseged, F. and Massa, D., 2017. Household food insecurity and its association with nutritional status of children 6–59 months of age in east Badawacho District, south Ethiopia. *Journal of environmental and public health*, 2017.

Bhattacharyya, H. and Barua, A., 2013. Nutritional status and factors affecting nutrition among adolescent girls in urban slums of Dibrugarh, Assam. Natl J Community Med, 4(1), pp.35-39.Bhutta, Z.A. and Salam, R.A., 2012. Global nutrition epidemiology and trends. *Annals of Nutrition and Metabolism*, 61(Suppl. 1), pp.19-27.

Bisset, S., Fournier, M., Pagani, L. and Janosz, M., 2013. Predicting academic and cognitive outcomes from weight status trajectories during childhood. *International journal of obesity*, 37(1), pp.154-159.

Black, M.M., Pérez-Escamilla, R. and Fernandez Rao, S., 2015. Integrating nutrition and child development interventions: scientific basis, evidence of impact, and implementation considerations. *Advances in Nutrition*, 6(6), pp.852-859.

Boah, M., Azupogo, F., Amporfro, D.A. and Abada, L.A., 2019. The epidemiology of undernutrition and its determinants in children under five years in Ghana. *Plos one*, 14(7), p.e0219665.

Bose, K., Biswas, S., Bisai, S., Ganguli, S., Khatun, A., Mukhopadhyay, A. and Bhadra, M., 2007. Stunting, underweight and wasting among Integrated Child Development Services (ICDS) scheme children aged 3–5 years of Chapra, Nadia District, West Bengal, India. *Maternal & child nutrition*, *3*(3), pp.216-221.

Bortolini, G.A., Gubert, M.B. and Santos, L.M.P., 2012. Food consumption Brazilian children by 6 to 59 months of age. *Cadernos de saude publica*, 28, pp.1759-1771.

Botha, M.M., 2021. The effect of therapeutic feed in the management of severe acute malnutrition in children, South Africa (Doctoral dissertation).

Browne, C.A., 2021. Food-based dietary guidelines for South Africans: an under-utilised tool for improving nutritional well-being. *South African Journal of Clinical Nutrition*, 34(sup1), pp.Si-Sii.

Budree, S., Goddard, E., Brittain, K., Cader, S., Myer, L. and Zar, H.J., 2017. Infant feeding practices in a South African birth cohort—A longitudinal study. *Maternal & child nutrition,* 13(3), p.e12371.

Burkhalter, T.M. and Hillman, C.H., 2011. A narrative review of physical activity, nutrition, and obesity to cognition and scholastic performance across the human lifespan. *Advances in Nutrition*, *2*(2), pp.201S-206S.

Campisi, S.C., Cherian, A.M. and Bhutta, Z.A., 2017. World perspective on the epidemiology of stunting between 1990 and 2015. *Hormone research in paediatrics*, 88(1), pp.70-78.

Casadei, K. and Kiel, J., 2019. Anthropometric measurement.

Caulfield, L.E., Bose, A., Chandyo, R.K., Nesamvuni, C., de Moraes, M.L., Turab, A., Patil, C., Mahfuz, M., Ambikapathi, R. and Ahmed, T., 2014. Infant feeding practices, dietary adequacy, and micronutrient status measures in the MAL-ED study. *Clinical Infectious Diseases,* 59(suppl_4), pp.S248-S254.

Chakona, G., 2020. Social circumstances and cultural beliefs influence maternal nutrition, breastfeeding and child feeding practices in South Africa. *Nutrition Journal*, 19(1), pp.1-15.

Cusick, S.E. and Georgieff, M.K., 2016. The role of nutrition in brain development: the golden opportunity of the “first 1000 days”. *The Journal of pediatrics,* 175, pp.16-21.

Daelmans, B., Darmstadt, G.L., Lombardi, J., Black, M.M., Britto, P.R., Lye, S., Dua, T., Bhutta, Z.A. and Richter, L.M., 2017. Early childhood development: the foundation of sustainable development. *The Lancet*, 389(10064), pp.9-11.

Das, S. and Gulshan, J., 2017. Different forms of malnutrition among under five children in Bangladesh: a cross sectional study on prevalence and determinants. *BMC Nutrition*, 3(1), pp.1-12.

Demirci, A. and Kartal, M.E.H.T.A.P., 2016. The prevalence of developmental delay among children aged 3–60 months in Izmir, Turkey. *Child: care, health and development*, 42(2), pp.213-219.

De Onis, M. and Branca, F., 2016. Childhood stunting: a global perspective. *Maternal & child nutrition*, 12, pp.12-26.

Disha, A.D., Rawat, R., Subandoro, A. and Menon, P., 2012. Infant and young child feeding (IYCF) practices in Ethiopia and Zambia and their association with child nutrition: analysis of

demographic and health survey data. *African Journal of Food, Agriculture, Nutrition and Development*, 12(2), pp.5895-5914.

Dukhi, N., 2020. Global prevalence of malnutrition: evidence from literature. *Malnutrition*, 1, pp.1-16.

Dukhi, N., Sartorius, B. and Taylor, M., 2017. Mid-upper arm circumference (MUAC) performance versus weight for height in South African children (0–59 months) with acute malnutrition. *South African Journal of Clinical Nutrition*, 30(2).

Du Plessis, P. and Mestry, R., 2019. Teachers for rural schools–a challenge for South Africa. *South African Journal of Education*, 39.

Edokpayi, J.N., Rogawski, E.T., Kahler, D.M., Hill, C.L., Reynolds, C., Nyathi, E., Smith, J.A., Odiyo, J.O., Samie, A., Bessong, P. and Dillingham, R., 2018. Challenges to sustainable safe drinking water: a case study of water quality and use across seasons in rural communities in Limpopo Province, South Africa. *Water*, 10(2), p.159.

Edwards, V.B., 2017. Putting It All Together. *Aspen Institute*.

Ertem, I.O., Krishnamurthy, V., Mulaudzi, M.C., Sguassero, Y., Balta, H., Gulumser, O., Bilik, B., Srinivasan, R., Johnson, B., Gan, G. and Calvocoressi, L., 2018. Similarities and differences in child development from birth to age 3 years by sex and across four countries: a cross-sectional, observational study. *The Lancet Global Health*, 6(3), pp.e279-e291.

Faber, M., Laubscher, R. and Laurie, S., 2013. Availability of, access to and consumption of fruits and vegetables in a peri-urban area in KwaZulu-Natal, South Africa. *Maternal & Child Nutrition*, 9(3), pp.409-424.

Faber, M., Van Jaarsveld, P.J. and Laubscher, R., 2007. The contribution of dark-green leafy vegetables to total micronutrient intake of two-to five-year-old children in a rural setting. *Water SA,* 33(3), pp.407-412.

Fanta, A.B., Berkowitz, B., Khumalo, J., Mutsonziwa, K., Maposa, O. and Ramsamy, P., 2017. Digitisation of social grant payments and financial inclusion of grant recipients in South Africa–Evidence from FinScope surveys. Midrand: FinMark Trust.

Flores-Quispe, M.D.P., Restrepo-Méndez, M.C., Maia, M.F.S., Ferreira, L.Z. and Wehrmeister, F.C., 2019. Trends in socioeconomic inequalities in stunting prevalence in Latin

America and the Caribbean countries: differences between quintiles and deciles. *International Journal for Equity in Health*, 18(1), pp.1-10.

Frempong, R.B. and Annim, S.K., 2017. Dietary diversity and child malnutrition in Ghana. *Heliyon*, 3(5), p.e00298.

Gadade, S.T. and Kale, A.B., 2019. Assess the Awareness and Information Needs Regarding Normal Developmental Milestones of 1 to 3 Year Children among the Mothers of Infants, in a View to Prepare Information Booklet. *Indian Journal of Public Health Research & Development,* 10(8).

Gale, C.R., Martyn, C.N., Marriott, L.D., Limond, J., Crozier, S., Inskip, H.M., Godfrey, K.M., Law, C.M., Cooper, C., Robinson, S.M. and Southampton Women's Survey Study Group, 2009. Dietary patterns in infancy and cognitive and neuropsychological function in childhood. *Journal of Child Psychology and Psychiatry*, *50*(7), pp.816-823.

Galgamuwa, L.S., Iddawela, D., Dharmaratne, S.D. and Galgamuwa, G.L.S., 2017. Nutritional status and correlated socio-economic factors among preschool and school children in plantation communities, Sri Lanka. *BMC public health,* 17, pp.1-11.

GBD 2015 Obesity Collaborators, 2017. Health effects of overweight and obesity in 195 countries over 25 years. *New England journal of medicine*, 377(1), pp.13-27.

Ghosh-Jerath, S., Singh, A., Jerath, N., Gupta, S. and Racine, E.F., 2017. Undernutrition and severe acute malnutrition in children. *BMJ*, 359.

Grantham-McGregor, S., Cheung, Y.B., Cueto, S., Glewwe, P., Richter, L., Strupp, B. and International Child Development Steering Group, 2007. Developmental potential in the first 5 years for children in developing countries. *The lancet*, *369*(9555), pp.60-70.

Grimes, C.A., Szymlek-Gay, E.A., Campbell, K.J. and Nicklas, T.A., 2015. Food sources of total energy and nutrients among US infants and toddlers: National Health and Nutrition Examination Survey 2005–2012. *Nutrients,* 7(8), pp.6797-6836.

Haines, J., Haycraft, E., Lytle, L., Nicklaus, S., Kok, F.J., Merdji, M., Fisberg, M., Moreno, L.A., Goulet, O. and Hughes, S.O., 2019. Nurturing Children's healthy eating: Position statement. *Appetite*, 137, pp.124-133.

Harding, K.L., Aguayo, V.M. and Webb, P., 2018. Factors associated with wasting among children under five years old in South Asia: implications for action. *PloS one*, 13(7), p.e0198749.

Hemson, D., 2016. Water, sanitation and health: South Africa's remaining and existing issues. *South African Health Review,* 2016(1), pp.25-34.

Herber, C., Bogler, L., Subramanian, S.V. and Vollmer, S., 2020. Association between milk consumption and child growth for children aged 6–59 months. *Scientific reports*, 10(1), p.6730.

Hill. Liu, J. and Raine, A., 2017. Nutritional status and social behaviour in preschool children: the mediating effects of neurocognitive functioning. *Maternal & child nutrition*, 13(2), p.e12321.

Huong, P.T.T., Lam, N.T., Thu, N.N., Quyen, T.C., Lien, D.T.K., Anh, N.Q., Henry, E.G., Oliver, L., Apovian, C.M., Ziegler, T.R. and Lenders, C., 2014. Prevalence of malnutrition in patients admitted to a major urban tertiary care hospital in Hanoi, Vietnam. *Asia Pacific Journal of Clinical Nutrition,* 23(3), p.437.

Ibeanu V, Okeke E, Onyechi U and Ejiofor U. 2012. Assessment of anthropometric indices, iron and zinc status of preschoolers in a peri-urban community in south east Nigeria. *International Journal of Basic and Applied Science Vol: 12 No*: 05; 1213005-2727.

Javed, A., Jumean, M., Murad, M.H., Okorodudu, D., Kumar, S., Somers, V.K., Sochor, O. and Lopez-Jimenez, F., 2015. Diagnostic performance of body mass index to identify obesity as defined by body adiposity in children and adolescents: a systematic review and meta-analysis. *Pediatric obesity,* 10(3), pp.234-244.

Jimoh, A.O., Anyiam, J.O. and Yakubu, A.M., 2018. Relationship between child development and nutritional status of under-five Nigerian children. *South African Journal of Clinical Nutrition*, *31*(3), pp.50-54.

Johnson-Staub, C., 2014. First Steps for Early Success: State Strategies to Support Developmental Screening in Early Childhood Settings. *Center for Law and Social Policy, Inc.* (CLASP).

Kang, Y., Aguayo, V.M., Campbell, R.K. and West Jr, K.P., 2018. Association between stunting and early childhood development among children aged 36–59 months in South Asia. *Maternal & Child Nutrition*, 14, p.e12684.

Kebede, A., Jirström, M., Worku, A., Alemu, K., Berhane, H.Y., Turner, C., Ekström, E.C. and Berhane, Y., 2022. Residential food environment, household wealth and maternal education association to preschoolers' consumption of plant-based vitamin a-rich foods: the EAT Addis survey in Addis Ababa. *Nutrients*, 14(2), p.296.

Keyvanfar, S., Amir Ali Akbari, S., Tork Zahrani, S. and Nasiri, M., 2021. Comparison of Parenting Styles in Parents of 3-5-Year-Old Kindergarten Children with and without Developmental Delay. *International Journal of Pediatrics*, *9*(3), pp.13225-13235.

Khadilkar, V.V. and Khadilkar, A.V., 2015. Revised Indian Academy of Pediatrics 2015 growth charts for height, weight and body mass index for 5–18-year-old Indian children. *Indian journal of endocrinology and metabolism*, 19(4), p.470.

Khamis, A.G., Mwanri, A.W., Ntwenya, J.E. and Kreppel, K., 2019. The influence of dietary diversity on the nutritional status of children between 6 and 23 months of age in Tanzania. *BMC pediatrics*, 19(1), pp.1-9.

Koetaan, D., Smith, A., Liebenberg, A., Brits, M., Halkas, C., Van Lill, M. and Joubert, G., 2018. The prevalence of underweight in children aged 5 years and younger attending primary health care clinics in the Mangaung area, Free State. *African Journal of Primary Health Care and Family Medicine*, *10*(1), pp.1-5.

Kojima, M., 2021. Primary household energy for cooking and heating in 52 developing economies.

Korkalo, L., Nissinen, K., Skaffari, E., Vepsäläinen, H., Lehto, R., Kaukonen, R., Koivusilta, L., Sajaniemi, N., Roos, E. and Erkkola, M., 2019. The contribution of preschool meals to the diet of Finnish Preschoolers. *Nutrients*, 11(7), p.1531.

Labadarios, D., Steyn, N.P., Maunder, E., Macintryre, U., Gericke, G., Swart, R., Huskisson, J., Dannhauser, A., Vorster, H.H., Nesamvuni, A.E. and Nel, J.H., 2005. The national food consumption survey (NFCS): South Africa, 1999. *Public health nutrition*, 8(5), pp.533-543.

Laillou, A., Prak, S., de Groot, R., Whitney, S., Conkle, J., Horton, L., Un, S.O., Dijkhuizen, M.A. and Wieringa, F.T., 2014. Optimal screening of children with acute malnutrition requires a change in current WHO guidelines as MUAC and WHZ identify different patient groups. *PloS one*, 9(7), p.e101159.

Lamsal, K.P., Parajuli, K.R., Pun, B.K., Adhikari, R.P., Bashyal, M., Dangol, B. and Cunningham, K., 2021. Accuracy of using mid-upper arm circumference to detect wasting among children aged 6–59 months in Nepal. *Global Health: Science and Practice*, 9(4), pp.881-889.

Lannotti, L., Jean Louis Dulience, S., Wolff, P., Cox, K., Lesorogol, C. and Kohl, P., 2016. Nutrition factors predict earlier acquisition of motor and language milestones among young children in Haiti. *Acta Paediatrica*, 105(9), pp.e406-e411.

Larson, L.M., Young, M.F., Ramakrishnan, U., Webb Girard, A., Verma, P., Chaudhuri, I., Srikantiah, S. and Martorell, R., 2017. A cross-sectional survey in rural Bihar, India, indicates that nutritional status, diet, and stimulation are associated with motor and mental development in young children. *The Journal of nutrition*, 147(8), pp.1578-1585.

Laus, M.F., Duarte Manhas Ferreira Vales, L., Braga Costa, T.M. and Sousa Almeida, S., 2011. Early postnatal protein-calorie malnutrition and cognition: a review of human and animal studies. *International Journal of Environmental Research and Public Health*, *8*(2), pp.590-612.

Lee, R.D. and Nieman, D.C., 2013. Nutritional Assessment; 6th Edition, New York: McGraw

Li, Z., Kim, R., Vollmer, S. and Subramanian, S.V., 2020. Factors associated with child stunting, wasting, and underweight in 35 low-and middle-income countries. *JAMA network open*, 3(4), pp.e203386-e203386.

Litterbach, E.K.V., Campbell, K.J. and Spence, A.C., 2017. Family meals with young children: an online study of family mealtime characteristics, among Australian families with children aged six months to six years. *BMC Public Health*, 17, pp.1-9.

Lobo, S., Lucas, C.J., Herbert, J.S., Townsend, M.L., Smith, M., Kunkler, E. and Charlton, K.E., 2020. Nutrition information in pregnancy: Where do women seek advice and has this changed over time?. *Nutrition & Dietetics*, 77(3), pp.382-391. Australia.

Lv, Y., Kraus, V.B., Gao, X., Yin, Z., Zhou, J., Mao, C., Duan, J., Zeng, Y., Brasher, M.S., Shi, W. and Shi, X., 2020. Higher dietary diversity scores and protein-rich food consumption were associated with lower risk of all-cause mortality in the oldest old. *Clinical Nutrition*, 39(7), pp.2246-2254.

Madan, E.M., Frongillo, E.A., Unisa, S., Dwivedi, L., Johnston, R., Daniel, A., Agrawal, P.K., Deb, S., Khera, A., Menon, P. and Nguyen, P.H., 2020. Effect of Differences in Month and Location of Measurement in Estimating Prevalence and Trend of Wasting and Stunting in India in 2005–2006 and 2015–2016. *Current Developments in Nutrition*, 4(6), p.nzaa092.

Madiba, S., Chelule, P.K. and Mokgatle, M.M., 2019. Attending informal preschools and daycare centers is a risk factor for underweight, stunting and wasting in children under the age of five years in underprivileged communities in South Africa. *International journal of environmental research and public health*, 16(14), p.2589.

Mahan, L., Escott-Stump, S. and Raymond, L., 2012. Krause's Food & the Nutrition Care Process. 13th. St. Louis, Mo, USA: Saunders.

Makanjana, O. and Naicker, A., 2021. Nutritional status of children 24–60 months attending early child development centres in a semi-rural community in South Africa.

Maleki, M., Chehrzad, M.M., Kazemnezhad Leyli, E., Mardani, A. and Vaismoradi, M., 2019. Social skills in preschool children from teachers' perspectives. *Children*, 6(5), p.64.

Mandla, N., Mackay, C. and Mda, S., 2022. Prevalence of severe acute malnutrition and its effect on under-five mortality at a regional hospital in South Africa. *South African Journal of Clinical Nutrition*, 35(4), pp.149-154.

Matvienko-Sikar, K., Toomey, E., Delaney, L., Harrington, J., Byrne, M. and Kearney, P.M., 2018. Effects of healthcare professional delivered early feeding interventions on feeding practices and dietary intake: A systematic review. *Appetite*, 123, pp.56-71.

McCoy, D.C., Peet, E.D., Ezzati, M., Danaei, G., Black, M.M., Sudfeld, C.R., Fawzi, W. and Fink, G., 2016. Early childhood developmental status in low-and middle-income countries: national, regional, and global prevalence estimates using predictive modelling. *PLoS medicine*, 13(6), p.e1002034.

McKersie, J. and Baard, M.L., 2014. Obesity in 7-10-year-old children in urban primary schools in Port Elizabeth. *South African Journal of Sports Medicine*, 26(2), pp.55-58.

McPhie, S., Skouteris, H., Daniels, L. and Jansen, E., 2014. Maternal correlates of maternal child feeding practices: a systematic review. *Maternal & child nutrition*, 10(1), pp.18-43.

Mekonnen, T.C., Workie, S.B., Yimer, T.M. and Mersha, W.F., 2017. Meal frequency and dietary diversity feeding practices among children 6–23 months of age in Wolaita Sodo town, Southern Ethiopia. *Journal of Health, Population, and Nutrition*, 36(1), pp.1-8.

Mello, C.S., Barros, K.V. and Morais, M.B.D., 2016. Brazilian infant and preschool children feeding: literature review. *Jornal de pediatria*, 92, pp.451-463.

Mensah, D.O., Nunes, A.R., Bockarie, T., Lillywhite, R. and Oyebode, O., 2021. Meat, fruit, and vegetable consumption in sub-Saharan Africa: a systematic review and meta-regression analysis. *Nutrition Reviews*, 79(6), pp.651-692.

Metwally, A.M., Abdallah, A.M., Salah El-Din, E.M., Khadr, Z., Raouf, E.R.A., Elghareeb, N.A., Saleh, R.M., Abuelela, M.H., Amer, H.A., Hasanin, H.M. and Mawla, M.A.A., 2022. A national prevalence and profile of single and multiple developmental delays among children: an Egyptian community-based study. *Child and Adolescent Psychiatry and Mental Health*, 16(1), p.63.

Miglioli, T.C., Fonseca, V.M., Gomes, S.C., Silva, K.S.D., Lira, P.I.C.D. and Batista, M., 2015. Factors associated with the nutritional status of children less than 5 years of age. *Revista de saude publica*, 49, pp.1-9.

Mkhawani, K., Motadi, S.A., Mabapa, N.S., Mbhenyane, X.G. and Blaauw, R., 2016. Effects of rising food prices on household food security on female headed households in Runnymede Village, Mopani District, South Africa. *South African journal of clinical nutrition*, 29(2), pp.69-74.

Mkhize, M. and Sibanda, M., 2020. A review of selected studies on the factors associated with the nutrition status of children under the age of five years in South Africa. *International Journal of Environmental Research and Public Health*, 17(21), p.7973.

Modjadji, P. and Madiba, S., 2019. Childhood undernutrition and its predictors in a rural health and demographic surveillance system site in South Africa. *International journal of environmental research and public health*, 16(17), p.3021. (a)

Modjadji, P. and Madiba, S., 2019. The double burden of malnutrition in a rural health and demographic surveillance system site in South Africa: A study of primary schoolchildren and their mothers. *BMC Public Health*, 19(1), pp.1-11. (b)

Modjadji, P., Molokwane, D. and Ukegbu, P.O., 2020. Dietary diversity and nutritional status of preschool children in North West Province, South Africa: A cross-sectional study. *Children*, 7(10), p.174.

Montenegro, C.R., Gomez, G., Hincapie, O., Dvoretskiy, S., DeWitt, T., Gracia, D. and Misas, J.D., 2022. The pediatric global burden of stunting: Focus on Latin America. *Lifestyle Medicine*, *3*(3), p.e67.

Möller, I., Du Plessis, L.M. and Daniels, L.C., 2021. Field-testing of the revised, draft South African Paediatric Food-Based Dietary Guidelines among Siswati-speaking mothers/caregivers of children aged 0–36 months in Kabokweni, Mpumalanga Province, South Africa. *South African Journal of Clinical Nutrition*, *34*(4), pp.145-150.

Motadi, S.A., Mbhenyane, X.G., Mbhatsani, H.V., Mabapa, N.S. and Mamabolo, R.L., 2015. Prevalence of iron and zinc deficiencies among preschool children ages 3 to 5 y in Vhembe district, Limpopo Province, South Africa. *Nutrition*, *31*(3), pp.452-458.

Muhoozi, G.K., Atukunda, P., Mwadime, R., Iversen, P.O. and Westerberg, A.C., 2016. Nutritional and developmental status among 6-to 8-month-old children in southwestern Uganda: a cross-sectional study. *Food & nutrition research*, 60(1), p.30270.

Mundy, L., 2013. The richer sex: How the new majority of female breadwinners is transforming our culture. Simon and Schuster.

Munthali, A.C., Mvula, P.M. and Silo, L., 2014. Early childhood development: the role of community based childcare centres in Malawi. *SpringerPlus*, 3(1), pp.1-10.

Murphy, R., Jolley, E., Lynch, P., Mankhwazi, M., Mbukwa, J., Bechange, S., Gladstone, M.J. and Schmidt, E., 2020. Estimated prevalence of disability and developmental delay among preschool children in rural Malawi: Findings from "Tikule Limodzi," a cross-sectional survey. *Child: Care, Health and Development*, 46(2), pp.187-194.

Mushaphi, L.F., 2011. Impact of a nutrition education programme on the nutritional status of children aged 3 to 5 years and the nutritional practices and knowledge of their caregivers in rural Limpopo Province, South Africa (Doctoral dissertation, University of the Free State).

Mushaphi, L.F., Dannhauser, A., Walsh, C.M., Mbhenyane, X.G. and Van Rooyen, F.C., 2017. The impact of a nutrition education programme on feeding practices of caregivers with children aged 3 to 5 years in rural Limpopo Province, South Africa. *South African Journal of Clinical Nutrition*, 30(4), pp.101-108.

Mutisya, M., Kandala, N.B., Ngware, M.W. and Kabiru, C.W., 2015. Household food (in) security and nutritional status of urban poor children aged 6 to 23 months in Kenya. *BMC public health*, 15(1), pp.1-10.

Mutunga, M., Frison, S., Rava, M. and Bahwere, P., 2020. The forgotten agenda of wasting in Southeast Asia: Burden, determinants and overlap with stunting: A review of nationally representative cross-sectional demographic and health surveys in six countries. *Nutrients*, 12(2), p.559.

National Department of Health (NDoH), Infant and Young Child Feeding Policy 2013.

National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and ICF, 2019. South Africa demographic and health survey 2016. NDoH, Stats SA, SAMRC, & ICF.

Negash, S., Agyemang, C., Matsha, T.E., Peer, N., Erasmus, R.T. and Kengne, A.P., 2017. Differential prevalence and associations of overweight and obesity by gender and population group among school learners in South Africa: a cross-sectional study. *BMC obesity*, 4(1), pp.1-8.

Nesamvuni, C.N., 2014. Food safety indicators in household food security in the Rural Vhembe district, Limpopo Province, South Africa (Doctoral dissertation, University of the Free State).

Niawaroh, Z. and Santosa, F.R.E., 2018. Identification of Factors Affecting Household Waste Management for SDGs Achievements in North Sumatra. *IJIEEB International Journal of Integrated Education, Engineering and Business eISSN 2615-1596 pISSN 2615-2312*, 1(2), pp.163-168.

Niles, M.T., Emery, B.F., Wiltshire, S., Brown, M.E., Fisher, B. and Ricketts, T.H., 2021. Climate impacts associated with reduced diet diversity in children across nineteen countries. *Environmental Research Letters*, 16(1), p.015010.

Ntenda, P.A., Nkoka, O., Bass, P. and Senghore, T., 2018. Maternal anaemia is a potential risk factor for anaemia in children aged 6–59 months in Southern Africa: a multilevel analysis. *BMC public health*, 18(1), pp.1-13.

Nyaradi, A., Li, J., Hickling, S., Foster, J. and Oddy, W.H., 2013. The role of nutrition in children's neurocognitive development, from pregnancy through childhood. *Frontiers in human neuroscience*, *7*, p.97.

Ochola, S. and Masibo, P.K., 2014. Dietary intake of schoolchildren and adolescents in developing countries. *Annals of Nutrition and Metabolism*, 64(Suppl. 2), pp.24-40.

Ogechi, U.P. and Chilezie, O.V., 2017. Assessment of dietary diversity score, nutritional status and socio-demographic characteristics of under-5 children in some rural areas of Imo State, Nigeria. *Malaysian Journal of Nutrition*, 23(3), pp.425-435.

Olivieri, C., 2020. Childhood Obesity, Health & Nutrition and Its Effects on Learning. *Journal for Leadership and Instruction*, *19*(1), pp.31-37.

Onyango, A.W., Borghi, E., de Onis, M., del Carmen Casanovas, M. and Garza, C., 2014. Complementary feeding and attained linear growth among 6–23-month-old children. *Public health nutrition*, 17(9), pp.1975-1983.

Otitoola, O., Oldewage-Theron, W. and Egal, A., 2021. Prevalence of overweight and obesity among selected schoolchildren and adolescents in Cofimvaba, South Africa. *South African Journal of Clinical Nutrition*, 34(3), pp.97-102.

Oumer, A., Fikre, Z., Girum, T., Bedewi, J., Nuriye, K. and Assefa, K., 2022. Stunting and underweight, but not wasting are associated with delay in child development in southwest Ethiopia. *Pediatric Health, Medicine and Therapeutics*, pp.1-12.

Pantoja-Mendoza, I.Y., Meléndez, G., Guevara-Cruz, M. and Serralde-Zúñiga, A.E., 2015. Review of complementary feeding practices in Mexican children. *Nutrición Hospitalaria*, 31(2), pp.552-558.

Patel, D. and Issac, G., 2019. Study on impact of protein energy malnutrition on development in children. *Int J Contemp Pediatr*, 6, pp.2566-70.

Perera, T., Frei, S., Frei, B., Wong, S.S. and Bobe, G., 2015. Improving nutrition education in us elementary schools: Challenges and opportunities. *Journal of education and practice*, 6(30), pp.41-50.

Pérez-Escamilla, R. and Moran, V.H., 2017. The role of nutrition in integrated early child development in the 21st century: contribution from the *Maternal and Child Nutrition journal*.

Pienaar, A.E., 2015. Prevalence of overweight and obesity among primary school children in a developing country: NW-CHILD longitudinal data of 6–9-yr-old children in South Africa. *BMC obesity*, 2(1), pp.1-10.

Prado, E.L., Abbeddou, S., Adu-Afarwuah, S., Arimond, M., Ashorn, P., Ashorn, U., Bendabenda, J., Brown, K.H., Hess, S.Y., Kortekangas, E. and Lartey, A., 2017. Predictors and pathways of language and motor development in four prospective cohorts of young children in Ghana, Malawi, and Burkina Faso. *Journal of Child Psychology and Psychiatry*, 58(11), pp.1264-1275.

Press, R., 2015. Developmental milestones of young children. Redleaf Press.

Quaidoo, E.Y., Ohemeng, A. and Amankwah-Poku, M., 2018. Sources of nutrition information and level of nutrition knowledge among young adults in the Accra metropolis. *BMC public health*, 18, pp.1-7.

Quamme, S.H. and Iversen, P.O., 2022. Prevalence of child stunting in Sub-Saharan Africa and its risk factors. *Clinical Nutrition Open Science*.

Rehm, C.D., Peñalvo, J.L., Afshin, A. and Mozaffarian, D., 2016. Dietary intake among US adults, 1999-2012. *Jama*, 315(23), pp.2542-2553.

Reilly, J.J., 2017. Mid-upper arm circumference (MUAC): new applications for an old measure. *Archives of Disease in Childhood*, 102(1), pp.1-2.

Ronquest-Ross, L.C., Vink, N. and Sigge, G.O., 2015. Food consumption changes in South Africa since 1994. *South African Journal of Science*, 111(9-10), pp.01-12.

Sacolo-Gwebu, H., Chimbari, M. and Kalinda, C., 2019. Prevalence and risk factors of schistosomiasis and soil-transmitted helminthiases among preschool aged children (1–5 years) in rural KwaZulu-Natal, South Africa: a cross-sectional study. *Infectious diseases of poverty*, 8, pp.1-12.

Sanyaolu, A., Okorie, C., Qi, X., Locke, J. and Rehman, S., 2019. Childhood and adolescent obesity in the United States: a public health concern. *Global pediatric health*, 6, p.2333794X19891305.

Sartorius, B., Sartorius, K., Green, R., Lutge, E., Scheelbeek, P., Tanser, F., Dangour, A.D. and Slotow, R., 2020. Spatial-temporal trends and risk factors for undernutrition and obesity among children (< 5 years) in South Africa, 2008–2017: findings from a nationally representative longitudinal panel survey. *BMJ open*, 10(4), p.e034476.

Schienkiewitz, A., Damerow, S. and Schaffrath Rosario, A., 2018. Prevalence of underweight, overweight and obesity among children and adolescents in Germany. *KiGGS Wave 2 results according to international reference systems*.

Senekal, Marjanne, Johanna H. Nel, Sonia Malczyk, Linda Drummond, Janetta Harbron, and Nelia P. Steyn. "Provincial Dietary Intake Study (PDIS): Prevalence and sociodemographic determinants of the double burden of malnutrition in a representative sample of 1 to under 10-year-old children from two urbanized and economically active provinces in South Africa." *International Journal of Environmental Research and Public Health 16*, no. 18 (2019): 3334.

Sheldrick, R.C., Schlichting, L.E., Berger, B., Clyne, A., Ni, P., Perrin, E.C. and Vivier, P.M., 2019. Establishing new norms for developmental milestones. *Pediatrics*, 144(6).

Shisana, O., Labadarios, D., Rehle, T., Simbayi, L., Zuma, K., Dhansay, A., Reddy, P., Parker, W., Hoosain, E., Naidoo, P. and Hongoro, C., 2014. The South African National Health and Nutrition Examination Survey, 2012: SANHANES-1: the health and nutritional status of the nation.

Shrestha, M.L., Perry, K.E., Thapa, B., Adhikari, R.P. and Weissman, A., 2022. Malnutrition matters: Association of stunting and underweight with early childhood development indicators in Nepal. *Maternal & Child Nutrition*, 18(2), p.e13321.

Skeens, K., Logsdon, M.C., Stikes, R., Ryan, L., Sparks, K., Hayes, P., Myers, J., Davis, D.W. and Dowling, D., 2016. Health literacy and preferences for sources of child health information of mothers with infants in the neonatal intensive care unit. *Advances in Neonatal Care*, 16(4), pp.308-314.

Soldateli, B., Vigo, A. and Giugliani, E.R.J., 2016. Effect of pattern and duration of breastfeeding on the consumption of fruits and vegetables among preschool children. *PLoS One*, 11(2), p.e0148357.

Solomon, D., Aderaw, Z. and Tegegne, T.K., 2017. Minimum dietary diversity and associated factors among children aged 6–23 months in Addis Ababa, Ethiopia. *International journal for equity in health*, 16(1), pp.1-9.

Srivastava, A., Mahmood, S.E., Srivastava, P.M., Shrotriya, V.P. and Kumar, B., 2012. Nutritional status of school-age children-A scenario of urban slums in India. *Archives of public health*, 70(1), pp.1-8.

Ssentongo, P., Ssentongo, A.E., Ba, D.M., Ericson, J.E., Na, M., Gao, X., Fronterre, C., Chinchilli, V.M. and Schiff, S.J., 2021. Global, regional and national epidemiology and prevalence of child stunting, wasting and underweight in low-and middle-income countries, 2006–2018. *Scientific reports*, 11(1), p.5204.

Statistics South Africa (2014), General household survey.

Steenkamp, L., Lategan, R. and Raubenheimer, J., 2016. Moderate malnutrition in children aged five years and younger in South Africa: are wasting or stunting being treated?. *South African Journal of Clinical Nutrition*, 29(1), pp.27-31.

Steyn, N.P., 2013. “Enjoy a variety of foods”: as a food-based dietary guideline for South Africa. *South African journal of clinical nutrition*, 26, pp.S13-S17.

Stober, E.O., 2019. Breaking the Poverty Trap: Is Education the Solution?. *Journal of Humanities and Social Sciences Studies*, 1(5), pp.1-14.

Strooband, K.F., de Rosnay, M. and Okely, A.D., 2021. Prevalence and risk factors of pre-schoolers' fine motor delay within vulnerable Australian communities. *Journal of Paediatrics and Child Health*, 57(1), pp.114-120.

Strydom, S., Du Plessis, L.M. and Daniels, L.C., 2021. Field testing of the revised, draft South African Paediatric Food-Based Dietary Guidelines among mothers/caregivers of children aged 12–36 months in the Stellenbosch Municipality in the Western Cape Province, South Africa. *South African Journal of Clinical Nutrition*, 34(4), pp.139-144.

Sui, Z., Raubenheimer, D. and Rangan, A., 2017. Exploratory analysis of meal composition in Australia: meat and accompanying foods. *Public health nutrition*, 20(12), pp.2157-2165.

Suleman, Y., Darko, E.T. and Agyemang-Duah, W., 2015. Solid waste disposal and community health implications in Ghana: Evidence from Sawaba, Asokore Mampong Municipal Assembly. *J Civil Environ Eng*, 5(6), p.202.

Sunguya, B.F., Poudel, K.C., Mlunde, L.B., Urassa, D.P., Yasuoka, J. and Jimba, M., 2014. Poor nutrition status and associated feeding practices among HIV-positive children in a food secure region in Tanzania: a call for tailored nutrition training. *PloS one*, 9(5), p.e98308.

Syahrul, S., Kimura, R., Tsuda, A., Susanto, T., Saito, R. and Ahmad, F., 2016. Prevalence of underweight and overweight among school-aged children and its association with children's sociodemographic and lifestyle in Indonesia. *International Journal of Nursing Sciences*, 3(2), pp.169-177.

Symington, E.A., Gericke, G.J., Nel, J.H. and Labadarios, D., 2016. The relationship between stunting and overweight among children from South Africa: Secondary analysis of the National Food Consumption Survey–Fortification Baseline I. *South African Medical Journal*, 106(1), pp.65-69.

Thorne-Lyman, A.L., Shrestha, M., Fawzi, W.W., Pasqualino, M., Strand, T.A., Kvestad, I., Hysing, M., Joshi, N., Lohani, M. and Miller, L.C., 2019. Dietary diversity and child development in the far west of Nepal: a cohort study. *Nutrients*, 11(8), p.1799.

Tigga, P.L., Sen, J. and Mondal, N., 2015. Association of some socio-economic and socio-demographic variables with wasting among pre-school children of North Bengal, India. *Ethiopian journal of health sciences*, 25(1), pp.63-72.

Titaley, C.R., Ariawan, I., Hapsari, D., Muasyaroh, A. and Dibley, M.J., 2019. Determinants of the stunting of children under two years old in Indonesia: a multilevel analysis of the 2013 Indonesia Basic Health Survey. *Nutrients*, 11(5), p.1106.

Torlesse, H. and Le, M.T., 2020. South Asia and child wasting–unravelling the conundrum. *Field Exchange* 63, p.7.

Tosheno, D., Mehretie Adinew, Y., Thangavel, T. and Bitew Workie, S., 2017. Risk factors of underweight in children aged 6–59 months in Ethiopia. *Journal of nutrition and metabolism*, 2017.

Troesch, B., Biesalski, H.K., Bos, R., Buskens, E., Calder, P.C., Saris, W.H., Spieldenner, J., Verkade, H.J., Weber, P. and Eggersdorfer, M., 2015. Increased intake of foods with high nutrient density can help to break the intergenerational cycle of malnutrition and obesity. *Nutrients*, 7(7), pp.6016-6037.

Tuyisenge, V., Mushimiyimana, F., Kanyamuhunga, A., Rukabyarwema, J.P., Patel, A.A. and O'Callahan, C., 2023. Screening for developmental delay in urban Rwandan children: a cross sectional study. *BMC pediatrics*, 23(1), p.522.

UNICEF. Malnutrition in children—UNICEF data. UNICEF. 2021. https://data.unicef.org/resources/jme-report-2021/

Utkualp, N. and Ercan, I., 2015. Anthropometric measurements usage in medical sciences. *BioMed research international*, *2015*.

Van Beekum, M., Berger, J., Van Geystelen, J., Hondru, G., Som, S.V., Theary, C., Laillou, A., Poirot, E., Bork, K.A., Wieringa, F.T. and Fortin, S., 2022. The associations between stunting and wasting at 12 months of age and developmental milestones delays in a cohort of Cambodian children. *Scientific Reports*, 12(1), p.17859.

Van der Linde, J., Swanepoel, D.W., Glascoe, F.P., Louw, E.M. and Vinck, B., 2015. Developmental screening in South Africa: Comparing the national developmental checklist to a standardized tool. *African Health Sciences*, 15(1), pp.188-196.

Vatanparast, H., Islam, N., Patil, R.P., Shamloo, A., Keshavarz, P., Smith, J. and Whiting, S., 2019. Consumption of yogurt in Canada and its contribution to nutrient intake and diet quality among Canadians. *Nutrients*, 11(6), p.1203.

Voress, J.K., Maddox, T., 2013. Developmental assessment of young children. 2nd Ed. Examiners manual.

Vorster, H., 2013. Revised food-based dietary guidelines for South Africa: challenges pertaining to their testing, implementation, and evaluation. *South African Journal of Clinical Nutrition*, 26, pp.S3-S4.

Vorster, H.H., Badham, J.B. and Venter, C.S., 2013. An introduction to the revised food-based dietary guidelines for South Africa. *South African Journal of Clinical Nutrition*, *26*, pp.S5-S12.

Vorster, H.H., Badham, J.B. and Venter, C.S., 2013. An introduction to the revised food-based dietary guidelines for South Africa. *South African Journal of Clinical Nutrition*, 26, pp.S5-S12.

Wali, N., Agho, K.E. and Renzaho, A.M., 2020. Factors associated with stunting among children under 5 years in five South Asian countries (2014–2018): Analysis of demographic health surveys. *Nutrients*, 12(12), p.3875.

Workicho, A., Belachew, T., Feyissa, G.T., Wondafrash, B., Lachat, C., Verstraeten, R. and Kolsteren, P., 2016. Household dietary diversity and animal source food consumption in Ethiopia: evidence from the 2011 welfare monitoring survey. *BMC public health*, 16(1), pp.1-11.

WHO, 2010. Nutrition Landscape Information System (NLIS) country profile indicators: interpretation guide. Woolford, S.J., Sidell, M., Li, X., Else, V., Young, D.R., Resnicow, K. and Koebnick, C., 2021. Changes in body mass index among children and adolescents during the COVID-19 pandemic. *Jama*, 326(14), pp.1434-1436.

Wong, P.L. and Fleer, M., 2013. The Development of Learning as the Leading Activity for Hong Kong Immigrant Families in Australia. *International Research in Early Childhood Education*, *4*(1), pp.18-34.

World Health Organization, 1995. Physical status: The use of and interpretation of anthropometry, Report of a WHO Expert Committee. World Health Organization.

World Health Organization, 2008. Indicators for assessing infant and young child feeding practices: part 1: definitions: conclusions of a consensus meeting held 6-8 November 2007 in Washington DC, USA. World Health Organization.

World Health Organization, 2010. Indicators for assessing infant and young child feeding practices: part 2: measurement.

World Health Organization, 2017. Nutrition in the WHO African region.

World Health Organization, 2019. Nutrition Landscape Information System (NLIS) country profile indicators: interpretation guide.

World Health Organization, 2021. Indicators for assessing infant and young child feeding practices: definitions and measurement methods.

Yang, H.W., Ostrosky, M.M., Favazza, P.C., Stalega, M.V. and Block, M.E., 2019. Embedding motor activities into inclusive preschools. *Young Exceptional Children*, 22(4), pp.177-186.

Zayed, A.A., Beano, A.M., Haddadin, F.I., Radwan, S.S., Allauzy, S.A., Alkhayyat, M.M., Al-Dahabrah, Z.A., Al-Hasan, Y.G. and Yousef, A.M.F., 2016. Prevalence of short stature, underweight, overweight, and obesity among school children in Jordan. *BMC Public Health*, 16, pp.1-10.

Zhao, C., Guan, H., Shi, H., Zhang, J., Huang, X. and Wang, X., 2021. Relationships between dietary diversity and early childhood developmental outcomes in rural China. *Maternal & Child Nutrition*, 17(1), p.e13073.

Zhang, J., Guo, S., Li, Y., Wei, Q., Zhang, C., Wang, X., Luo, S., Zhao, C. and Scherpbier, R.W., 2018. Factors influencing developmental delay among young children in poor rural China: a latent variable approach. *BMJ open*, *8*(8), p.e021628.

Zungu, N., Van Onselen, A., Kolanisi, U. and Siwela, M., 2020. Assessing the nutritional composition and consumer acceptability of Moringa oleifera leaf powder (MOLP)-based snacks for improving food and nutrition security of children. *South African Journal of Botany*, 129, pp.283-290.

APPENDICES

Appendix A Converting raw scores to age equivalent

Table A.1
Converting Raw Scores to Age Equivalents

Age equivalent in months	Raw scores									Age equivalent in months
	Cognitive	Communication	Receptive Language	Expressive Language	Social–Emotional	Physical Development	Gross Motor	Fine Motor	Adaptive Behavior	
<1	0–4	0–7	0–4	0–3	0–6	0–8	0–5	0–3	0–6	<1
1	5–6	8–9	5	4	7	9–10	6	4	7	1
2	7–8	10	—	5	8	11–13	7–8	5	—	2
3	9	11	6	—	9	14–16	9–10	6	8	3
4	10–11	12	—	6	10	17–20	11–13	7	9	4
5	12–13	13	7	—	11–12	21–24	14–15	8–9	10	5
6	14–15	14	—	7	13	25–28	16–17	10–11	11	6
7	16	15–16	8	8	14–15	29–32	18–20	12	12–13	7
8	17	17	—	9	16	33–36	21–23	13	14	8
9	18–19	18–19	9	10	17–18	37–39	24–25	14	15	9
10	20–21	20–22	10–11	11	19–20	40–43	26–28	15	16–17	10
11	22–23	23	12	—	21	44–45	29–30	—	18	11
12	24	24–25	13	12	22	46–47	31	16	19	12
13	25–26	—	—	—	23	48	32	—	20	13
14	27	26–27	14	13	24	49	33	—	—	14
15	28	—	—	—	25	50–51	34	17	21	15
16	—	28–29	15	14	26	52	35	—	—	16
17	29	30–31	16	15	27	53–54	36	18	22	17
18	30	—	—	—	—	55	37	—	23	18
19	—	32	—	16	28	56	38	—	—	19
20	31	33–34	17	17	29	57–58	39	19	24	20
21	32	—	—	—	30	—	—	—	25	21
22	—	35	18	—	31	—	—	—	26	22
23	33	36–37	19	18	32	59–60	40	20	27	23
24	34	38	—	19	—	—	—	—	28	24
25	35	39–40	20	20	33	—	—	—	29	25

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Appendix B Converting raw scores to standard scores

Table B.22. Converting Raw Scores to Standard Scores
Age 37–39 Months

Raw score	Standard score							Raw score
	Cognitive	Receptive Language	Expressive Language	Social–Emotional	Gross Motor	Fine Motor	Adaptive Behavior	
<9	<50	<50	<50	<50	<50	<50	<50	<9
9	<50	<50	50	<50	<50	50	<50	9
10	<50	50	53	50	<50	52	<50	10
11	<50	53	55	51	<50	56	50	11
12	<50	56	58	53	<50	60	51	12
13	<50	59	60	54	<50	64	53	13
14	50	62	63	56	<50	68	54	14
15	51	64	65	57	<50	72	56	15
16	53	67	68	59	<50	75	58	16
17	54	70	70	60	<50	79	60	17
18	56	73	73	62	<50	83	61	18
19	57	76	75	63	<50	87	63	19
20	59	79	78	65	<50	91	65	20
21	60	82	80	66	<50	95	66	21
22	62	85	83	68	<50	99	68	22
23	63	88	85	69	<50	103	70	23
24	65	91	88	71	<50	106	72	24
25	66	94	90	72	<50	110	73	25
26	68	97	93	74	<50	114	75	26
27	69	100	95	75	<50	118	77	27
28	71	103	98	77	50	122	79	28
29	72	106	100	78	52	124	80	29
30	74	109	103	80	55	128	82	30
31	75	112	105	81	58	130	84	31
32	77	115	108	83	61	133	86	32
33	79	118	110	84	64	134	87	33
34	80	121	113	86	67	—	89	34
35	82	124	115	87	70	—	91	35
36	83	127	118	89	73	—	93	36
37	85	130	120	90	76	—	94	37
38	86	—	123	92	79	—	96	38
39	88	—	125	93	82	—	98	39
40	89	—	128	95	85	—	99	40
41	91	—	130	96	88	—	101	41
42	92	—	—	98	91	—	103	42
43	94	—	—	99	94	—	105	43
44	95	—	—	101	100	—	106	44
45	97	—	—	102	106	—	108	45

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Appendix C Converting standard scores to percentile rank

Table C.1
Converting Standard Scores to Percentile Ranks

Standard score	Percentile rank	Standard score	Percentile rank	Standard score	Percentile rank
160	>99.9	119	90	78	7
159	>99.9	118	88	77	6
158	>99.9	117	87	76	5
157	>99.9	116	86	75	5
156	>99.9	115	84	74	4
155	>99.9	114	82	73	4
154	>99.9	113	81	72	3
153	>99.9	112	79	71	3
152	>99.9	111	77	70	2
151	>99.9	110	75	69	2
150	>99.9	109	73	68	2
149	>99.9	108	70	67	1
148	99.9	107	68	66	1
147	99.9	106	66	65	1
146	99.9	105	63	64	1
145	99.9	104	61	63	1
144	99.8	103	58	62	1
143	99.8	102	55	61	0.5
142	99.7	101	53	60	0.4
141	99.7	100	50	59	0.3
140	99.6	99	47	58	0.3
139	99.5	98	45	57	0.2
138	99	97	42	56	0.2
137	99	96	39	55	0.1
136	99	95	37	54	0.1
135	99	94	34	53	0.1
134	99	93	32	52	0.1
133	99	92	30	51	<0.1
132	98	91	27	50	<0.1
131	98	90	25	49	<0.1
130	98	89	23	48	<0.1
129	97	88	21	47	<0.1
128	97	87	19	46	<0.1
127	96	86	18	45	<0.1
126	96	85	16	44	<0.1
125	95	84	14	43	<0.1
124	95	83	13	42	<0.1
123	94	82	12	41	<0.1
122	93	81	10	40	<0.1
121	92	80	9		
120	91	79	8		

Appendix D Converting sums of subdomain standard scores to domain standard scores

Table D.1
Converting Sums of Subdomain Standard Scores to Domain Standard Scores

Sum of RL + EL or GM + FM	Standard score	Sum of RL + EL or GM + FM	Standard score	Sum of RL + EL or GM + FM	Standard score
100–101	49	166–167	83	227–229	117
102	50	168–170	84	230–231	118
103	51	171–172	85	232–233	119
104–105	52	173–174	86	234–235	120
106–107	53	175–176	87	236–237	121
108–109	54	177–178	88	238–239	122
110–111	55	179–180	89	240–241	123
112–113	56	181–182	90	242–243	124
114–115	57	183–184	91	244–245	125
116–117	58	185–186	92	246–247	126
118–119	59	187–188	93	248–249	127
120–121	60	189–190	94	250–251	128
122–123	61	191–192	95	252–253	129
124–125	62	193–195	96	254–255	130
126–127	63	196–197	97	256	131
128–129	64	198	98	257–258	132
130–131	65	199	99	259–260	133
132–133	66	200	100	261–262	134
134–135	67	201	101	263–264	135
136–137	68	202	102	265–266	136
138–139	69	203–204	103	267–268	137
140–141	70	205	104	269–270	138
142–143	71	206–207	105	271–272	139
144	72	208–209	106	273–274	140
145–146	73	210–211	107	275–276	141
147–148	74	212	108	277–278	142
149–150	75	213–214	109	279–280	143
151	76	215–216	110	281–282	144
152–153	77	217–218	111	283–284	145
154–155	78	219	112	285–286	146
156–158	79	220–221	113	287–288	147
159–160	80	222–223	114	289–292	148
161–163	81	224	115	293–296	149
164–165	82	225–226	116	297–300	150

Note. RL = Receptive Language; EL = Expressive Language; GM = Gross Motor; FM = Fine Motor.

Appendix E Converting sums of domain standard scores to general development index

Table E.1
Converting Sums of Domain Standard Scores to General Development Index

Sum of COG + COM + SE + PD + AB	General Development Index	Sum of COG + COM + SE + PD + AB	General Development Index	Sum of COG + COM + SE + PD + AB	General Development Index
250	49	437–440	83	563–565	117
251	50	441–445	84	566–569	118
252–253	51	446–449	85	570–572	119
254–258	52	450–454	86	573–576	120
259–263	53	455–458	87	577–579	121
264–268	54	459–462	88	580–583	122
269–274	55	463–466	89	584–586	123
275–279	56	467–471	90	587–590	124
280–285	57	472–475	91	591–593	125
286–291	58	476–479	92	594–597	126
292–296	59	480–483	93	598–600	127
297–302	60	484–487	94	601–604	128
303–308	61	488–491	95	605–608	129
309–315	62	492–496	96	609–611	130
316–321	63	497	97	612–615	131
322–327	64	498	98	616–619	132
328–334	65	499	99	620–623	133
335–341	66	500–503	100	624–628	134
342–348	67	504–506	101	629–632	135
349–354	68	507–510	102	633–637	136
355–361	69	511–514	103	638–643	137
362–368	70	515–518	104	644–650	138
369–375	71	519–521	105	651–657	139
376–381	72	522–525	106	658–667	140
382–387	73	526–529	107	668–678	141
388–393	74	530–533	108	679–688	142
394–399	75	534–536	109	689–698	143
400–405	76	537–540	110	699–707	144
406–410	77	541–544	111	708–715	145
411–416	78	545–547	112	716–722	146
417–421	79	548–551	113	723–729	147
422–426	80	552–554	114	730–736	148
427–431	81	555–558	115	737–742	149
432–436	82	559–562	116	743–750	150

Note. COG = Cognitive; COM = Communication; SE = Social–Emotional; PD = Physical Development; AB = Adaptive Behavior.

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Appendix F: Letter of information

RESEARCH ETHICS COMMITTEE

UNIVEN Informed Consent

LETTER OF INFORMATION

Title of the Research Study: Nutritional status and milestone development of children aged 3 to 5 years attending early childhood development centers at Chief Albert Luthuli Municipality

Principal Investigator/s/ researcher : Mthokozisi Khumalo, Bachelor of Science in Nutrition

Co-Investigator/s/supervisor/s : Dr. Mushaphi LF - PhD
: Mr. Mahopo TC - PhD
: Ms. Mbhatsani HV - PhD

Brief Introduction and Purpose of the Study: Sufficient nutrition is essential in early childhood to ensure healthy growth, strong immune system, proper organ formation, and neurological as well as cognitive development. However, nutritional inadequacies have been reported in children below five years. The study will aim to investigate the nutritional status and milestone development of children in early childhood development centers at Chief Albert Luthuli municipality.

Outline of the Procedures: Data will be collected using a questionnaire developed in consultation with the study supervisor and literature in line with the aim and objectives of the study. Participants will be interviewed in a private room using the local language and mothers/caregivers will be informants. Children attending ECD centers fulltime in Chief Albert Luthuli municipality will be included in the study. Children who will be sick during data collection will be excluded. Children with known immune suppression diseases will also be excluded. Children with disability will as well be excluded as it will be difficult to assess them and get accurate measurements. Child socio-demographic data will be collected including child age, gender, maternal characteristics and household characteristics information. Anthropometric measurements are going to be taken and children will be required to wear minimal clothing without shoes. Child dietary assessment will also be done. Dietary assessment will go on for 2 more days from first day of data collection for 24-hour recall data collection, through phone call. Developmental screening will be assessed through developmental domains caregiver will affirm child can do affirmatively using a screening tool adopted from the National Department of Health, South Africa. The data collection process may take ±15 minutes per individual.

Risks or Discomforts to the Participant: You will be interviewed and children weight and height/length will be measured during data collection. Your participation is voluntarily and you are free to withdraw from the study at any time and without giving reasons for withdrawal.

Benefits: There are no direct benefits to the participants and the study results. ECD center menus would be reviewed to follow the early childhood food based dietary guidelines. The study will be published as an article to add to the body of knowledge. Information obtained will also be shared with the relevant stakeholders in order to improve the health status of children in ECD. If you participate, the information you will provide will help for the improvement of the nutritional status and developmental milestones, by knowing the nutritional status and milestone development trying to improve on them if there is need. This will assist in improvement of infant's health in Mpumalanga, South Africa.

Reason/s why the Participant May Be Withdrawn from the Study: Children who will be sick during data collection will be withdrawn. Children who develop illness during the study will also be withdrawn. The will be no adverse consequences for the participant should they choose to withdraw.

Remuneration : No remuneration will be received by participants.

Costs of the Study : No cost will be paid by participants in the study.

Confidentiality : All information you provide during the research study will be conduct in confidence and your name will not appear in any report or publication of the research. You will be identified only by a code and your personal information will be handled with a high level of confidentiality. Your data will be safely stored in a locked facility and the researcher and his supervisors will have access to this information. Only members of the University Higher Degree Committee (UHDC) may be allowed access to patient data for quality control purposes under conditions of strict confidentiality.

Research-related injury: Appropriate referrals will be done in case of research related injury. There is no compensation available for any incurred injury.

Persons to Contact in the Event of Any Problems or Queries:

Dr. Mushaphi LF (0824447326). Please contact the researcher (0835956303), my supervisor (0159628334) or the University Research Ethics Committee Secretariat on 015 962 9058. Complaints can be reported to the Director: Research and Innovation, Prof GE Ekosse on 015 962 8313 or Georges Ivo.Ekosse@univen.ac.za General:

Potential participants must be assured that participation is voluntary and the approximate number of participants to be included should be disclosed. A copy of the information letter should be issued to participants. The information letter and consent form must be translated and provided in the primary spoken language of the research population

Appendix G: Caregiver consent form

Statement of Agreement to Participate in the Research Study:

- I……..... hereby confirm that I have been informed by the researcher,

Mthokozisi Khumalo, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____

- I have also received, read and understood the above written information (*Participant Letter of Information*) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during this research which may relate to my participation will be made available to me.

Full Name of Participant_____Date_____Time _____ Signature_____

I, Mthokozisi Khumalo herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Full Name of Researcher

Mthokozisi Khumalo Date_____ Signature_____

Full Name of Witness (If applicable)

..... Date ..... Signature.....

Full Name of Legal Guardian (If applicable)

..... Date..... Signature.....

Please note the following:

Research details must be provided in a clear, simple and culturally appropriate manner and prospective participants should be helped to arrive at an informed decision by use of appropriate language (grade 10 level- use Flesch Reading Ease Scores on Microsoft Word), selecting of a non-threatening environment for interaction and the availability of peer counseling (Department of Health, 2004)

If the potential participant is unable to read/illiterate, then a right thumb print is required and an impartial witness, who is literate and knows the participant e.g. parent, sibling, friend, pastor, etc. should verify in writing, duly signed that informed verbal consent was obtained (Department of Health, 2004).

If anyone makes a mistake completing this document e.g. a wrong date or spelling mistake, a new document has to be completed. The incomplete original document has to be kept in the participant's file and not thrown away, and copies thereof must be issued to the participant.

References:

Department of Health: 2004. *Ethics in Health Research: Principles, Structures and Processes*

http://www.doh.gov.za/docs/factsheets/guidelines/ethnics/

Department of Health. 2006. *South African Good Clinical Practice Guidelines*. 2nd Ed. Available at:

http://www.nhrec.org.za/?page_id=14

Appendix H: ECD Teacher consent form

CONSENT TO PARTICIPATE IN RESEARCH AS AN INFORMANT

Statement of Agreement to Participate in the Research Study:

I……..... hereby confirm that I have been informed by the researcher, Mthokozisi Khumalo, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: SHS/20/NUT/22/0212.

- I have also received, read and understood the above written information (*Participant Letter of Information*) regarding the study.
- I am aware that the results of the study, including personal details will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during this research which may relate to my participation will be made available to me.

I, Mthokozisi Khumalo herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_____ _____

Signature of teacher Date

_____ _____

Signature of Researcher/Fieldworker Date

Appendix I: Assent to participate in research

ASSENT TO PARTICIPATE IN RESEARCH

You have been asked to participate in a research study. You have been told about this study by _____

You can only take part in this study if you want to, and you are comfortable with it. If you do not feel like taking part, it is OK you will not be punished for not agreeing.

If you agree to take part, you will nod your head. Then you will be asked to allow us to put ink in your thumb and then you put your thumb on the form to show that you agree.

What will be happening in the study was verbally explained to me and I understand what will be done by me and to me.

Thumb Print	_____ Date
_____ Signature of caregiver	_____ Date
_____ Signature of Researcher/Fieldworker	_____ Date

Appendix J: Questionnaire

Code					

Date of interview: Year……. Month…….Date……..

Researcher: Khumalo Mthokozisi, MSc (Public Nutrition) student
University of Venda

Instructions: I thank you for your time and accepting to participate in the study. Please answer the following questions as accurately as possible. There is no right or wrong answer. Everything you tell me is confidential. I will put a mark next to the answer that best describe your situation. Feel free to ask me anything you don't understand from now as we are about to start with questions.

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

Information of the child

1. Date of birth

Year	Month	Date	Age (for office use only)

2. Gender

Boy	1	
Girl	2	

Maternal characteristics

3. Date of birth

Year	Month	Date	Age (for office use only)

4. Ethnic group

African	1	
White	2	
Coloured	3	

Indian	4	
Other (specify)	5	

5. Marital status

Single	1	
Married	2	
Living together	3	
Divorced	4	
Widowed	5	

6. Level of education

No education	1	
Grade 1 – 4	2	
Grade 5 – 7	3	
Grade 8 – 10	4	
Grade 11 – 12	5	
Passed grade 12	6	
Tertiary education, specify	7	

7. Who is the breadwinner at home?

Source	1=Yes	2=No
A. Mother		
B. Father		
C. Mother and father		
D. Grandparents		
E. Other (specify)		

7.1 Type of employment of the breadwinner (only one breadwinner)

Teacher	1	
Health care worker	2	
State security force (Police, soldier, traffic officer)	3	
Mine worker	4	
Community worker (home based carer, EPWP)	5	
Hospitality worker	6	
Farm worker	7	
Security guard	8	
Driver	9	
Shop worker	10	
Self employed	11	
No employment	12	
Other (specify)	13	

7.2. Type of employment of the second breadwinner (in case two breadwinners)

Teacher	1	
Health care worker	2	
State security force (Police, soldier, traffic officer)	3	
Mine worker	4	

Community worker (home based carer, EPWP)	5	
Hospitality worker	6	
Farm worker	7	
Security guard	8	
Driver	9	
Shop worker	10	
Self employed	11	
No employment	12	
Other (specify)	13	

8. Do you get any social grant?

Yes	1
No	2

8.1 If yes, specify

Source	1=Yes	2=No
A. Child support		
B. Old age		
C. Disability		
D. Care dependency		
E. Foster child		
F. Other (specify)		

9. Household income per month

<R2000	1	
R2001 – R4000	2	
R4001 – 7000	3	
R7001 – R12000	4	
R12001 – R20000	5	
R20001 – R33000	6	
R33001 – R50000	7	
>R50001	8	

Household characteristics

10. Do you have livestock at home?

Yes	1
No	2

11. If yes, indicate the type of livestock

Type of livestock	1=Yes	2=No
11.1 Cattle		
11.2 Goats		
11.3 Sheep		
11.4 Pigs		
11.5 Chicken		
11.6 Other (specify)		

12. Does household have land for food production?

Yes	1
No	2

13. If yes, indicate the type of land for food production

Type of land for food production	1=Yes	2=No
13.1 Vegetable garden		
13.2 Fruit garden or orchard		
13.3 Subsistence field for ploughing maize/sorghum, etc		
13.4 Other (specify)		

14. Source of drinking water

Home tap water	1	
Communal tap water	2	
Borehole	3	
River	4	
Well	5	
Dam/pool/stagnant water	6	
Water tanker	7	
Other (specify)	8	

15. Type of dwelling

Brick/concrete house	1	
Traditional dwelling/hut/structure made of traditional material	2	
Flat or apartment	3	
Town house	4	
Semi-detached house	5	
House/room in backyard	6	
Informal dwelling/shack	7	
Rented room/flatlet	8	
Other (specify)	9	

16. What is the main way of dumping garbage in the household?

Removed by municipality/private company at least once a week	1	
Removed by municipality/private company less often	2	
Communal refuse dump	3	
Own refuse dump/pit	4	
No rubbish disposal	5	
Other (specify)	6	

17. What is the main type of toilet facility used by the household?

Flush toilet connected with sewerage system	1	
Flush toilet with septic tank	2	
Chemical toilet	3	
Pit toilet	4	

No toilet	5	
Other (specify)	6	

18. Source of energy/fuel for cooking

Source	1=Yes	2=No
18.1 Electricity		
18.2 Gas		
18.3 Paraffin		
18.4 Wood		
18.5 Coal		
18.6 Solar		
18.7 Animal dung		
18.8 Other (specify)		

19. Sources of nutrition information

Source	1=Yes	2=No
19.1 Health care worker		
19.2 Momconnect		
19.3 Television		
19.4 Radio		
19.5 Social media		
19.6 Magazine		
19.7 Other (specify)		

SECTION B: DIETARY ASSESSMENTS

20. How often do you give your child food per day?

Once a day	1	
Twice per day	2	
Three times a day	3	
Four times a day	4	
More than four times a day	5	

21. How often do you give your child vegetables?

Everyday	1	
3 – 5 times per week	2	
Less than 3 times per week	3	
Not sure/once in a while	4	
Never	5	

22. Which of the following vegetables do you usually give to your child?

Vegetable	1=Yes	2=No
22.1 Spinach		
22.2 Pumpkin leaves/tintsanga		
22.3 Beans/mabhontjisi		
22.4 Likhabishi		
22.5 Lidlekedleke		
22.6 Inkaka		

22.7 Tinhlumaya		
22.8 Black jack/chuchuza		
22.9 Lettuce		
22.10 Ligusha		
22.11 Tomato/injujela		
22.12 Potatoes		
22.13 Sweet potato		
22.14 Other vegetables		

23. Do you give your child milk and milk product?

Yes	1
No	2

24. Which of the following milk and milk products do you usually give to your child?

Milk and milk products	1=Yes	2=No
24.1 Fresh milk		
24.2 Emasi		
24.3 Yogurt		
24.4 Cheese		
24.5 Dairy-based ice-cream		
24.6 Other milk and milk products		

25. How often do you give your child milk and milk products?

Everyday	1	
3 – 5 times per week	2	
Less than 3 times per week	3	
Not sure/once in a while	4	
Never	5	

26. Which of the following snacks do you usually give to your child?

Snack type	1=Yes	2=No
26.1 Simba chips		
26.2 Sweets		
26.3 Cold drink		
26.4 Biscuits		
26.5 Squash		
26.6 Other snacks		

27. How often do you give your child snacks?

Everyday	1	
3-5 times per week	2	

Less than 3 times per week	3	
Not sure/once in a while	4	

28. Which of the following fruits do you usually give to your child?

Fruit	1=Yes	2=No
28.1 Mantulwa		
28.2 Manumbela		
28.3 Tincozi		
28.4 Magumence		
28.5 Banana		
28.6 Orange		
28.7 Apple		
28.8 Pear		
28.9 Guava		
28.10 Ovacado		
28.11 Other fruits		

29. How often do you give your child fruits?

Everyday	1	
3-5 times per week	2	
Less than 3 times per week	3	
Not sure/once in a while	4	

30. 24-hour recall

Please tell me what your child ate yesterday and indicate when the food was given to the child, how much of the food the child ate at a time and how many times a day the child ate meals. To help you to describe the amount of food, I will show you utensils and models of different amounts of the food. Please say which model is closest to the amount eaten. Amounts must be reported as cups (c), tablespoon (T), serving spoon (SP), teaspoon (t).

First 24-hour recall

Time	What did the child eat yesterday?	How was it prepared/ what was added?	Amount in cups/spoon/etc.	Amount ml/g (office use)

Second 24 hour recall

Time	What did the child eat yesterday?	How was it prepared/ what was added?	Amount in cups/spoon/etc.	Amount ml/g (office use)

Third 24 hour recall

Time	What did the child eat yesterday?	How was it prepared/ what was added?	Amount in cups/spoon/etc.	Amount ml/g (office use)

SECTION C: ANTHROPOMETRIC MEASUREMENTS

31. Anthropometric measurements

Anthropometry	**Measurement 1**	**Measurement 2**	**Average**
Birth weight		----------	----------
Birth length		----------	----------
Head circumference at birth			
Current weight (kg)			
Current height (cm)			
Current MUAC(cm)			
Current head circumference			

31.1 First MUAC

First MUAC	

31.2 Child age when first MUAC was recorded

6 months	1	
7 – 9 months	2	
10 – 12 months	3	
13 – 15 months	4	
16 – 18 months	5	
> 18 months	6	

32. Did child receive vitamin A supplementation in the previous six months?

Yes	1
No	2

SECTION D: MILESTONE DEVELOPMENT ASSESSMENT

Now I will ask you and observe the milestone development of your child on five development domains: cognitive development, communication development, social-emotional development, physical development, and adaptive behaviour domain. I will ask and observe if your child does exhibit the behaviour described most of the time or did when he/she was younger but has outgrown the behaviour or if your child does not exhibit the behaviour described or exhibits the behaviour inconsistently. Entry/starting points are determined by the child's age and entry/starting points are marked with a star-sign (*).

COGNITIVE DOMAIN
24-35 months: **Item 29** 36-47 months: **Item 40** 48-59 months: **Item 53** 60 months and older: **Item 65**

Entry points	**Milestone Development Domain**	**Score (1 or 0)**
	Cognitive development domain	
*	29. Looks at picture book with adult, may name or point to simple objects	
	30. Manages three to four toys by setting one aside when given a new toy	
	31. Spontaneously names five or more objects	
	32. Stacks six to seven blocks	
	33. Imitates activities using substitute objects to represent real one (e.g., sticks for spoon, wash cloth for doll blanket)	
	34. Matches five or more objects to a corresponding picture	
	35. Sequences related actions in play involving two to three steps (e.g., feeds doll with bottle, then pats it on the back, then puts doll to bed)	
	36. Repeats finger plays with words and actions	
	37. Tells own age (may state or hold up appropriate number of fingers)	
	38. Understands concepts of ''one'' (e.g., ''Give me one block''), ''one more'' (e.g., ''Give me one more''), and ''all'' (e.g., ''Give me all the blocks.'')	
	39. Matches circle, square, and triangle	
*	40. Puts graduated sizes in order (e.g., nests four boxes or stacks rings on peg in order of size)	
	41. States accurately whether boy or girl	
	42. Counts by rote to five	
	43. Counts up to five objects	
	44. Builds bridges using three blocks/cubes (adults models)	
	45. Matches objects by color, shape, and size	
	46. Tells if objects are "heavy'' or ''light''	
	47. Understands concepts of ''same'' and ''different'' (e.g., ''Are these two colours the same?'')	

	48. Matches three pairs of objects that have the same function (e.g., comb and brush, bowl and plate)	
	49. Understands ‘’more’’ and ‘’less’’ (e.g., ‘’Which pile has more?’’)	
	50. Understands concept of ‘’three’’ (e.g., ‘’Give me three blocks.’’)	
	51. Sorts objects by physical characteristics (Give child three or more pictures or objects across at least two variables, e.g., shape or color, and state, ‘’Put these into groups that are alike.’’)	
	52. Sorts objects into categories (Give child three or more objects from at least two categories, e.g., toys or animals, and state, ‘’Put these into groups that are alike.’’)	
*	53. Identifies objects that do not belong in a group (e.g., recognizes that dog does not belong with food item) for three or more object sets	
	54. Imitates drawing of a face with at least three features	
	55. Retells story from picture book with reasonable accuracy	
	56. Builds pyramids of six blocks (adult models)	
	57. Draws people, may be stick figures	
	58. Copies own name; may use large, irregular letters	
	59. Predicts what may happen next (e.g., ask child what may happen next in a story)	
	60. Identifies ‘’first,’’ ‘’last,’’ and ‘’middle’’ (e.g., ‘’Point to the child who is first in line’’)	
	61. Knows sequence of reading a book from left to right, top to bottom	
	62. Distinguish between real and make-believe and living and non-living (e.g., “Is the truck alive?’’ ‘’Show me which of these things are make-believe.’’)	
	63. Understands concept of zero (e.g., ‘’Which cup has zero cubes?’’)	
	64. Identifies ‘’half’’ and ‘’whole’’ objects	
*	65. Names 20 or more letters	
	66. Draws person with six recognizable parts	
	67. Prints first name legibly without a model	
	68. Identifies the larger of two numbers for three or more number sets (e.g., “Which is more, 2 or 3?” ‘’8 or 6?”)	
	69. Matches the number of items in a set to the correct numerical for three or more sets; does not need to state numerical	
	70. Sorts groups of objects in more than one way (Give child pictures or objects across at least two categories, e.g., color, size, or shape, and state, “Put these into groups that are alike. Now sort them in another way.”)	
	71. Puts three pictures in a sequence to tell a story	
	72. Counts up to 20 objects	
	73. Draws five or more identifiable objects without a model	
	74. Arranges numbered tiles or cards (1-10) in sequenced order at least two times	
	75. Consistently tells month and day of birth	
	76. Names days of the week in order	
	77. Writes first and last name from memory	
	78. Consistently tells own street and town	
	79. For numbers 1 through 30, can state the preceding and following numbers for three numbers (e.g., “What number comes before 19?’’ “What number comes afte19?”)	
	80. Can state use of at least three body parts (e.g., “What do you do with your …eyes, nose, ears?”)	
	81. Reads 10 or more printed words	
	82. Names the months of the year	
	83. Writes numerals 1 to 19 without model	
	84. Counts by rote from 1 to 100	
	85. Calculates five or more single-digit addition problems	
	86. Calculates five or more single-digit subtraction problems	
	87. Writes name, address, and phone number	
	88. Measures length to the inch and half inch using ruler	

COMMUNICATION DOMAIN

Receptive language subdomain

24-35 months: **Item 16** 36-47 months: **Item 23** 48-59 months: **Item 27** 60 months and older: **Item 31**

Entry points	Communication development domain	Score (1 or 0)
	Receptive language subdomain	
*	16. Points to three body parts when asked	
	17. Carries out two-step directions that are related (e.g., “Go to the table and bring me the toy.”)	
	18. Points to six body parts when asked	
	19. Points to 15 or more pictures of common objects when they are named	
	20. Understands at least three possessives (e.g., mine, yours, and boys; ‘’Is this your ball?’’ “Show me the dogs food.”)	
	21. Points to five or more common objects described by their use (e.g., “Show me what you eat with.”)	
	22. Carries out two-step unrelated commands (e.g., “Put the ball on the shelf and then claps your hands.”)	
*	23. Understands negative (e.g., ‘’Which is not…red, the dog?’’)	
	24. Knows ‘’big’’ and ‘’little’’ (e.g., ‘’Throw the big ball to me.’’)	
	25. Responds to ‘’who’’ and ‘’whose’’ questions (e.g., ‘’Who has a red shirt today?’’)	
	26. Follows directions about placing one item ‘’beside’’ and ‘’under’’ another	
*	27. Understands ‘’in front of’’ and ‘’behind’’ (e.g., ‘’What is behind the screen?’’)	
	28. Answers comprehension questions when told a story	
	29. Demonstrates understanding of passive sentences (e.g., “Show me the train was pushed by the car.’’)	
	30. Carries out three-step commands that are not related (e.g., “Put the ball on the table, shut the door, and turn around.”)	
*	31. Tells whether two words rhyme or have same ending sound for at least three-word pairs (e.g., Do cat and pat have the same ending sound?”)	
	32. Responds to questions involving time concepts (e.g., “When do we eat lunch?”)	
	33. Understands all four seasons of the year and what you do in each (e.g., “What do we do in summer?”)	
	34. Can identify at least three opposites using pictures or objects (“Show me the opposite of…big/little, hot/cold, tall/short.”)	
	35. Identifies “left” and “right” on own body (e.g., “Raise your right hand.”)	
	36. Can identify at least three units of currency (e.g., “Point to the…cent, silver, note”)	
	37. Can identify at least three complete sentences (“Tell me if this is a complete sentence.” brown dog; The boy ran away.)	

Expressive language subdomain

24-35 months: **Item 16** 36-47 months: **Item 24** 48-59 months: **Item 30** 60 months and older: **Item 34**

Entry points	Expressive language subdomain	Score (1 or 0)
*	16. Can name familiar characters or items seen on TV or in movies (e.g., Big birds)	
	17. Knows names of two or more playmates	
	18. Uses 10 to 15 words spontaneously	
	19. Produces three or more two-word phrases (e.g., more juice)	
	20. Names eight or more pictures of familiar objects	
	21. Whispers	
	22. Uses sentences of three or more words	
	23. Uses at least 50 difference words spontaneous speech	
*	24. Describes what he or she is doing (e.g., responds to ‘’What are you doing?’’)	
	25. Asks ‘’what’’ or ‘’where’’ questions (e.g., “Where is my ball”?)	
	26. Uses five or more regular plurals (e.g., boys, toys)	
	27. Changes speech depending on listener (e.g., talks differently to babies than to adults)	
	28. Gives full name on request (e.g., ‘’What is your name?’’)	
	29. Answers question, ‘’What happens if…’’ (e.g.,” … you drop an egg.’’)	
*	30. Uses five or more contractions (e.g., I’ll, can’t)	
	31. Uses facial expressions and body language to demonstrate at least five emotions (e.g., “Show me how you would look if you were….angry, proud, frightened, scared.”)	

	32. Makes statement about cause and effect (e.g., It won't roll because the wheel is off.'')	
	33. Defines five simple words (e.g., ''What is a car?")	
*	34. Completes at least three simple verbal analogies (e.g., "Daddy is a man; Mommy is a ……?)	
	35. States similarities between objects for at least three object pairs (e.g., "How are shoes and boot alike?")	
	36. Responds to ''Tell me the opposite of ……." (for three words)	
	37. Uses irregular plurals correctly (e.g., foot/feet, goose/geese)	
	38. Tells simple jokes	
	39. States difference between objects for at least three object pairs (e.g., "How are milk and water different?")	
	40. Uses "yesterday" and "tomorrow" meaningfully	
	41. Uses irregular comparatives correctly (e.g., good, better, best)	

SOCIAL-EMOTIONAL DOMAIN

24-35 months: **Item 28** 36-47 months: **Item 38** 48-59 months: **Item 46** 60 months and older: **Item 51**

Entry points	Social-emotional development domain	Score (1 or 0)
*	28. Shows pride in accomplishments	
	29. Quietly listens to story, music, movie, or TV	
	30. Sings familiar songs with adult	
	31. Uses "please" and ''thank you'' appropriately; may need to be reminded	
	32. Asks for assistance when having difficulty	
	33. Looks at person when speaking with him or her	
	34.Usually takes turns	
	35. Recognizes when another person is happy or sad	
	36. Avoids common dangers (e.g., sharp knives, fire, hot stove)	
	37. Plays dress-up	
*	38. Shows off by repeating rhymes, songs, or dances for others	
	39. Changes from one activity to another when required by teacher	
	40. Interacts appropriately with others during group games or activities	
	41. Knows and follows classroom rules	
	42. Gains attention from peers in appropriate ways	
	43. Plays group board or card games	
	44. Volunteers for tasks	
	45. Quiets down after active play	
*	46. Likes competitive games	
	47. Returns objects to their appropriate place	
	48. Accepts mild, friendly teasing	
	49. Explains rules of a game to others	
	50. Expresses anger with nonaggressive words rather than with physical action	
*	51. Offers item or activity to another in exchange for an item or activity	
	52. Accepts valid criticism without crying, pouting, or refusing to continue	
	53. Asks before using another's belongings	
	54. Provides or offers assistance to others when appropriate	
	55. Helps with group projects	
	56. Ends conversations with "good-bye" or other appropriate phrase	
	57. Apologizes if he or she hurts someone's feelings	
	58. Remains calm when small requests are denied (e.g., cannot have a snack)	
	59. Works alone at chore for 20 to 30 minutes	
	60. Completes pencil/paper games (e.g., dot-to-dot, hidden pictures, mazes)	
	61. Initiates group activities	
	62. Congratulates others when appropriate	
	63. Answers the phone, remembers a simple message, and delivers it to the correct person	

PHYSICAL DEVELOPMENT DOMAIN

Gross motor subdomain

24-35 months: **Item 37** 36-47 months: **Item 40** 48-59 months: **Item 43** 60 months and older: **Item 47**

Entry points	Physical development domain	Score (1 or 0)
	Gross motor subdomain	
*	37. Walks up and down stairs with support from rail or wall; may place both feet on each step	
	38. Throws a ball overhand with relative accuracy	
	39. Walks backwards at least 10 ft	
*	40. Walks upstairs, alternating feet, in adults fashion while holding on to rail or wall	
	41. Walks swinging arms and legs freely in cross pattern similar to adult walk pattern	
	42. Catches ball from straight arm position, trapping ball against chest	
*	43. Walks forward heel to toe without losing balance for four or more steps	
	44. Hops forward on one foot without losing balance for four or more steps	
	45. Gallops, leading with one foot and transferring weight smoothly and evenly	
	46. Jumps over objects up to 6 inch high; lands with both feet	
*	47. Balances on one foot with hands on hips for at least 10 seconds	
	48. Swings on swing maintaining own momentum; uses legs to propel	
	49. Bounces and catches tennis ball (or any ball of similar size)	
	50. Skips alternating feet, maintaining balance for 10 feet	
	51. Drops a ball and kicks it forward before it hits the floor	
	52. Catches a small ball (about 4 in) in hands only (doesn't trap against chest)	
	53. Can dribble an 8- to 10-in ball at least four times: uses only one hand and doesn't move feet	
	54. Jumps rope by self	

Fine motor subdomain

24-35 months: **Item 17** 36-47 months: **Item 19** 48-59 months: **Item 22** 60 months and older: **Item 26**

Entry points	Fine motor subdomain	Score (1 or 0)
*	17. Uses one hand consistently in most activities	
	18. Uses hand to hold paper in place when drawing	
*	19. Imitates circular, vertical, and horizontal strokes	
	20. Uses vertical, horizontal, and circular motions when drawing	
	21. Holds pencil between first two fingers and thumb (i.e., adult grasp)	
*	22. Cuts with scissors, making several snips on paper	
	23. Copies a cross	
	24. Pastes or glues neatly	
	25. Copies a square	
*	26. Cuts a 6-in straight line with scissors within ¼ in of the line	
	27. Places at least five paper clips on paper	
	28. Rapidly touches each finger to thumb	
	29. Colours within lines	
	30. Cuts out simple geometric shapes (e.g., circle, square, triangle) with scissors within ¼ in of the line	
	31. Folds paper in half with edges parallel	
	32. Copies a diamond with straight, connected lines	
	33. Cuts intricate shapes within ¼ in of the line	

ADAPTIVE BEHAVIOUR DOMAIN

24-35 months: **Item 23** 36-47 months: **Item 34** 48-59 months: **Item 44** 60 months and older: **Item 50**

Entry points	Adaptive behaviour development domain	Score (1 or 0)
*	23. Tries to wash own hands and face	
	24. Removes loose clothing such as a jacket, shorts, or a shirt without assistance	
	25. Opens door by using handle or knob	
	26. Puts on simple clothing independently (e.g., hat, pants)	
	27. Independently eats entire meals with spoon	
	28. Wipes own nose; may need to be reminded	
	29. Sits on toilet for at least 1 minute supervised	
	30. Squats, holds self, or verbalizes bowel and bladder needs most of the time	
	31. Washes and dries hands and face without assistance	
	32. Cleans up spills, getting own cloth	
	33. Show care when handling an infant or small animal	
*	34. Pours milk or juice with some assistance	
	35. Tells adults of toilet needs in time to get to toilet	
	36. Takes responsibility for toileting; may require assistance in wiping	
	37. Gets drink of water from tap unassisted (may need help getting cup from cupboard	
	38. Brushes teeth independently	
	39. Recognizes own home	
	40. Manipulates large buttons or snaps	
	41. Covers mouth and nose when coughing and sneezing (using hand, elbow, tissue)	
	42. Sleeps through the night without wetting	
	43. Hangs up clothes (hanger, hook, or other designated device)	
*	44. Dresses self completely, except for trying shoelaces (includes underwear; clothes may be on correctly, including all fasteners)	
	45. Serves self at the table (adult may need to hold serving dish)	
	46. Often wants privacy in bathroom	
	47. Answers what-to-do-if question (e.g., “What would you do if you cut your finger?”)	
	48. Fastens seat belt in automobile independently	
	49. Crosses street safely (e.g., looks both ways, uses crosswalks)	
*	50. Puts dirty dishes in washbowl, sink or dishwasher	
	51. Request food to be passed at the table	
	52. Selects clothing appropriate for temperature and occasion	
	53. Makes own bed; may need to be reminded	
	54. Sets and clears table without assistance	
	55. Uses table knife for spreading soft butter, jelly, or peanut butter	
	56. Plans ahead to meet toileting needs before beginning an activity	
	57. Takes shower or bath independently	
	58. Cleans counter or work surface with sponge or paper towels	
	59. Dusts furniture	
	60. Makes simple breakfast and lunch	
	61. Washes own hair	
	62. Takes care of minor cuts (clean and applies bandage)	
	63. Rides a bicycle safely without training wheels	
	64. Cuts food (including meat) into bite-sized pieces	

THANK YOU…

Appendix K

MILESTONE DEVELOPMENT ASSESSMENT TRAINING MANUAL

Training manual for milestone development assessment using the Developmental Assessment of Young Children-Second Edition (DAYC-2) examiner's manual. The following procedures are followed to determine milestone development:

- Method of administration.
- Testing time.
- Entry points, basals, and ceilings.
- Specific administration and scoring instructions for the domains.

1. Consent

Ask the caregiver for the consent form. If caregiver haven't completed it, allow him/her to ask any questions regarding the study and answer politely and honestly. Upon agreement ask him/her to sign the informed consent. Then explain to the child in lay language the study procedure and ask whether he/she is agreeing to participate. After the child give a verbal assent, you can start with the assessment.

2. Method of administration

The scores for the items can be based on any one or all of the three sources, however applying all the three sources avoid under and over scoring. The three sources per the examiner's manual include:

- Observation of the child in their school or home environment (Challenge – you may lack the opportunity to observe the children engaged in day-to-day activities).
- Structured interviews with caregivers or teachers (The most used method of assessment as caregivers and teachers spend most of their time with children. Challenge – caregivers may either under or over report child's development skills).
- Direct assessment of the child (Challenge – young children are shy, mostly can't exhibit their skills to their full potential, while some can exhibit their skills in the presence of their caregivers and teachers once a rapport is established).

Therefore, to avoid under or over scoring children, scores for children development should be based on more than one sources.

3. Testing time

- Testing time has no time limit.
- It depends on the child's age and how well the examiner knows the child. It also depends on the number of domains targeted for assessment.

- For example, much of the information needed to complete the DACY-2 for infants will be obtained by structured interviews with the caregiver. In such cases the length of time required to assess a domain will be relatively short. For older children, additional direct assessment may be needed, and more items may be required to establish a ceiling and basal.

4. Entry points, basals, and ceilings

Entry points, basals, and ceilings are used to shorten testing time. For each domain, begin administration at the appropriate entry point. The entry point for each domain is determined by the child's chronological age and vary from domain to domain. The entry points were determined by selecting the points at which typically developing children would likely be successful on the first few items. Entry points/starting items are shown in Table 3.3 and on each Domain Scoring Form. The items for DAYC-2 are scored either "passed" or "not passed". Passed items earn 1 point; items not passed score 0. The basal is established when the child receives a score of 1 on three items in a row. Begin testing with the entry point item. If the child does not score 1 on each of the first three items administered, that is, if the child receives a 0 on any of the first three items administered starting from the entry point, you should test backward until the child scores 1 on three items in a row. This is the basal. All items below the basal are scored 1. The items become difficult with growing age, so if you are testing backward, items become easy to achieve, thus after the basal all items below are scored 1.

A ceiling occurs when three consecutive items receive a score of 0. If the child did not receive a 0 on three items in succession during the establishment of the basal, return to the highest item number scored and continue testing until a ceiling is established. A true ceiling is the set of three items scored 0 that is closest to the basal. Even though a child may have passed some of the items above the ceiling, they are still counted as incorrect based on the ceiling rule. Because you may use interview, observation, and direct assessment, establishing basals and ceilings may not proceed directly as stated above. Typically, you will interview caregivers as the first option for gathering information to complete the DAYC-2 assessment, focusing on skills near the child's entry point. Since the child will be present, you will/may simultaneously observe the child and record scores as the skills are observed or discussed in the interview. In most cases, that will not be in the same order as the items are listed on the Domain Scoring Form. Because items may not be scored in sequential order, it is important to record scores for all skills observed in case the items are needed to determine a ceiling or basal.

Table 3.3 Starting items for the DAYC-2 based on child's age

Age (months)	Cognitive	Receptive language	Expressive language	Social-emotional	Gross motor	Fine motor	Adaptative behaviour behaviour
Birth–11	1	1	1	1	1	1	1
12-23	19	8	8	16	27	13	14
24-35	29	16	16	28	37	17	23
36-47	40	23	24	38	40	19	34
48-59	53	27	30	46	43	22	44
>60	65	31	34	51	47	26	50

Source: (Voress and Maddox, 2013)

5. Specific administration and scoring instructions for the domains

- Each domain and subdomain have developmental items, and starting points for assessment are determined by child age in months because the Domain Scoring Form for DAYC-2 is presented in months (Appendix J, Section D).
- On the items based on child age, you score 1 if the child does exhibit the behaviour described most of the time or did when he or she was younger but has outgrown the behaviour and you score a 0 if the child does not exhibit the behaviour described or exhibits the behaviour inconsistently.
- To start with the assessment, determine the child's age months since developmental items per domain are assigned numbers on the Domain Scoring Form, and entry points are highlighted.
- Start with the assessment from the entry point then last item to obtain a score of 1 before the ceiling it's the raw score of the child milestone development for that domain under assessment.
- Convert this raw score into normative scores (age equivalent, standard score, percentile rank) using Appendix A, B, and C of the DAYC-2 examiner's guide.
- The communication and physical domains have two subdomains. Record raw score for each subdomain is recorded first and converted into normative scores using the appendices mentioned above.
- Sum the two subdomain raw scores and the two subdomain standard scores.
- Convert the sum of subdomain raw scores into the domain age equivalent using Appendix A.
- Convert the sum of standard scores for the two subdomains into a composite standard score using Appendix D.
- Use Appendix C to convert the composite standard score to a percentile rank.

- After determining each standard score, a descriptive term is recorded for that standard score of development, and they range from very poor to very superior (Table 3.4).
- Sum all the standard scores of the five domains to determine the composite standard score which is called the General Development Index (GDI).
- Look for the index that corresponds with sum of all the five standard scores in Appendix E to find GDI standard score.

Table 3.4 Descriptive terms for standard scores

Standard score	Descriptive term
>130	Very Superior
121 - 130	Superior
111 – 120	Above average
90 – 110	Average
80 – 89	Below average
70 – 79	Poor
<70	Very poor

Source: (Voress and Maddox, 2013)

Appendix L: Training manual

TRAINING MANUAL FOR FIELDWORKERS

1. SAMPLE SELECTION

- From the list of ECD centers in that respective circuit, do random sampling to identify an ECD center to collect data.
- Introduce yourself.
- Explain the purpose of the study, and request permission to collect data from the ECD center principal.
- Upon agreement request the principal to organise a caregivers meeting.
- Meet caregivers and teachers to explain the procedure, aim, and objectives of the study. Politely and honestly answer arising questions, then distribute information sheets and consent forms.
- Verbally clarify to those who need more information, obtain children assent and start data collection immediately.
- Fill in socio-demographic data, dietary assessments, obtain anthropometric measurements, and assess milestone development.

2. CONSENT

Ask the caregiver for the consent form. If caregiver haven't completed it, allow him/her to ask any questions regarding the study and answer politely and honestly. Upon agreement ask him/her to sign the informed consent. Then explain to the child in lay language the study procedure and ask whether he/she is agreeing to participate. After the child give a verbal assent, you can start with the assessment.

3. CONDUCTING INTERVIEWS

3.1 Interview schedule

- In this interview that you will conduct, there are four sections that you need to complete: Socio-demographic data, dietary assessments, anthropometric measurements, and milestone development screening.

3.2 Interview Skills

You need to apply the following guidelines when conducting interviews:

- Introduce yourself. Highlight the information regarding the study aim, and procedures as you explained during the caregivers meeting.
- Request for the signed consent form, then request assent from the child before starting the interview.

- Explain that you will ask questions on socio-demographic data, dietary assessments, and conduct milestone development screening. Explain that you will need to measure weight, height, and Mid Upper Arm Circumference (MUAC) of the child.
- Assure the caregiver of confidentiality of the information that she/he will provide the importance of providing honest answers.
- Ask the questions in the order that they appear on the interview schedule.
- Ask the questions as they are written on the questionnaire.
- Do not try to influence the way the interviewee answers. Do not to lead the interviewee to give you the answer that you expect.
- Keep control of the interview. Do not hurry the interviewee. Allow her to think.
- Make sure that you have completed all the questions on the interview schedule and record sheet.

4. Techniques

4.1 Anthropometric measurements

4.1.1. Weight

- Use a Seca solar scale to measure the weight of children.
- Place the scale on a flat hard surface and zero it using a known weight before taking measurements.
- Children should be weighed without wearing shoes and wearing light clothes. Take an average of two weighings and record numerically on the questionnaire to the nearest 0.01kg, and if the current values appeared unusual, the measurements were repeated (Lee and Nieman, 2013: 170).

4.1.2. Height

- Height will be measured using a Seca 0123 portable stadiometer.
- The child will be asked to remove shoes and remain with light clothes, then stand straight with heels together, arms on the side, relax shoulders and look straight with heels, buttocks, scapular (shoulder blade), and back of the head against the vertical surface of the scale.
- Moderately compress hair and hair ornamentation if it interferes with the measurement.
- Height will be taken twice and recorded on the questionnaire to the nearest 0.1 cm (Lee and Nieman, 2013: 168-169).

4.1.3. Mid Upper Arm Circumference (MUAC)

- MUAC of the left upper arm will be measured at the mid-point between the tip of the shoulder and elbow.
- Mark the mid-point, let the arm hang straight down, and wrap a MUAC tape around the midpoint mark.
- Record MUAC measurement on the questionnaire to the nearest 1mm.

4.2 Dietary assessment

4.2.1. Dietary Practices Questionnaire

- Dietary practice questions will be asked from the interview schedule to:
  - determine the frame the child normally eats at home, and
  - to validate the information from the 24-hour recall.

4.2.2 24-hour recall

- You will collect three 24-hour recalls on different days, with one being a weekend.
- Ask caregivers to recall in detail all foods and beverages consumed by their children in the recent 24 hours. This will be a three-day process.
- Collect a list of foods consumed, the description, and preparation methods for each food item on the list.
- Probe for additional eating occasions that the caregiver might have missed recalling like snacks and fruits.
- Household utensils will be used to estimate portion sizes.

4.3 Milestone development

- For milestone development techniques, refer to Appendix K.

Appendix M: Ethics Certificate

ETHICS APPROVAL CERTIFICATE

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mr M Khumalo

STUDENT NO:
11639744

PROJECT TITLE: **Nutritional status and milestone development of children aged 3 to 5 years attending early childhood development centers at Chief Albert Luthuli municipality.**

ETHICAL CLEARANCE NO: SHS/20/NUT/22/0212

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr LF Mushaphi	University of Venda	Supervisor
Mr TC Mahopo	University of Venda	Co - Supervisor
Ms HV Mbhatsani	University of Venda	Co - Supervisor
Mr. M Khumalo	University of Venda	Investigator – Student

Type: Masters Research
Risk: Minimal risk to humans, animals or environment
Approval Period: November 2020 – November 2022

The Human and Clinical Trails Research Ethics Committee (HCTREC) hereby approves your project as indicated above.

General Conditions
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following.

- The project leader (principal investigator) must report in the prescribed format to the REC:
  - Annually (or as otherwise requested) on the progress of the project, and upon completion of the project
  - Within 48hrs in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project.
  - Annually a number of projects may be randomly selected for an external audit.
- The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project,. the project leader must apply for approval of these changes at the REC. Would there be deviated from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date; a new application must be made to the REC and new approval received before or on the expiry date.
- In the interest of ethical responsibility, the REC retains the right to:
  - Request access to any information or data at any time during the course or after completion of the project,
  - To ask further questions; Seek additional information; Require further modification or monitor the conduct of your research or the informed consent process.
  - withdraw or postpone approval if:
  - Any unethical principles or practices of the project are revealed or suspected.
  - It becomes apparent that any relevant information was withheld from the REC or that information has been false or misrepresented.
  - The required annual report and reporting of adverse events was not done timely and accurately,
  - New institutional rules, national legislation or international conventions deem it necessary

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: September 2020

Name of the HCTREC Chairperson of the Committee: Prof MS Maputle

Signature: MSMaputle

UNIVERSITY OF VENDA
OFFICE OF THE DIRECTOR
RESEARCH AND INNOVATION
2020 -12- 2
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University of Venda
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"A quality driven financially sustainable, rural-based Comprehensive University"

Appendix N: Approval Letter

social development
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

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Mpumalanga Province, Private Bag X 11213, Mbombela, 1200
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Litiko Letekutfutfukisa Tenhlalakahle | UmNyango WezokuThuthukiswa KwezokuHlalokuhle | Departement van Maatskaplike Ontwikkeling

Enq: Ms. Elize Botha
Tel: 013 766 3053
Ref No.: 12/5/R

MR. M. Khumalo
mthokozisikhumalo@gmail.com
Cell: 083 595 6303

RE: REQUEST TO CONDUCT RESEARCH STUDY WITH EARLY CHILDHOOD DEVELOPMENT CENTRES IN CHIEF ALBERT LUTHULI

Dear Mr. Khumalo,
Student No. 11639744

Your communique dated 21 January 2021 has reference.

The Department gladly supports your research on "Nutritional Status and Milestone Development of Children Aged 3 to 5 Years attending Early Childhood Development Centres at Chief Albert Luthuli Municipality." In principle the department has no objection against you accessing Early Childhood Development (ECD) Centres to conduct your research, however:

- Even though the Department of Social Development supports and works closely with these Centres, they remain autonomous and you will have to obtain consent from them.
- As per your project proposal the required written consent has to be obtained.
- Since the Department will have an interest in the outcomes of your study, you are requested to share your final report with the programme manager for ECD.

You can contact Ms. Doreen Malinga who is the manager for the ECD programme regarding the database required for your sampling. Tel: 013 766 3627 / DoreenM@dsdmpu.gov.za

The Department wishes you all the best of with your endeavours and look forward to the outcomes of your study.

Kind regards,

MS SM MTSWENI
HEAD: SOCIAL DEVELOPMENT
DATE: 27·01·2021

Appendix O: Editorial Letter

Editorial letter

This serves to confirm that I, Dr. TE Sikitime, attached to University of Venda, Department of English Media Studies and Linguistics have proofread a dissertation titled: **Nutritional Status And Milestone Development Of Children Aged 3 To 5 Years Attending Early Childhood Development Centers At Chief Albert Luthuli Municipality**

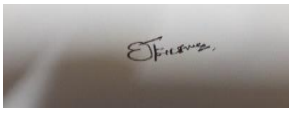
BY

Khumalo Mthokozisi

Student number: 11639744

Editorial work focused mainly on technical precision and common errors relating to syntax, diction, word order and formulation of ideas. Corrections and suggestions were made for the student to effect before submission.

Signature **Date 22/02/2024**



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