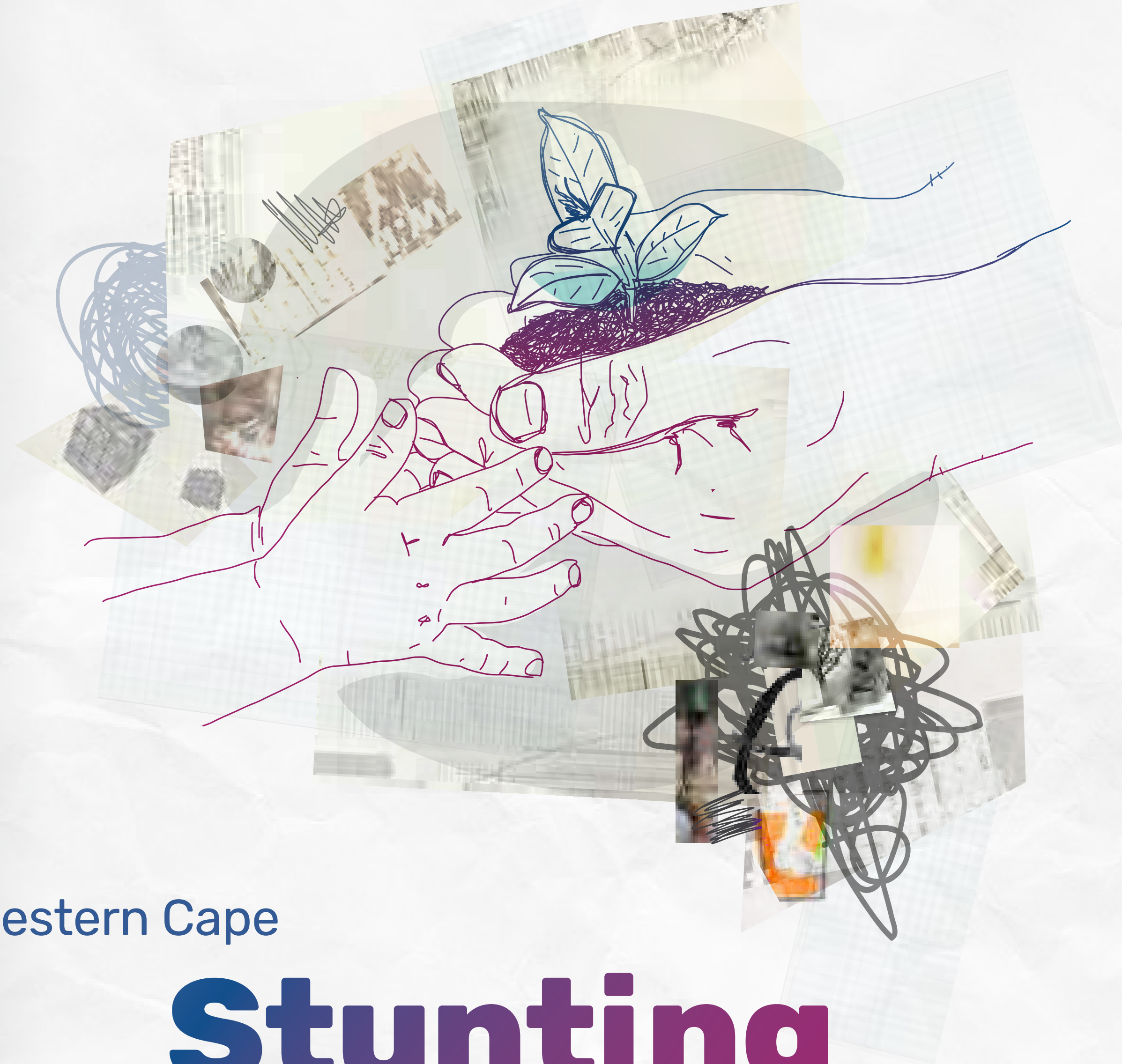

Western Cape

# Stunting Baseline Survey

on under-5-year-old children

A collaboration between the Western Cape Department of Health and Wellness and the DG Murray Trust.

Western Cape Government
Health and Wellness
FOR YOU

F1RST 1000 days
Right Start. Bright Future.

UNIVERSITY OF CAPE TOWN

DG MT

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***All 1 214 participants and their caregivers who were willing to give us some of their time and personal information***

Data collection period: 4 June–27 October 2022

The investigators spent countless hours on this study in the hope that the outcomes will make a major contribution to ensuring healthy growth and overall well-being of children in the Western Cape Province and South Africa as a whole.

*We dedicate this report to all children in South Africa.*

February 2023

# FOREWORD

Reducing the prevalence of stunting in the province is one of the six main outcomes for the Western Cape Government in line with its Vision-Inspired Priority of Empowering People. It is a key measure of success in achieving childhood well-being. Without adequate nutrition, children cannot be healthy or learn properly, and without learning, our society and economy cannot grow. For this reason, the Western Cape Government: Health and Wellness (WCG: H&W) partnered with the DG Murray Trust (DGMT) and the University of Cape Town (UCT) to conduct a stunting baseline survey in the province as part of its commitment to a data-led and evidence-informed learning culture. If we are to track progress, we need good information.

WCG: H&W supports the full institutionalisation of the multi-sectoral Nurturing Care Framework in order for all children to thrive and reach their full potential. The nurturing care framework outlines five key components that are interrelated and indivisible: good health, adequate nutrition, safety and security, responsive caregiving and opportunities for early learning. Nurturing care refers to a stable environment created by parents and other caregivers which ensures good health and nutrition for children, protects them from threats and gives them opportunities for early learning through responsive, supportive interactions. All these components are important and need to be provided in alignment with each other in order for children to be nurtured in early childhood.

The fieldwork and report-writing for this survey were completed during the 2022/23 financial year. The good news is that since previous surveys, the prevalence of stunting appears to have decreased. However, it is still far too high. The findings also highlight the need for key interventions to address both stunting and obesity simultaneously while optimising the use of limited resources to improve the well-being of individuals and communities.

The Western Cape Government ultimately aims to reduce stunting rates as part of its well-being recovery plan. The representative data derived from this survey helps us understand the drivers of stunting and allows us to plan and strengthen appropriate interventions across the whole government and society, and to inform local targeted interventions.

Practical steps that can be taken include: advocating for public policy reforms (e.g. accurate and easy-to-understand food labelling; stronger controls on the marketing of unhealthy foods, etc.); incentivising the provision of affordable healthy food through viable food supply systems; supporting vulnerable families with food choices; and monitoring child growth specifically supporting children under two years of age whose growth is faltering. The collection, analysis and use of good-quality data and evidence should guide future action and track progress.

WCG: H&W has invested in a range of interventions across the Department as part of the First Thousand Days (FTD) Initiative since 2016, in collaboration with a wide range of partners, including NPOs, CBOs, academic units and other government departments.

This project is an example of what can be done through partnership, and lays the basis for an accelerated joint response to improving the nutrition, health and well-being of the children of the Western Cape.

**Dr Keith Cloete**
Head of the Department of Health and Wellness, Western Cape

**Dr David Harrison**
Chief Executive Officer, DG Murray Trust

# EXECUTIVE SUMMARY

## BACKGROUND

It is generally acknowledged that stunting is the best indicator of a child's well-being and that a child's linear growth potential is largely determined by the time they turn 2 years old. Many countries in sub-Saharan Africa, including South Africa, also have a high prevalence of overweight and obesity in children, amounting to a double burden of malnutrition. Stunting is associated with many disorders including reduced neurodevelopment, lifelong cognitive deficits, educational and employment challenges, increased risk of obesity and non-communicable diseases (NCDs) in adulthood, and cycles of intergenerational poverty.

In an attempt to address the burden of malnutrition in the Western Cape, the Western Cape Department of Health (WCDoH) and DG Murray Trust (DGMT) in collaboration with investigators from the University of Cape Town (UCT) and Stellenbosch University (SU), conducted a survey to compile a comprehensive anthropometric malnutrition profile (stunting, underweight, thinness, overweight and obesity) in a representative sample of infants and children under 5 years of age in the province. The secondary aims were to investigate potential causes of malnutrition in the Western Cape, including direct causes (dietary intake and disease) and underlying causes (food security, caring capacity of caregivers and environmental hygiene), as well as to assess indicators of early childhood development (ECD).

## METHODS AND PROCEDURES

The sampling frame for this survey includes three EA (enumerator area)-type domains: (1) urban formal (UF) areas (formal cities and towns characterised by higher population densities, high levels of economic activities and high levels of infrastructure), (2) urban informal (UI) areas (unplanned settlements on land that has not been surveyed or proclaimed as residential, and consists mainly of informal dwellings, also referred to as "shacks") and (3) rural towns (RT) (small towns surrounded by farmland that includes both UF and UI areas). Each was subdivided into three strata according to age: infants under 6 months old, children 6–<24 months old (2 years) and children 2–<5 years old. A total sample of 1 214 children was recruited. Measures included height, weight and mid-upper arm circumference to assess anthropometric status of children, and the height and weight of the primary caregiver. Further data was collected using an interviewer-administered questionnaire which was developed for the purposes of this study to investigate potential drivers of malnutrition in under-5-year-old children in the Western Cape, deriving core concepts from both the original UNICEF Framework for the development of malnutrition and the adapted version referred to as the Conceptual Framework for surviving and thriving of children. A Wealth Index, as well as two novel indices were developed using rigorous methodology to assess the three underlying drivers of childhood malnutrition, namely household socio-economic indicators (Wealth Index) and food security (Wealth Index), mother and childcare/caregiving capacity (Care Index) and water availability, sanitation and hygiene (WASH Index).

*UF*
*urban formal*

*UI*
*urban informal*

*RT*
*rural towns*



## KEY RESULTS AND CONCLUSIONS

The key conclusion of the Western Cape Stunting Baseline Survey (WCSBS) is that a double burden of malnutrition, stunting and overweight/obesity, remains a concern in the province. The prevalence of stunting in the WCSBS (17.5%) was close to the upper cut-off of the medium public-health-concern category of 10–19% for 0–59-month-old children. Stunting in the very vulnerable <2-year-old age group was 19.7%, pushing it into the high public-health-concern category for this age group. The prevalence of underweight (5.6%) was just above the lower cut-off of the medium (5–9%) and wasting (3.4%) in the low (2.5–<5%) public-health-concern categories for 0–59-month-old children. The prevalence of overweight (15.1%) fell in the very high public-health-concern category of ≥15%. Stunting-overweight was not common at 2.4%.

The WHO/UNICEF's (2021b) goal is to reduce stunting prevalence in under-5-year-olds by 50% by 2030 (WHO/UNICEF, 2021b). The prevalence of stunting in the Western Cape in the WCSBS (17.5%) is a considerable reduction from the 27.4% prevalence reported in the 2016 South African Demographic and Health Survey (SADHS) (NDoH et al., 2018). Moreover, the 2022 prevalence of stunting in 1–<5-year-old children in the WCSBS was 18.2% compared to the 20.8% found in the 2018 Provincial Anthropometric and Dietary Intake Survey (PDIS) in the same age group. To date only the 2016 SADHS reported on stunting in children under 6 months old, where it was found that 32.3% were stunted (NDoH et al., 2018). In the WCSBS the prevalence was 25.2%, thus 7.1% lower than the 2016 national prevalence. Stunting levels in the Western Cape therefore seem to be much lower than in the rest of the country and seem to have been decreasing in the province despite the Covid-19 pandemic that has gripped the country since early 2020. This could mean that the various interventions that have been put in place by the Western Cape Government, NGOs, NPOs and others have been making a difference. With a 12.5% reduction over a four-year period (September–November 2018 to June–October 2022), it could be feasible to reduce the stunting prevalence by another 25% from 2022 to 2030 if current initiatives continue. However, this will not yet be sufficient to achieve the goal of a 50% reduction by 2030.

**The value the WCSBS adds is not only a profile of stunting in under-5-year-old children, but also current predictors of the condition. These include:**

- A Wealth Index score in the lowest tertile in the total group of 6-month–<5-year-olds [Odds Ratio (OR)(95% Confidence Interval (CI)) 1.74(1.13–2.67)]. The Wealth Index comprised a score that reflects 10 indicators covering household possessions, dwelling type, main energy source for cooking, Internet access and number of rooms in the dwelling. Initiatives to address poverty in the Western Cape should thus continue to reduce stunting prevalence.
- A Care Index score in the lowest tertile in the total group of 6-month–<5-year-olds [OR(CI) 1.58(1.06–2.35)], and specifically in the vulnerable 6-month–<2-year-olds [OR(CI) 2.08(1.05–4.14)]. This novel Care Index comprised a score that reflects maternal marital status, educational level, current employment, employment status and age when the child was born; paternal educational level and current employment; child attendance of an early childhood care and education (ECCE) programme and availability of children's books in the household. Importantly, each of the retained variables contributed to the score, and should be addressed in stunting-prevention initiatives.
- A WASH Index score in the lowest tertile in the 2–<3-year-olds [OR(CI) 2.54(1.21–5.34)]. This novel WASH Index score reflects water availability, sanitation and hygiene indicators in the dwelling, inclusive of piped water inside the dwelling, piped water in the yard, handwashing facility available in the dwelling, handwashing facility available in the yard, soap/detergent available for handwashing, water available for handwashing, flush toilet, toilet inside dwelling, toilet shared, bucket toilet, house with clean floor, child with clean clothes, main source of water from a neighbour's/public tap. This particular risk may be more prominent in the UI EA-type.
- Smoking, alcohol use and drug use during pregnancy in the total sample of 6-month–<5-year-olds as reflected in the respective ORs [smoking OR(CI) 1.60(1.07–2.14); alcohol use OR(CI) 1.79(1.19–2.69); drug use OR(CI) 1.59(1.05–2.40)]. This also reflects a specific long-term risk beyond the first 1 000-day window of these risky lifestyle behaviours. These behaviours need urgent attention to reduce the risk of stunting in the Western Cape.

- Low birthweight in the total group of 6-month–<5-year-olds [OR(CI) 2.47(1.65–3.71)]. Predictors of low birthweight were a gestational age of <37 weeks [OR(CI) 3.81(2.42–5.960], smoking during pregnancy [OR(CI) 1.73(1.14–2.65)], having a low income [OR(CI) 1.74(1.04–2.91)] and Care Index in the lowest tertile [OR(CI) 3.16(1.34–7.44)].
- Incomplete immunisation in the total group of 6-month–<5-year-olds [OR(CI) 1.89(1.19–2.99)]. Predictors of an incomplete immunisation status were: caregivers ran out of money for food [OR(CI) 1.96(1.25–3.08)], a child went hungry in the past week [OR(CI) 2.05(1.15–3.52)], a child who was never breastfed [OR(CI) 2.6(1.33–5.12)] and living in an UI EA-type [OR(CI) 2.17(1.26–3.73)].
- Living in the RT EA-type in the total groups of 6-month–<5-year-olds [OR(CI) 1.73(1.04–2.87)].

The latter two results may indicate that interventions targeting children living in RT and UI EA-types may need specific attention when considering the way forward with intervention strategies.

No dietary variables were found to be risks for stunting in the WCSBS. Only 18% were being exclusively breastfed (BF), although most mothers did initiate BF at birth. Key reasons for not ever having BF the child were that the mother did not have enough milk, that the baby did not want to take breastmilk and, concerningly, that the mother was advised not to BF by a health worker. There were no predictors for "not having ever BF a child".

Dietary quality results show that the dietary diversity of 1 in 2 of the total group of 6-month–<5-year-olds is poor, that 1 in 4 may not be consuming sufficient egg and/or a flesh food, 1 in 5 may not be consuming sufficient fruits/vegetables, and 7 in 10 may not be consuming sufficient milk products to meet calcium needs. Furthermore, 4 in 5 of 6-month–<5-year-old children consumed sweet food items, 3 in 5 consumed salty/fatty food items and 1 in 2 consumed a sugar-sweetened beverage in the 24 hours preceding their interview. Predictors of poor dietary diversity in 6-month–<5-year-olds included a Wealth Index in the lowest tertile [OR(CI) 2.23(1.59–3.12)], and a child that had been hungry in the past week [OR(CI) 1.86 (1.06–3.27)].

Although the key focus of the WCSBS was on stunting, the WHO/UNICEF's (2021b) goal is also to reduce the prevalence of overweight/obesity in children to less than 3% by 2030 (WHO/UNICEF, 2021b). With the prevalence of overweight in the WCSBS sample in the very high public-health-concern category of ≥15%, it should not be ignored, especially as interventions focused on reducing stunting prevalence may inadvertently promote obesity risk in this target population (Tzioumis et al., 2016).

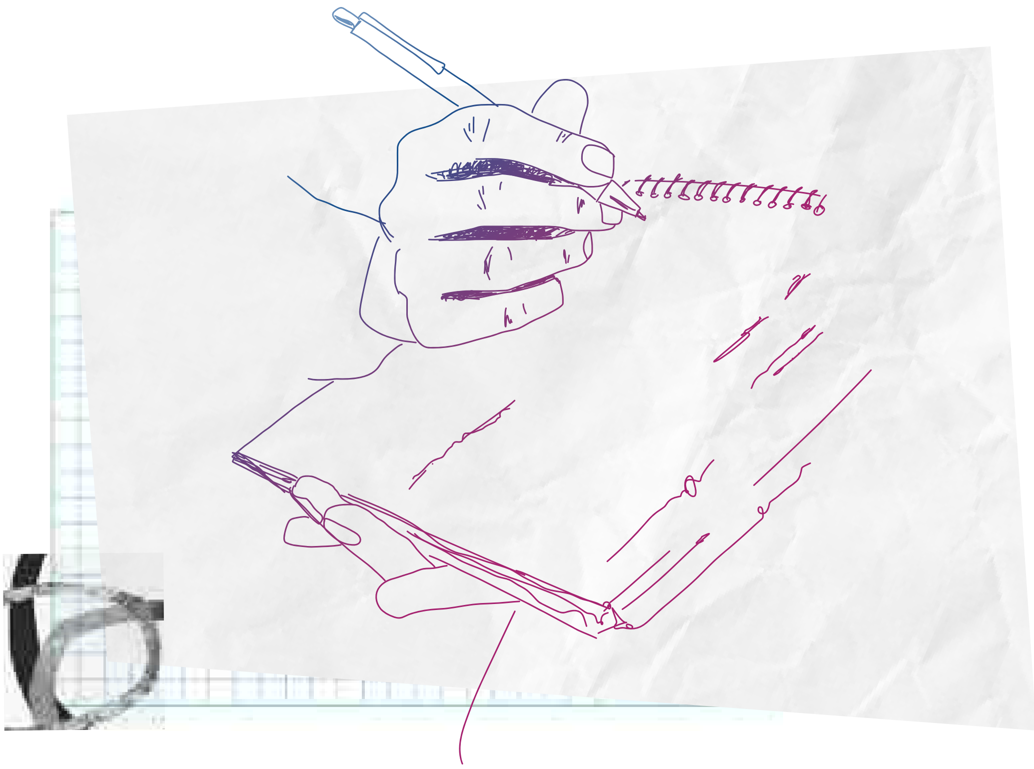
**Current predictors of overweight/obesity identified using multiple logistic regression analyses in the study sample include:**

- An overweight/obese caregiver [OR(CI) 1.88(1.21–2.91)], specifically also in the 2–<3-year-olds [OR(CI) 2.21(1.31–3.71)]. Caregivers were the mother (71%), grandmother, father or another family member, and more than 50% were overweight or obese. The publication of the updated edition of the 2015–2020 Strategy for the Prevention and Control of Obesity in South Africa is a matter of urgency, as the target of reducing obesity by 10% by 2020 has clearly not been achieved, which, in turn, also impacts negatively on the prevention and control of obesity in children.
- Not ever BF in 6-month–<2-year-olds [OR(CI) 2.95(1.36–6.40)], reflecting the importance of initiatives to promote initiation of BF, excusive BF up to 6 months old and continued BF with the addition of healthy and age-appropriate complementary foods.
- Having consumed sugar in tea/coffee or on porridge in 6-month–<2-year-olds [OR(CI) 2.21(1.23–3.95)]. The fact that this risk factor remained as an independent risk in the multivariate regression model emphasises the gravity of this situation; sugar was given regularly to young children in the WCSBS, and it predicted overweight/obesity in under-2-year-olds.

## KEY STRENGTHS AND LIMITATIONS OF THE STUDY

**STRENGTHS** of this study include the rigorous sampling structure and execution thereof, resulting in a sample of under-5-year-old children that is representative of this target population. Results in terms of the malnutrition profile and predictors thereof that were identified using multivariate regression models are thus robust and a good baseline for monitoring changes in the malnutrition profile of children in the Western Cape, while also providing good insights in current predictors of both stunting and overweight/obesity that can advise critical assessment of current interventions and the need for, and nature of, additional measures that need to be put in place. A further strength is the richness of the data collected to enable us to reflect on the drivers of malnutrition along the pathways of the UNICEF Framework for malnutrition. For these purposes we also developed indices to investigate the three underlying causes of malnutrition in children, namely a Wealth Index (assets and wealth status) and two novel indices, one that reflects mother and childcare/caregiving capacity (Care Index) and the other that reflects water availability, sanitation and hygiene in the household (WASH Index). The majority of questions included in the research questionnaire were from internationally standardised instruments for the target age group, which were adapted for use in South Africa as recommended, e.g. the WHO/UNICEF infant and young child feeding questionnaire, as well as the 2022 Census questionnaire.

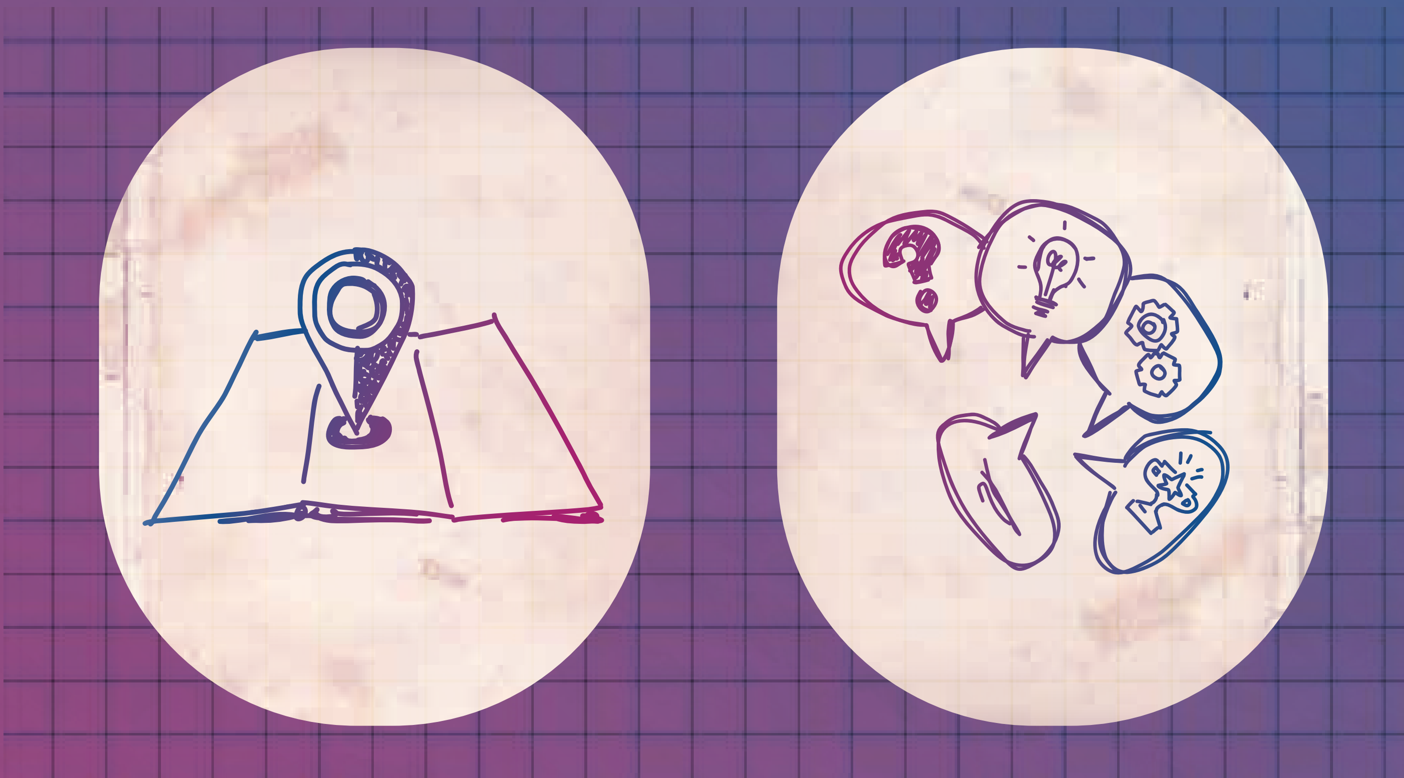
**LIMITATIONS** of the study include that two important childhood health intervention indicators, namely whether the vitamin A supplementation was on track and receival of deworming medications were up to date, were not assessed. Finally, as is the challenge in surveys that are dependent on self-reported information, a level of respondent bias may have been present. However, we attempted to minimise this limitation with rigorous training of fieldworkers and quality control measures.



## RECOMMENDATIONS

Numerous interventions to prevent and control malnutrition in under-5-year-old children in the Western Cape are presently in place, and, as indicated in the conclusion section, may have resulted in reducing the prevalence of stunting, but not necessarily overweight/obesity.

**The two key recommendations for taking this work forward are:**



Build a current map of all initiatives/interventions – whether governmental, NPOs, NGOs, universities and research organisations such as the HSRC and SAMRC – that aim to improve the nutritional status, ECD and general well-being of under-5-year-old children, and capture the goals, strategies, ground-level actions, outcomes and lessons learnt for each of the initiatives.

Conduct a series of workshops with multisectoral stakeholders to consider the outcomes and recommendations of this research within the context of the current intervention map to plan the way forward to address the malnutrition risks for under-5-year-old children identified in the WCSBS.

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# LIST OF KEY ABBREVIATIONS

| | |
|---|---|
| ACC/SCN | UN Administrative Committee on Coordination, Subcommittee on Nutrition |
| BAZ | BMI-for-age Z-score |
| BF | breastfeeding/breastfed |
| BMI | body mass index |
| CES-D-10 | 10-item Centre for the Epidemiological Studies of Depression Short Form |
| CI | confidence interval |
| Covid | coronavirus disease |
| CPF | community police forum |
| DDS | dietary diversity score |
| DGMT | DG Murray Trust |
| EA | enumerator area |
| ECCE | early childhood care and education |
| ECD | early childhood development |
| ELP | Early Learning Programme |
| HAZ | height-for-age Z-score |
| HH | household |
| HSRC | Human Sciences Research Council |
| LMIC | low-income and middle-income countries |
| MAM | moderate acute malnutrition |
| MC | multiple comparison |
| MICS | Multiple Indicator Cluster Surveys |
| MUAC | mid-upper arm circumference |
| NCD | non-communicable diseases |
| NDoH | National Department of Health |
| NFCS | National Food Consumption Survey |
| NGO | non-governmental organisation |
| NIDS | National Income Dynamics Study |
| NIDS-CRAM | National Income Dynamics Study – Coronavirus Rapid Mobile Survey |
| NPO | non-profit organisation |
| OR | odds ratio |
| PDIS | Provincial Anthropometric and Dietary Intake Survey |
| PI | principal investigator |
| PPS | probability proportional to size |
| RT | rural town |
| RtHB | Road-to-health booklet |
| SADHS | South African Demographic and Health Survey |
| SA-IYCFQ | South African Infant and Young Child Feeding Questionnaire |
| SAM | severe acute malnutrition |
| SAMRC | South African Medical Research Council |
| SD | standard deviation |
| SSB | sugar-sweetened beverage |
| SU | Stellenbosch University |
| UCT | University of Cape Town |
| UF | urban formal |
| UI | urban informal |
| UNICEF | United Nations International Children's Emergency Fund |
| USAID | United States Agency for International Development |
| VIF | variance inflation factor |
| WASH | water availability, sanitation and hygiene |
| WAZ | weight-for-age Z-score |
| WC | Western Cape |
| WCDoH | Western Cape Department of Health |
| WCSBS | Western Cape Stunting Baseline Survey |
| WHO | World Health Organization |
| WHZ | weight-for-height Z-score |

*

# ENUMERATOR AREA MAP

Map showing the location of the selected EAs in the Western Cape.



Google Earth, earth.google.com/web

# 1. INTRODUCTION

**Children are the essence of a healthy sustainable society and hence safeguarding the health of every child (Black et al., 2021) is imperative. The Food and Nutrition Technical Assistance III Project (Cashin & Oot, 2018) states: "Good nutrition, adequate health care, and a nurturing environment all contribute to children reaching their full growth and development potential. This is especially important during the 1 000 days from the beginning of the mother's pregnancy to the child's second birthday, when children are growing and developing most rapidly. To support this growth, young children have relatively high nutritional needs and are more vulnerable to malnutrition and its consequences than other age groups."**

It is generally acknowledged that stunting (height-for-age Z-score <-2SD) is the best indicator of a child's well-being (de Onis & Branca, 2016). Children's linear growth potential is largely determined by the time they turn 2 years old (Tzioumis et al., 2016), and it is a period of rapid brain development when they build foundational skills that define their health and well-being throughout life (Black et al., 2020). Stunting is associated with many disorders, including reduced neurodevelopment (Mendez et al., 1999), lifelong cognitive deficits, educational and employment challenges, increased risk of obesity and non-communicable diseases (NCD) in adulthood, and cycles of intergenerational poverty (Victora et al., 2008; Black et al., 2020). According to Victora et al. (2021) evidence shows that stunting and wasting might already be present at birth, and that the incidence of both conditions peaks in the first 6 months of life.

Victora et al. (2021) writes in the most recent *Lancet* series on maternal and child undernutrition (progress 1) that, 13 years after the first *Lancet* series on this topic, a review of progress achieved based on global estimates and new analyses of 50 low-income and middle-income countries (LMIC), shows that the prevalence of childhood stunting has decreased. This decrease was substantial in middle-income countries, but less so in low-income countries. Within the South African context tracking of national surveys from 1994 to 2016 shows that the prevalence of childhood stunting does not seem to have declined nationally (Senekal et al., 2019), but these researchers showed that there may have been a downturn in the curve in the Western Cape and Gauteng provinces between 2016 and 2018 (ibid.).

The drivers of stunting are not limited to an absolute lack of food alone (hunger) but perpetuated by nutrition-specific factors including non-exclusive or no breastfeeding, poor complementary feeding practices, and lack of dietary diversity. Nutrition-sensitive factors such as poor pre- and post-natal maternal care, ante- and post-natal maternal mental/physical health problems and substance abuse, poor childcaring capacity, limited household purchasing power, poor household hygiene, sanitation, and related disease conditions (gastrointestinal infections and/or worms) also contribute (UNICEF, 1990; Said-Mohamed et al., 2015; Hall et al., 2017; Black et al., 2020). The original UNICEF Framework for malnutrition was adapted by Black et al. (2020) to reflect these nuances (Figure 1).

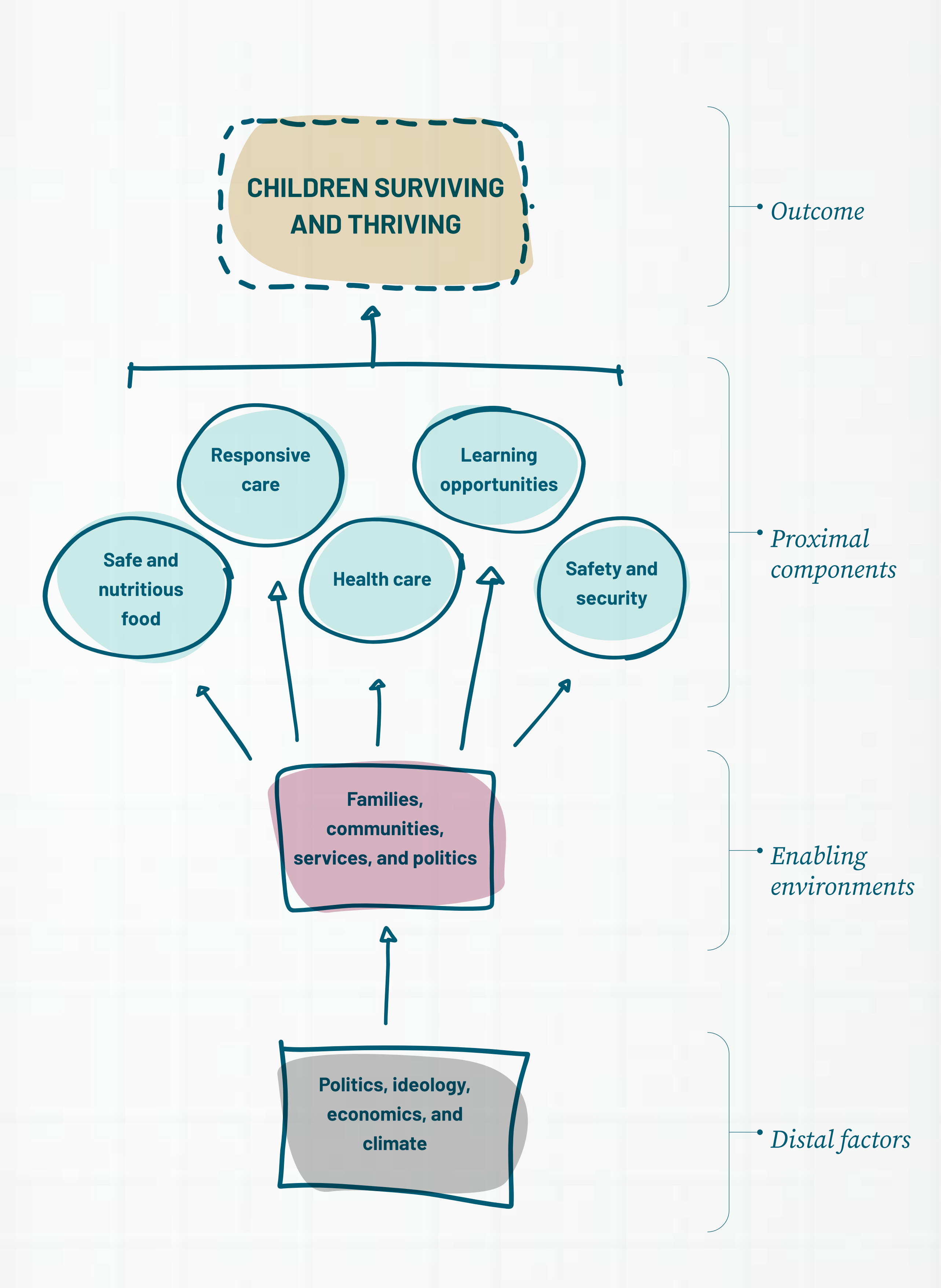



**Figure 1**
Conceptual Framework for all children surviving and thriving, adapted from the 1990 UNICEF Framework for the causes of malnutrition and death (from Black et al., 2020)

The National Income Dynamics Study (NIDS) reported that 18% of households in South Africa experienced hunger in 2020 and child hunger was prevalent at 16% (Bridgman et al., 2020). Statistics South Africa (2019) indicated that about 1.6 million households experienced hunger in 2017, with more than 60% of these households being in urban areas. These results indicate that many South Africans are not food secure, even though food balance sheets indicate that nationally South Africa is food secure (Statistics SA, 2019). Food-insecure children may have limited access to adequate food because of poverty, amongst other drivers) and this may result in an inadequate and poor-quality food intake (Kaur et al., 2015).

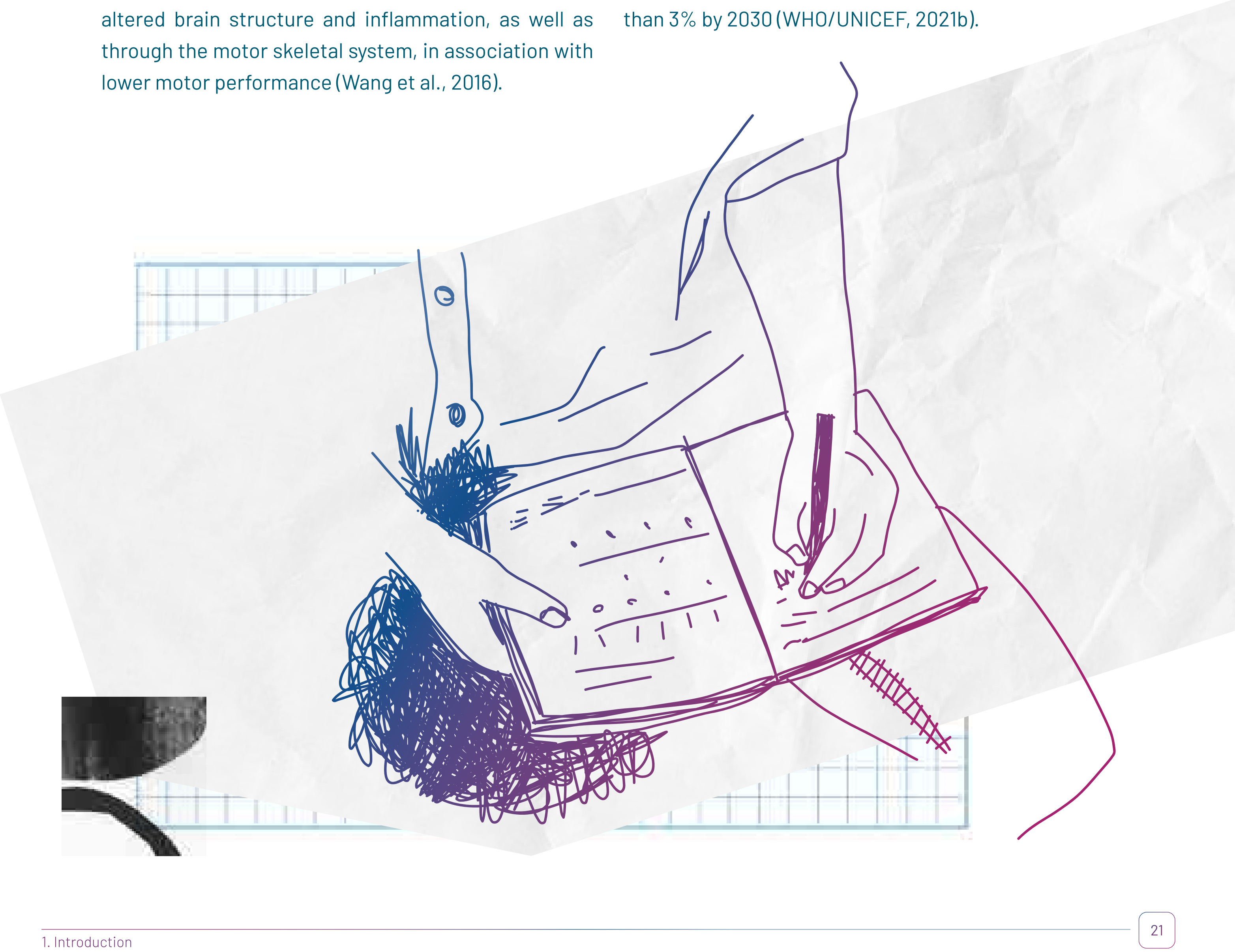
The caring capacity of mothers (or alternative primary caregivers), which impacts on most elements that are key to normal growth and development in children, depends on proximate determinants that involve choices they make and the opportunities they have to act on these choices. Factors that influence choices and actionability thereof include mothers' educational level and relevant knowledge, as well as the physical and social support they receive during pregnancy, childbirth and postpartum. Ultimately, familial factors, medical/healthcare availability, cultural attitudes and norms, demographic and economic conditions and resources, commercial pressures, and national and international policies and norms, moderate the mentioned factors and thus maternal care of infants and young children (ACC/SCN, 2000).

The water availability, sanitation, and hygiene (WASH) profile of households (HHs) where children develop and grow is highly related to their nutritional status. Poor (WASH) conditions have been proposed as one of the main causes of child stunting (Dominguez, 2017). Direct and indirect pathways exist between WASH and stunting. They include diarrheal diseases, environmental enteric dysfunction, socio-economic conditions and time constraints to childcare practices (ibid.). Classic reflections from the 1970s on malnutrition and infection by Mata (1979) still resonate today: "The home (microenvironment) plays a role in the development of malnutrition and infection. Crowded homes with dirty floors, thatched roofs and cracked walls favour transmission of respiratory and enteric agents, and proliferation of arthropods and rodents. Deficient sanitation is the most important feature of poor housing. Lack of a safe piped-water supply, inadequate disposal of faeces and garbage, inadequate preparation and storage of food, the presence of animals in the home, and deficient personal hygiene, result in large doses of pathogenic agents on hands, and in food and water. Such environments also may deprive the child of psychological and social stimuli beneficial to nutrition and growth." It is unacceptable that more than forty years later, poor WASH conditions and undernutrition are not close to being eradicated.

In a paper in the 2021 *Lancet Series* on maternal and child undernutrition (progress 2), Heidkamp et al. (2021) remark: "As the world counts down to the 2025 World Health Assembly nutrition targets and the 2030 Sustainable Development Goals, millions of women, children, and adolescents worldwide remain undernourished (underweight, stunted, and deficient in micronutrients), despite evidence on effective interventions and increasing political commitment to, and financial investment in, nutrition. The Covid-19 pandemic has crippled health systems, exacerbated household food insecurity, and reversed economic growth, which together could set back improvements in undernutrition across LMICs." In their conclusion they state that: "Our growing evidence base affirms that multi-sector strategies that reach populations during the first 1000 days of life are effective in reducing undernutrition and, with adequate resourcing, can be implemented at large scale. Progress in scaling interventions has been too slow, as evidenced in the health system by low coverage and the failure to introduce several proven interventions. There is no *one-size-fits-all* strategy for addressing undernutrition. Rather, depending on each nation's gaps and priorities, countries must decide which direct and indirect actions to scale within and across sectors and how to address specific implementation and utilisation challenges. *In all cases, countries need strong nutrition information* and accountability systems, coupled with implementation research and programme evaluation. Effective cross-sectoral approaches require the presence of other enabling factors and processes including proactive political leadership, and adequate budgets and financing."

Any nutrition intervention rolled out to alleviate the burden of undernutrition should be sensitive to the growing problem of obesity, as intervention needs may differ. For example, Tzioumis et al. (2016) caution that interventions which target only stunting, especially those that promote "catch-up" growth, may unintentionally contribute to overweight/obesity risk. Many countries in sub-Saharan Africa, including South Africa, face a high prevalence of overweight and obesity in children, amounting to a double burden of malnutrition in children. Rapid weight gain in infancy is associated with increased risk of adult weight gain and development of NCDs (de Onis et al., 2016; Singhal, 2017). Limited research has examined the association between obesity and child development. According to Black et al. (2020) research in LMICs has shown that children with obesity may have poorer social and emotional behaviour, cognition and language skills, may have lower fine and gross motor skills and fare poorer academically than their normal weight peers. Obesity may influence cognition through altered brain structure and inflammation, as well as through the motor skeletal system, in association with lower motor performance (Wang et al., 2016).

To conclude, for a child to survive and thrive, it should receive safe and nutritious food, responsive care, quality health care, be provided with learning opportunities and be kept safe and secure (Black et al. 2020). In an attempt to address the burden of stunting in the WC, the Western Cape Department of Health (WCDoH) and DG Murray Trust (DGMT), in collaboration with primary investigators from the University of Cape Town and Stellenbosch University, set out to conduct a survey to compile a malnutrition profile and drivers thereof in under-5-year-old children. The Western Cape Stunting Baseline Survey (WCSBS) was conducted to inform the WCDoH on growth problems experienced by infants and young children and drivers thereof. This research serves to inform provincial-level strategic planning to address malnutrition in infants and young children in the province. The survey also serves as a baseline for tracking progress towards the WHO/UNICEF goal of reducing stunting in under-5-year-olds by 50% by 2030 and reducing overweight/obesity in children to less than 3% by 2030 (WHO/UNICEF, 2021b).



# 2. AIMS AND OBJECTIVES OF THE STUDY

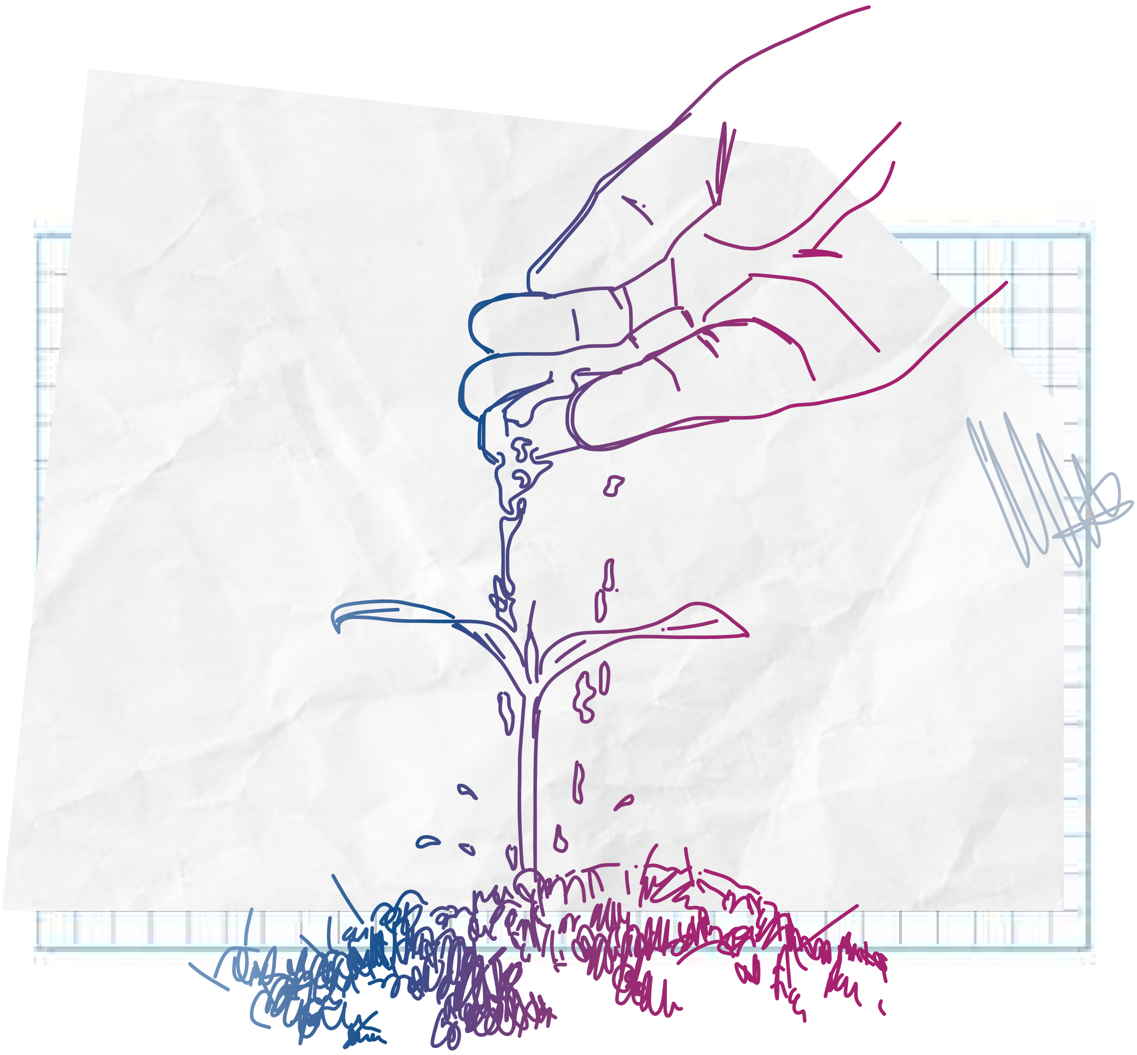
## 2.1 AIMS

The primary aim of this research was to establish a baseline profile of malnutrition (stunting, underweight, thinness/wasting, overweight and obesity) in a representative sample of infants and children under 5 years old in the Western Cape. Secondary aims were to investigate drivers of childhood malnutrition in the province, including direct drivers (dietary intake and disease) and underlying drivers (HH economic profile and food security), mother and childcare/caregiving capacity and WASH indicators.

## 2.2 OBJECTIVES

**Malnutrition profile in under-5-year-olds in the Western Cape**

- To measure the height, weight and mid-upper arm circumference (MUAC) to determine the prevalence of the following forms of malnutrition in the target population:
  - Stunting, underweight, thinness (wasting) and severe acute malnutrition
  - Risk for underweight, overweight and obesity.



### Direct drivers of malnutrition in under-5-year-olds in the Western Cape

- To assess breastfeeding indicators.
- To assess complementary feeding practices.
- To assess dietary diversity, unhealthy food choices and identify most commonly consumed foods.
- To assess disease indicators and vaccination status.

### Underlying drivers of malnutrition in under-5-year-olds in the Western Cape

- To assess household demographics, as well as socio-economic and food security indicators.
- To assess perinatal care of the mother.
- To assess the primary caregiver's caring capacity and practices.
- To assess WASH-related indicators.

### Early development in under-5-year-olds in the Western Cape

- To assess age-specific early childhood development (ECD) indicators.

### Drivers of malnutrition in under-5-year-olds in the Western Cape

- To identify direct and underlying drivers of stunting and overweight/obesity in under-5-year-old children in the Western Cape.

# 3. METHODS AND PROCEDURES

## 3.1 STUDY SAMPLE

### 3.1.1 Target population and study sample

The target population for this research was under-5-year-old infants and young children living in the Western Cape. The sampling frame included three EA-type domains: (1) urban formal (UF) areas (formal cities and towns characterised by higher population densities, high levels of economic activity and high levels of infrastructure), (2) urban informal areas (UI) (unplanned settlements on land that has not been surveyed or proclaimed as residential, and consists mainly of informal dwellings, also referred to as "shacks") (Statistics SA, 2012; Statistics SA, 2019) and (3) rural towns (RT) (a small town that was surrounded by farmland). The initial definition of rural areas was in line with the Statistics SA (2012) definition of areas that are sparsely populated in which people farm or are dependent on natural resources, including smallholdings, dispersed villages and small towns. However, after fieldwork commenced it became evident in the case of rural areas that HHs were very scarce in large farmlands, to which access was severely hindered by security measures farmers had put in place. After long distances had been travelled with no success, coverage of this EA-type was obtained by targeting a small RT to replace each rural EA that formed part of the sample. These towns were within a maximum of 16 km radius of the original rural EA and were surrounded by farmland.

**UF**
*urban formal*

**UI**
*urban informal*

**RT**
*rural towns*

Additionally, each domain was subdivided into three strata according to age: infants under 6 months old, children 6–<24 months old (2 years) and children 2–<5 years old.

The sample size calculation was done using the Multiple Indicator Cluster Surveys (MICS) sample calculator template for multiple domains, as indicted below (MICS UNICEF.org).

$$n = \frac{[4(r)(1-r)(f)]}{[(Er)^2(p)(n_h)R]}$$

*where*

***n*** *is the required sample size, or in this case the number of households; using stunting as key indicator, this value is calculated as 397;*

**4** *is a factor to achieve 95% level of confidence;*

***r*** *is the anticipated prevalence of stunting, taken as 0.26[1];*

***f*** *is the design effect, estimated as 1.22[2];*

***E*** *is the relative sampling error of r, therefore Er = (0.3)(0.26) = 0.078 is the margin of error to be tolerated at the 95% level of confidence;*

***p*** *is the proportion of the total population upon which r is calculated, P = 0.12;*

$n_h$ *is the average household size in the Western Cape, calculated as 3.3[3]; and*

***R*** *is the anticipated response rate, estimated as 0.98.*

1 Derived from prevalence reported in SADHS 2003 (Dhansay et al., 2018), SADHS 2016 (NDoH et al., 2018) and PDIS (Senekal et al., 2019)
2 Derived from the PDIS (Senekal et al., 2019)
3 Calculated using Census 2011: Interactive data in SuperCROSS, Statistics SA (2012), for urban formal, urban informal and rural areas in the Western Cape

The estimated sample size per stratum was determined to be n=398, or approximately 400 households. Therefore, the total number of households proposed for this survey was 400 x 3 age strata = 1 200. HH distribution was expected to vary by region in the sampling frame. For national-level indicators proportional distribution of surveys (children) by region would provide the best precision. However, small rural and urban informal regions would be allocated a sample size that would be too small to achieve the degree of precision desired for regional or domain-level estimates. To ensure acceptable estimates across regions, experience shows that a minimum of 150 interviews per stratum (at least 50 per age domain) are needed so that reliable estimations for most of the indicators can be obtained. The final sample allocation reflects a power allocation between the proportional allocation and the equal size allocation, which was a trade-off between the national-level precision and the domain-level precision.

An alpha power allocation with an appropriate power value $\alpha$ ($0 \leq \alpha \leq 1$) was used to guarantee sufficient sample size in small domains/strata. The following formula was used to calculate the sample sizes per stratum for different power levels (USAID, 2012).

$$n_h = n \frac{M_h^\alpha}{\sum_{h=1}^{H} M_h^\alpha}$$

*where*

$n_h$ *is the resulting number of households in the stratum* ***h****;*

$n$ *is the total number of households;*

$M_h$ *is the proportional sample size of stratum* ***h****, when the alpha power is equal to 1;*

$H$ *is the total number of strata; and*

$\alpha$ *is the power value.*

An alpha power of 0.75 was used to achieve the goal of a minimum of 150 households (HHs) per stratum (Table 1). The number of HHs was then divided by 20 and rounded up to the next integer to obtain the number of enumerator areas (EAs). This ensured that each stratum had at least 150 HHs. Table 1 reflects the sample sizes in terms of number of households and number of EAs for different precision levels.

**Table 1**
Number of households for different levels of power

| Number of HH | | | | | Number of EAs | | | |
|---|---|---|---|---|---|---|---|---|
| ALPHA POWER | RURAL | URBAN FORMAL | URBAN INFORMAL | TOTAL | RURAL | URBAN FORMAL | URBAN INFORMAL | TOTAL |
| 0 | 400 | 400 | 400 | 1 200 | 20 | 20 | 20 | 60 |
| 0.25 | 307 | 567 | 326 | 1 200 | 16 | 29 | 17 | 62 |
| 0.5 | 216 | 739 | 245 | 1 200 | 11 | 37 | 13 | 61 |
| 0.75 | 141 | 890 | 169 | 1 200 | 8 | 45 | 9 | 62 |
| 1 | 86 | 1 004 | 110 | 1 200 | 5 | 51 | 6 | 62 |

### 3.1.2 Selection of EAs

At the first stage of the two-stage cluster sampling process, the EAs were selected with probability proportional to size (PPS) in each stratum. The steps suggested by the United States Agency for International Development (USAID, 2012) for selection of EAs were followed:

1. For a given stratum all EAs with their number of HHs were listed.
2. The total number of HHs in that stratum were then calculated.
3. With $n$ set as the number of EAs to be selected from a total of $N$ EAs, the sampling interval $I$, i.e. the total number of households in all EAs divided by $n$, was computed.
4. A random number $R$ between 0 and 1 was generated, and $R*I$, $R*I+I$, $R*I+2*I$, …, $R*I+(n–1)*I$ was computed.
5. For each sampling number $R*I+(j–1)*I$, the jth sampled EA was considered the target EA if the cumulative size was the first cumulative size bigger than the sampling number $R*I + (j–1)*I$.

The following example illustrates this process:

1. Let $N$=20 EAs, $n$=5 EAs and the total number of HHs in all the EAs is 4 004.
2. The sampling interval $I$ = 4 004/5 = 801.
3. Let the random number (0.381 was chosen) multiplied by 801 ($R*I$) be 305.
4. The sampling numbers and the first two selected units are shown in Table 2.
5. Continue until the (in this example) 5 EAs have been selected.

Based on our experience from the 1999 National Food Consumption Survey (NFCS) and the 2018 Provincial Anthropometric and Dietary Intake Survey (PDIS), we knew that some of the selected EAs would be from informal or unstructured settlements with no clear demarcation of HHs. To ensure coverage within each of these EAs, segmentation was done. For these purposes, relevant EAs were segmented into multiple segments of about 50 households each and one segment was randomly selected for the survey, after which 20 eligible households were selected randomly. A cluster therefore was either an EA or a segment of an EA. As mentioned, in the case of rural EAs a small town that was surrounded by farmland and was within a 16 km radius of a particular rural EA was surveyed. Qualifying HHs in both formal and informal HHs in the town were targeted.

### 3.1.3 Selection of households and children within households

After the EAs were selected, maps of each of the relevant EAs (see example in Figure 2) were generated and passed on to the respective fieldwork teams for selection of HHs.

**Table 2**
An example of selecting EAs in a stratum using PPS

| EA NUMBER | NUMBER OF HH | CUMULATIVE NUMBER OF HH | SAMPLING NUMBER | UNIT SELECTED |
|---|---|---|---|---|
| 1 | 139 | 139 | | |
| 2 | 101 | 240 | | |
| 3 | 184 | 424 | 305 | 1 |
| 4 | 184 | 608 | | |
| 5 | 104 | 712 | | |
| 6 | 259 | 971 | | |
| 7 | 219 | 1 190 | 305 + 801 = 1 106 | 2 (etc.) |

Figure 2

Example of maps of an EA in each of the three EA-types for use by fieldworkers


The following process was followed for the selection of HHs in each EA:

1. Assuming that there were 400 HHs in a selected EA and, as indicated above, the number of HHs to be surveyed was 20, the team used the map to identify a route to be followed (planned route) though the EA to systematically cover all 400 HHs.
2. Subsequently one HH in the EA was randomly selected as a starting point.
3. The first 20 HHs (400/20=20) on the planned route to be followed from the starting-point HH was then identified on the EA map, and one of these 20 HHs was then selected at random for inclusion in the study. This HH was marked with a circle on the map.
4. The team repeated this process along the planned route, identifying every 20th HH and marking it with a circle on the EA map. By the time all 400 HHs in the EA were covered, there were 20 circled HHs marked on the map.
5. On the first day of data collection in the EA the first HH was visited.

One child was selected per HH. If there was more than one child present in the prescribed age interval in a HH, then all children in the HH were numbered in age order for random selection of one child using a "Random Number Table" designed for these purposes.

Inclusion criteria for HHs were (1) a family having lived in the EA-type for 6 months or longer; (2) child/children under 5 years old, male or female, present in the HH; (3) a parent/legal guardian/primary caregiver to provide informed, written consent; and (4) a mother/primary caregiver to assist with completion of the research questionnaire. A household was excluded if any one or more of the inhabitants were Covid-19 positive. Exclusion criteria were a child whose mother/caregiver was under 18 years old, a child who did not consume any food or energy-giving drinks over the past 24 hours because he/she was sick, and a child who stayed elsewhere for the 24 hours preceding the fieldworker visit to the HH. Fieldwork teams were extensively trained on the selection of HHs in EAs, as well as selection of a child in the HH.

If access to households in a particular EA was restricted because of people not being at home/not answering the door, safety concerns, heavy security around properties, security measures in gated communities and families living in blocks of flats with communal security gates and measures in place, the following additional recruitment measures were implemented:

1 The study coordinator contacted the owner of activity groups for young children (e.g. Toptots, gym classes, dance schools, swim schools) for permission to distribute an invitation to mothers (or alternative caregivers) to participate in the research. Appointments were then made with the mother (or alternative caregiver).

2 The study coordinator approached non-government play/pre-schools in target EAs for permission to distribute an invitation to parents to participate in the research or introduce the study at a parent gathering. Appointments were made with mothers (or alternative caregivers).

3 The principal investigator (PI) obtained UCT permission to recruit participants in university accommodation for families.

4 The fieldworkers placed posters and flyers in key stores in and around the selected EA to alert families in these areas that a research team would be recruiting children in the area.

5 The fieldworkers set up a stall at community markets that catered for children and recruited, obtained consent and assessed children on the spot.

## 3.2 ANTHROPOMETRIC MEASURES

### 3.2.1 Children

All anthropometric measures that involved infants and children were taken in the presence of the mother/primary caregiver in accordance with standard procedures (Cashin & Oot, 2018) (Supplementary materials S1: Anthropometric measures).

Infants/children up to 12 months old were weighed using a Scalerite Micro Digital Table Baby scale. Older children were weighed standing up on a Scalerite Micro Glass Digital bathroom scale. Recumbent length was taken to the nearest 0.1 cm for children under 2 years of age on a Seca 210 Mobile Measuring Mat for Babies and standing height to the nearest 0.1 cm for 2–<5-year-olds using a Seca 213 Portable Stadiometer (Cashin & Oot, 2018). The MUAC was measured to the nearest 0.1 cm using a non-flexible MUAC tape.

As standing height is approximately 0.7 cm less than recumbent length, which was considered in developing the WHO Growth Standards, length/height measures were adjusted accordingly. If a child under 2 years of age was not willing to lie down, standing height was measured and 0.7 cm added to convert it to length. If a child 2 years of age or older could not stand, recumbent length was measured, and 0.7 cm subtracted to convert it to height (Cashin & Oot, 2018).

**Table 3**
WHO growth standards for children 0 to <72 months (Cashin & Oot, 2018)

<table>
<tr><th></th><th colspan="2">Age</th><th colspan="7">Z-score</th></tr>
<tr><th>ANTHROPOMETRIC INDICATOR AND CONDITION</th><th>0-23 months</th><th>24-60 months</th><th><-3</th><th>≥-3 to <-2</th><th>≥-2 to <-1</th><th>≥-1 to ≤+1</th><th>>+1 to ≤+2</th><th>>+2 to ≤+3</th><th>>+3</th></tr>
<tr><td>Length-for-age<br>Stunting</td><td>✓</td><td></td><td rowspan="2">Severe stunting</td><td rowspan="2">Moderate stunting</td><td rowspan="2" colspan="4">Normal</td><td rowspan="2">Extreme tallness is not usually a nutrition issue. May indicate endocrine disorder.</td></tr>
<tr><td>Height-for-age<br>Stunting</td><td></td><td>✓</td></tr>
<tr><td>Weight-for-age<br>Underweight</td><td>✓</td><td>✓</td><td>Severe underweight</td><td>Moderate underweight</td><td colspan="2">Normal</td><td colspan="3">Do not use weight-for-age to determine overweight. Weight-for-length/height (0-60months) and BMI-for-age (all ages) are better for assessing overweight in children.</td></tr>
<tr><td>Weight-for-length<br>Wasting, overweight/obesity</td><td>✓</td><td></td><td rowspan="2">Severe wasting/ severe acute malnutrition (SAM)</td><td rowspan="2">Moderate wasting/ moderate acute malnutrition (MAM)</td><td rowspan="2" colspan="2">Normal</td><td rowspan="2">Possible risk of overweight</td><td rowspan="2">Overweight</td><td rowspan="2">Obesity</td></tr>
<tr><td>Weight-for-height<br>Wasting, overweight/obesity</td><td></td><td>✓</td></tr>
<tr><td>BMI-for-age*<br>Wasting, overweight/obesity</td><td>✓</td><td>✓</td><td>Severe wasting/SAM</td><td>Moderate wasting/MAM</td><td colspan="2">Normal</td><td>Possible risk of overweight</td><td>Overweight</td><td>Obesity</td></tr>
</table>

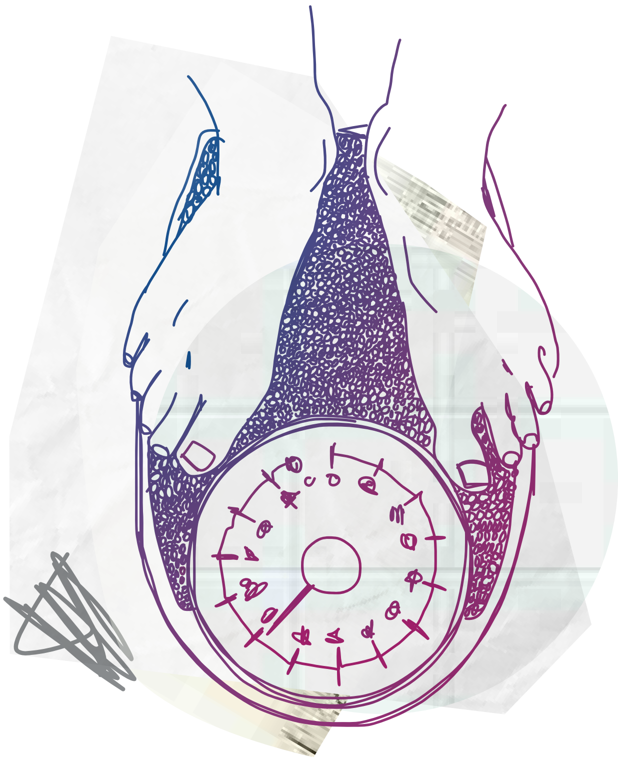
The WHO (2006) growth standards were used to calculate height-for-age Z-scores (HAZ), weight-for-age Z-scores (WAZ), weight-for-height Z-scores (WHZ) and BMI-for-age Z-scores (BAZ). Interpretation of the Z-scores was done using the WHO standards (Cashin & Oot, 2018) (see Table 3).

Criteria used for interpretation of MUAC in 6-month–<5-year-old children in the sample are as follows: MUAC <11.5 cm: severe acute malnutrition (SAM) and MUAC ≥11.5 cm and <12.5 cm: moderate acute malnutrition (MAM). Of note is that there is insufficient evidence to recommend using a MUAC cut-off for children under 6 months of age (Cashin & Oot, 2018).

### 3.2.2 Mother/primary caregiver

The mother/primary caregiver was weighed, and her height measured using the procedure as described for 2-year-old and older children (Supplementary materials S1: Anthropometric measures). They were measured in light clothing without coats, cardigans, or shoes, and without any hats, hair- or headpieces.

The weight and height of mothers/primary caregivers were used to calculate body mass index (BMI): weight/height (kg/m2). BMI was interpreted using WHO cut-offs (WHO, 2000): underweight: BMI <18.5 kg/m², normal weight: BMI 18.5–24.9 kg/m², overweight: BMI 25.0–29.9 kg/m² and obese: BMI ≥30.0 kg/m².



## 3.3 RESEARCH QUESTIONNAIRE

### 3.3.1 Overarching perspectives

The research questionnaire was specifically developed for the purposes of this study to investigate potential drivers of malnutrition in under-5-year-old children in the Western Cape, deriving core concepts from both the original UNICEF Framework for the development of malnutrition (UNICEF, 1990) and the adapted version by Black et al. (2020). The PI-team considered existing questionnaires used in the 2018 PDIS in the Western Cape and Gauteng (Senekal et al., 2019; Steyn et al., 2020), Grow Great surveys in Worcester (2016) (Mabaso et al., 2021a) and the Eastern Cape (2016) (Mabaso et al., 2021b), the MICS6 questionnaire for under-5-year-olds (https://mics.unicef.org/tools), the WASH questionnaire (https://sdg.iisd.org/news/unicef-who-issue-survey-questions-for-monitoring-wash/), the UNICEF/WHO Infant and Young Child Feeding Questionnaire (WHO/UNICEF, 2021a) and Minimum Diversity Questionnaire for women (FAO, 2021) in the development of the questionnaire. Where relevant, formulation of questions and response options were aligned with the South African Census 2022 questions (Private communication, Statistics SA, "Census 2022 CAPI CATI Household Questionnaire", received from User Information Services, Statistics SA, info@statssa.gov.za, 1 April 2022). The questionnaire was further refined and finalised for pilot testing, with the inputs of a broader team: Dr Hilary Goeiman: director: service priorities coordination, WCDoH and registered dietician (SA), Ms Anna-Marie Müller: innovation manager, DG Murray Trust; Dr Janetta Harbron: senior lecturer and RD (SA) UCT; Ms Fatima Hoosen: PhD and RD (SA); Ms Sonia Malczyk: UCT MMedSci graduate and RD (Canada) and Ms Nophiwe Job, UCT PhD candidate.

Sections and questions included in the questionnaire are summarised in Table 4. Detail on assessment of feeding practices and related indicators, the mental well-being of the mother/primary caregiver and food security indicators are presented in Sections 3.3.2–3.3.4. The questionnaire was translated from English into isiXhosa and Afrikaans by professional translators.

**Table 4**

Summary of sections and question focus in the WCSBS

| SECTION | QUESTION FOCUS | CONSIDERED FOR INDEX DEVELOPMENT FOR INCLUSION IN REGRESSION ANALYSES | SOURCE(S) OF QUESTIONS |
|---|---|---|---|
| Interviewee detail | Mother or alternative caregiver | Care Index | Census-Q 2022 NDoH/ MGDT-Q (unpublished) |
| HH and dwelling profile | Mother: biological, step, adoptive, foster | | |
| | Mother, father living in HH | Care Index | |
| | Language spoken in HH | | |
| | Marital status of mother | Care Index | |
| | Head of the HH | Care Index | |
| | Educational level of father and mother and primary caregiver if not a parent | Care Index | |
| | Employment status of father and mother | Care Index | |
| | HH assets | Wealth Index | Census-Q 2022 |
| | Ownership of livestock | | |
| | Vegetable gardening | | |
| | Internet access | Wealth Index | Census-Q 2022 |
| | Source of energy for cooking and lights | | |
| | Characteristics of the dwelling the HH lives in | | |
| | Number of people sleeping in dwelling | | |
| | Type and number of rooms in dwelling | | |
| | Experience of stressful events during the past 6 months relating to violence, crime, illness, death, fights/alienation, being arrested (any family member) | | NDoH/ MDGT-Q |
| | Family member with serious physical/mental health condition | | |
| | Substance abuse by a family member | | |
| Water availability, sanitation and hygiene | Main source of drinking water | WASH Index | Adapted from UNICEF/ WHO 2018 for SA using Census-Q 2022 |
| | Main source of water for cooking and handwashing | WASH Index | |
| | Sufficiency of drinking water | | |
| | Main toilet facility and whether shared | WASH Index | |
| | Location of toilet facility | WASH Index | |
| | Emptying of pit latrine, septic tank or bucket | | |
| | Location of facility for handwashing | WASH Index | |
| | Availability of water and soap at handwashing facility | WASH Index | |
| | Handwashing by caregiver | WASH Index | |
| | Refuse removal | WASH Index | |
| | Disposal of baby/child faeces in nappies | WASH Index | de Villiers et al. (2005) |
| | Cleanliness of floors and clothing of child | WASH Index | |
| | Use of a dummy | | |
| | Animals in outside areas where child plays | | |

Table 4 cont.

| SECTION | QUESTION FOCUS | CONSIDERED FOR INDEX/ SCORE DEVELOPMENT FOR INCLUSION IN REGRESSION ANALYSES | SOURCE(S) OF QUESTIONS |
|---|---|---|---|
| **Child health status** | Availability of birth certificate (BC) and Road-to-health booklet (RtHB) – reasons if not available | | PDIS-Q NDoH/ MDGT-Q MICS-Q |
| | Age (date of birth), gender, birth order | | |
| | Gestational age at birth and birthweight | | |
| | Immunisation status | | |
| | Disease: upper respiratory tract infections | | |
| | Disease: diarrhoea and treatment | | |
| **Early childhood development** | Care that includes organised learning (all) | Care Index | MICS-Q |
| | Books, picture books, toys in household (all) | | |
| | Learning/play activities with child in HH (all) | | |
| | Child development and socialising behaviour (3–<5-year-olds) | | |
| **Feeding practices and food intake** | Breastfeeding<br>Complementary feeding<br>Dietary diversity<br>Most commonly consumed foods<br>Methodological detail in Section 3.3.2 | Never been breastfed and poor diversity entered in regression models as independent variables | SA-IYCFQ |
| **Maternal ante- and post-natal health** | Presence of non-communicable and/or communicable disease | Care Index | NDoH/ MDGT-Q |
| | Pregnancy history | Care Index | |
| | Current pregnancy: ante-natal care; if not, reasons | Care Index | |
| | Employment at the time of birth of index child | Care Index | |
| | Maternity leave and related income | | |
| | Smoking, alcohol, and drug use during pregnancy with the index child | | |
| | Risk of depression<br>Methodological detail in Section 3.3.3 | Care Index | CED-D-10 English version validated in isiXhosa and Afrikaans |
| | Physical abuse of mother by husband/partner | | NDoH-Q |
| **HH income and hunger** | All income sources and HH assets | | PDIS-Q NDoH-Q Census-Q 2022 |
| | Receipt of specific SA government grants | | |
| | Estimated total HH income | | |
| | Food security | | NIDS-CRAM Survey instrument |

WCSBS=Western Cape Stunting Baseline Survey; NDoH=National Department of Health; Q=Questionnaire; PDIS=Provincial Anthropometric and Dietary Intake Survey; MICS=Multiple Indicator Cluster Surveys; SA-IYCFQ=South African Infant and Young Child Feeding Questionnaire; CED-D-10=Center for the Epidemiological Studies of Depression Short Form; NIDS-CRAM Survey=National Income Dynamics Study – Coronavirus Rapid Mobile Survey, WASH=water availability, sanitation and hygiene

### 3.3.2 Feeding practices, dietary diversity and commonly consumed foods

#### *WHO/UNICEF feeding and dietary indicators*

The generic Infant and Young Child Feeding Questionnaire (SA-IYCFQ) was adapted for use in the WCSBS using the recommendations made by WHO/UNICEF (2021a) for these purposes. The adapted questionnaire was used to assess breastfeeding practices (including reasons for not breastfeeding or cessation of breastfeeding), complementary feeding and dietary quality using WHO/UNICEF feeding indicators. These indicators were formulated for children younger than 2 years old but were also calculated for the older children as relevant:

- Percentage children who were ever breastfed, but are not breastfed anymore (all)
- Exclusive breastfeeding (under 6-month -olds only)
- Mixed-milk (formula/animal milk) feeding (under 6-month -olds only)
- Continued breastfeeding (all)
- Introduction of solid/semi-solid/soft foods from 6 months (6–8-month-olds only)
- Minimum dietary diversity (6-month–<5-year-olds)
- Egg and flesh food consumption (6-month–<5-year-olds)
- Sweetened beverage consumption (all) (includes fruit juice)
- Consumption of sentinel sweet (unhealthy) foods (all)
- Consumption of sentinel salty/fatty (unhealthy) foods (all)
- Zero fruit and vegetable intake (6-month–<5-year-olds).

We added items to the WHO/UNICEF template to determine frequency of intake of oil/fat and sugar added to tea/coffee/porridge. Dietary data was also used to identify the foods most consumed by the children.

#### *Dietary intake assessment*

The dietary intake assessment method was based on the WHO/UNICEF (2021a) generic questionnaire for assessment of dietary indicators, including the dietary diversity score (DDS), in infants and young children.

The DDS has become a widely used method of determining variety in the diet and, by proxy, nutrient adequacy. "It is a food group diversity indicator that reflects one key dimension of diet quality – micronutrient adequacy – summarised across 11 micronutrients: vitamin A, thiamine, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, vitamin C, calcium, iron, and zinc" (FAO, 2021). A diet lacking in diversity can increase the risk of micronutrient deficiencies, which may have a damaging effect on children's physical and cognitive development (WHO/UNICEF, 2021a).

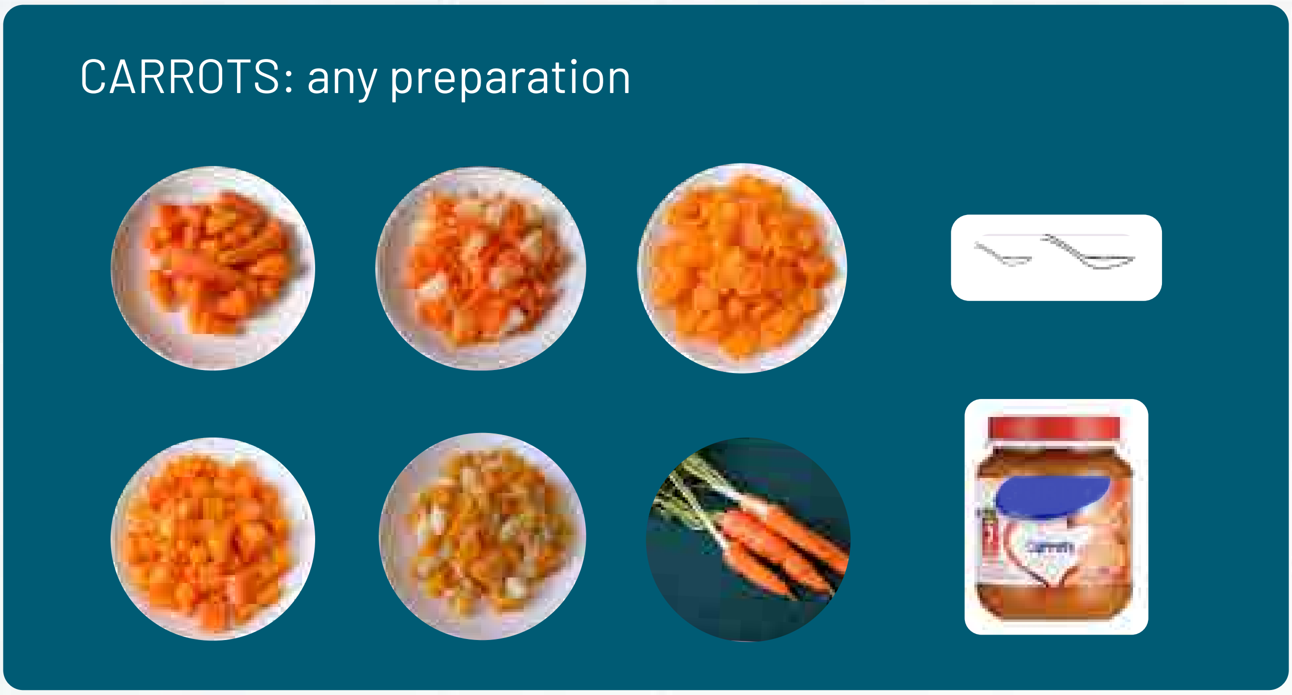
Food groups reflected in dietary intake questionnaire were aligned with the eight groups for infants and young children (WHO/UNICEF, 2021a), as well as the 10 groups for adult women (FAO, 2021), to allow for calculation of the DDS with both the eight and 10 food groups. Cut-offs that signify poor dietary diversity are <4 and <5 respectively (FAO, 2021; WHO/UNICEF, 2021a).

The food items allocated to food groups in the generic template of the WHO/UNICEF (2021a) were adapted for the WCSBS following the steps they recommend for this process.

1. We first considered the foods included in the 2010 IYCFQ that was adapted by Marjanne Senekal and colleagues for use in a birth cohort in Cape Town and surrounding areas (unpublished).
2. We considered the frequency of intake of all food items consumed by 1–<10-year-old children generated using the PDIS data set (Steyn et al., 2020).
3. We then conducted an expert consultation to allocate mixed dishes, e.g. spaghetti bolognaise, samp and beans, vegetable stews and custard (contains dairy which is healthy, but also sugar which is not healthy), to particular food groups for calculation of the DDS.

A set of 75 food cards depicting food items and their various preparations (as applicable, e.g. boiled cubed carrots, grated raw carrots, carrot puree) were developed and used in the administration of the dietary questionnaire for each food group.

Figure 3
An example of a food card depicting carrots and the various preparations




The procedure used to administer the food intake section of the dietary questionnaire was as follows (adapted from WHO/UNICEF, 2021a and FAO, 2021):

1. The fieldworker asked the interviewee to think about the child's day (activities) over the past 24 hours (from awakening yesterday), and then asked her/him to remember what he/she ate/drank during the day and the night.
2. The fieldworker then gave the interviewee the photocards of the first food group and asked her/him to sort them according to what the child ate/drank in the previous 24 hours. If any item on a card was eaten/drunk by the child, the interviewer circled the item on the questionnaire. This process was repeated until all the food groups listed in the questionnaire had been covered.
3. If the child had spent part of the past 24 hours outside the household, fieldworkers contacted the relevant person/caregiver to ascertain what the child ate during his/her time in the school/care facility.

### 3.3.3 Mental well-being of mother/primary caregiver

The mental well-being of the mother, or primary caregiver if not the mother, was assessed using the 10-item Centre for the Epidemiological Studies of Depression Short Form (CES-D-10), which is a widely used measure to screen for depression in primary care settings. IsiZulu, isiXhosa and Afrikaans translations of this questionnaire were tested for internal consistency, concurrent, construct and criterion validity of the CES-D-10 among speakers of these languages by Baron et al. (2017). These researchers concluded that the CES-D-10 is a valid, reliable screening tool for depression in isiZulu, isiXhosa and coloured Afrikaans-speaking populations. We obtained the translated versions of the tool from the researchers for use in the WCSBS.

The CES-D-10 includes 10 questions on ways that a respondent may have felt or behaved over the last week. The response options and scoring of the items are as follows: rarely or none of the time (less than 1 day); some or a little of the time (1–2 days); occasionally or a moderate amount of time (3–4 days); and all of the time (5–7 days). Questions 5 and 8 are scored 3, 2, 1, 0, while all other questions are scored 0, 1, 2 and 3. The total score is calculated by adding the score of each of the 10 items. The questionnaire should not be scored if more than two items are missing. The cut-off of ≥ 10 was used, as suggested by Andresen et al. (1994) to reflect risk of depression in English speakers.

### 3.3.4 Food security

The food security (hunger) questions included in the National Income Dynamics Study – Coronavirus Rapid Mobile Survey (NIDS-CRAM) that measure household and child hunger (van der Berg et al., 2022) were used in the WCSBS. The NIDS is a broadly nationally representative panel study following the lives of 28 000 South Africans and those they live with every two to three years since 2008.

**The three questions are as follows:**

1. In the past month, did your household run out of money to buy food (Y/N)?
2. In the last 7 days, has anyone in your household gone hungry because there wasn't enough food (Y/N)? *If YES, How often did they go hungry? (Frequency options: never, 1 or 2 days, 3 or 4 days, almost every day, every day)*
3. In the past 7 days, has any child in your household gone hungry because there wasn't enough food (Y/N) *If YES, how often did they go hungry? (Frequency options: never, 1 or 2 days, 3 or 4 days, almost every day, every day).*

### 3.3.5 Testing of questionnaires for face and content validity

The questionnaires and data collection tools were tested for face (formulation and comprehension of questions) and content validity (responses given), and were reviewed by the research team in collaboration with fieldworkers and community members during fieldworker training. Training included role-played interviews with mothers from the target population. A number of changes were made to the questionnaire and photo cards based on the feedback received.

## 3.4 SURVEY PROCEDURES

### 3.4.1 Team leaders and fieldworkers

An experienced registered dietician oversaw and coordinated all aspects of data collection, including quality control of completed questionnaires and logistics. Two teams of four fieldworkers led by a team leader were trained, standardised and deployed in the field to conduct the fieldwork. Fieldworkers worked in pairs. Each pair included one fieldworker proficient in English/isiXhosa and one proficient in English/Afrikaans to allow for interviews to be conducted in the language of choice of respondents.

To ensure team leader and fieldworker safety, local police stations, relevant community leaders and community security/policing forums (CPF) in each EA were contacted/approached either the day before or on the morning when entering an EA to gain insights into any safety concerns in the target areas. If deemed necessary by the police, CPFs were requested and remunerated to accompany fieldworkers. Local community members were identified as chaperones/facilitators of entry into individual households if necessary. Despite these measures, further safety support was needed and put in place in the form of a security officer for each team who accompanied them throughout the study.

### 3.4.2 Team-leader and fieldworker training

Team leaders and fieldworkers underwent a six-day training programme offered by the study PI and a registered dietician with substantial experience training fieldworkers in anthropometric measures and dietary intake assessment. The training covered sampling HHs in EAs; doing the necessary introductions when entering HHs; administration of the screening questionnaire; administration of the informed consent procedure; interviewing techniques and administration of the questionnaires; anthropometric measures (using the manual published by Wenhold et al., 2022 as a guide); plotting each of these measures on growth charts; and the study code of conduct. Team leaders received additional training on fieldworker management and checking.

Each fieldworker pair received a kit containing the following items to conduct interviews and measurements: digital adult and baby scales, a stadiometer, a length mat, MUAC tape measure, photocards for administration of the food intake component of the dietary questionnaire and copies of consent forms and questionnaires.

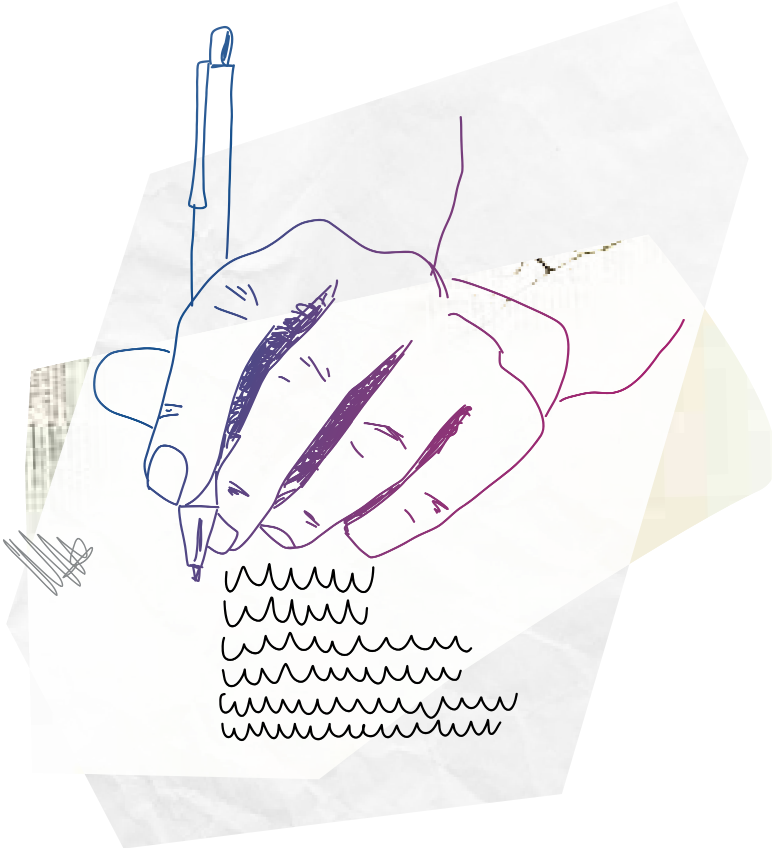
### 3.4.3 Fieldwork procedures

Team leaders knocked on the HH door, introduced themselves and briefly explained the purpose of the survey to the person answering the door. If the HH showed interest in participation, the screening questionnaire was administered. If the HH met the inclusion criteria of the study, a pair of fieldworkers was introduced to the HH, who then completed the informed consent procedure with a parent/primary caregiver. Fieldworkers then completed the anthropometric measures (child and mother/primary caregiver) and administered the questionnaires. If a child had been in care outside the house for any period during the previous 24 hours, the facility was contacted to check food intake during the time the child was there if the interviewee did not know this information.

## 3.5 QUALITY CONTROL

***Data quality control involved:***

- comprehensive training and standardisation of fieldworkers by an expert team led by a registered research dietician with comprehensive experience in fieldworker training for anthropometric and dietary surveys;
- calibration of equipment for anthropometric measures as recommended by Wenhold et al. (2022);
- repeating all anthropometric measures twice and using the average in statistical analyses;
- conducting interviews in the language of choice of mothers/primary caregivers;
- checking completed questionnaires for completeness and clarity of entries while still in the household by the person in the fieldwork pair who did not conduct the interview;
- checking completed questionnaires by the team leader at the conclusion of data collection each day, with the possibility to return to the HH the next day to check anything that was unclear/incomplete;
- regular collection (weekly, as the team's travel schedule allowed) and checking of all questionnaires by the study coordinator, study PI and data capturer; and
- regular site visits by the study coordinator to oversee data-collection procedures.



## 3.6 STATISTICAL ANALYSES

Data was analysed using Statistical Analysis Software (SAS) by a statistician with extensive experience in analysis of national malnutrition and dietary intake surveys, including the 1999 NFCS (Labadarios et al., 2005), the 2005 NFCS Fortification Baseline Study (Labadarios et al., 2008), the 2002 Dietary Intake Study (Steyn et al., 2003) and the 2018 PDIS (Senekal et al., 2019; Steyn et al., 2020). Descriptive statistics included mean (95% CI) and median (95% CI) for continuous variables and frequencies were tallied for categorical variables. The complex survey design was considered in all analyses and, consequently, the association between categorical descriptive variables and EA-type, UF, UI and RT was tested using the Rao-Scott Chi-square test. Comparison of continuous variables was done using the Bonferroni multiple comparison (MC) test (continuous variables) or the Kruskal-Wallis test (mostly for count variables, or for extremely skew distributions).

Prevalence of malnutrition amongst the children (stunting, underweight, overweight and obesity) was determined according to the cut-offs listed in Table 5 for different age groupings, including <6-month-old infants, 6-month–<1-year-olds, 1–<2-year-olds, <2-year-olds and 2–<5-year-olds. Associations between malnutrition and age groupings was tested using the Rao-Scott Chi-square test.

Dietary analyses included frequencies for feeding practices, calculation of the DDS for children 6 months and older, classification according to the WHO/UNICEF cut-off of less than four of the eight food groups, and calculation of WHO/UNICEF indicators other than the DDS (analyses were also done according to the cut-off of less than five of the 10 food groups, but results were not included in this report). Frequency of intake of items listed on the dietary questionnaire food list was used to identify the most consumed foods in the different age groupings.

Wealth, Care and WASH Indexes were generated for inclusion in logistic regression analyses using an iterated principal factor analysis process. Detail on the development of the indexes is included in Supplementary Materials 2.1 to 2.3 and variables that were retained in each index are presented in the results.

Five multivariate logistic regression models were constructed to identify potential drivers (predictors) of a DDS<4, a birthweight <2 500 g, incomplete immunisation status, HAZ<-2 (stunting) and BAZ>2 (overweight/obesity). Independent variables considered for inclusion in the multivariate logistic regression, apart from the Wealth, Care and WASH indexes, were selected based on expert insights of the research team in potential relationships based on their experience in similar studies and from literature. An iterative process was applied to evaluate the multivariate relationship. Variables that did not show any significant relationship in any of the selected age groups in a particular model were eventually discarded. Variables that remained in the final regression models and those that were considered but discarded are presented in relevant results tables. An odds ratio along with 95% confidence intervals were estimated to measure the strength of association. The statistical significance was set at a p value less than 0.05. Variance inflation factors (VIFs) were calculated to establish the presence of multicollinearity.

All analyses were weighted as per the sample design by the statistician.

## 3.7 ETHICAL CONSIDERATIONS

Ethical approval for this study as well as two amendments was obtained from the UCT Faculty of Health Sciences Human Research Ethics Committee (HREQ-REF292/2022) and from Stellenbosch University (REC: SBE-2022-26176). As the target population was minors, informed consent was obtained from a parent/primary caregiver, who was also interviewed on behalf of the minors. Race (population group) was included in the questionnaire for descriptive purposes and was not included in association analyses. The option to not disclose race is included in the questionnaire.

The length/height-for-age and weight-for-length/height of each child were plotted on growth charts that were given and explained to mothers/caregivers for educational purposes.

# 4. RESULTS

## 4.1 DEMOGRAPHIC CHARACTERISTICS OF CHILDREN

The mean (95% CI) age of children included in the study was 2.5 (2.3–2.6) years, with 17.5% in the 0–<1-year-old, 23.4% in the 1–<2-year-old, 20.7% in the 2–<3-year-old, 21.6% in the 3–<4-year-old and 16.6% in the 4–<5-year-old categories. There was no association between EA-type and child age. Gender representation was equal, with 49.6% males and 50.4% females and there was no association with EA-type and gender (Table S3.12, supplementary material).

Self-reported categorisation of race of the children as indicated by the interviewee was 33.6% black African, 57.4% coloured (mixed ancestry), 7.8% white (Caucasian), 0.6% Indian and 0.6% other. In the UF EA-type 33.6% were black African, 57.4% coloured, 0.6% Indian/Asian, 7.8% white and 0.6% other. In the UI EA-type 93.4% were black African and 6.6% were coloured. In the RT EA-type 9.2% were black African, 90.2% were coloured and 0.5% were white. Significance of the association between EA-type and race could not be tested due to a zero value in one cell (Table S3.1).

Results on birth order of children is as follows: 39.9% were first born, 30.6% second born, 18.4% third born, 7.5% fourth born, and 3.5% fifth to eight born. There was no association between EA-type and birth order (Table S3.14).

## 4.2 ANTHROPOMETRIC INDICATORS OF CHILDREN

### 4.2.1 Stunting

Stunting prevalence in the total study sample was 17.5% (Table 5). This was 25.2% in <6-month-old infants, which dropped to 7.7% in 6-month–<1-year-olds, increased to 23.9% in 1–<2-year-olds, after which it dropped to 18% in 2–<3-year-olds, 14.3% in 3–<4-year-olds and 15.7% in 4–<5-year-olds. The prevalence of stunting was similar in the <2-year-old (19.7%) and 3–<5-year-old (16%) groups (Table 5, Figure 4, Table S3.21).

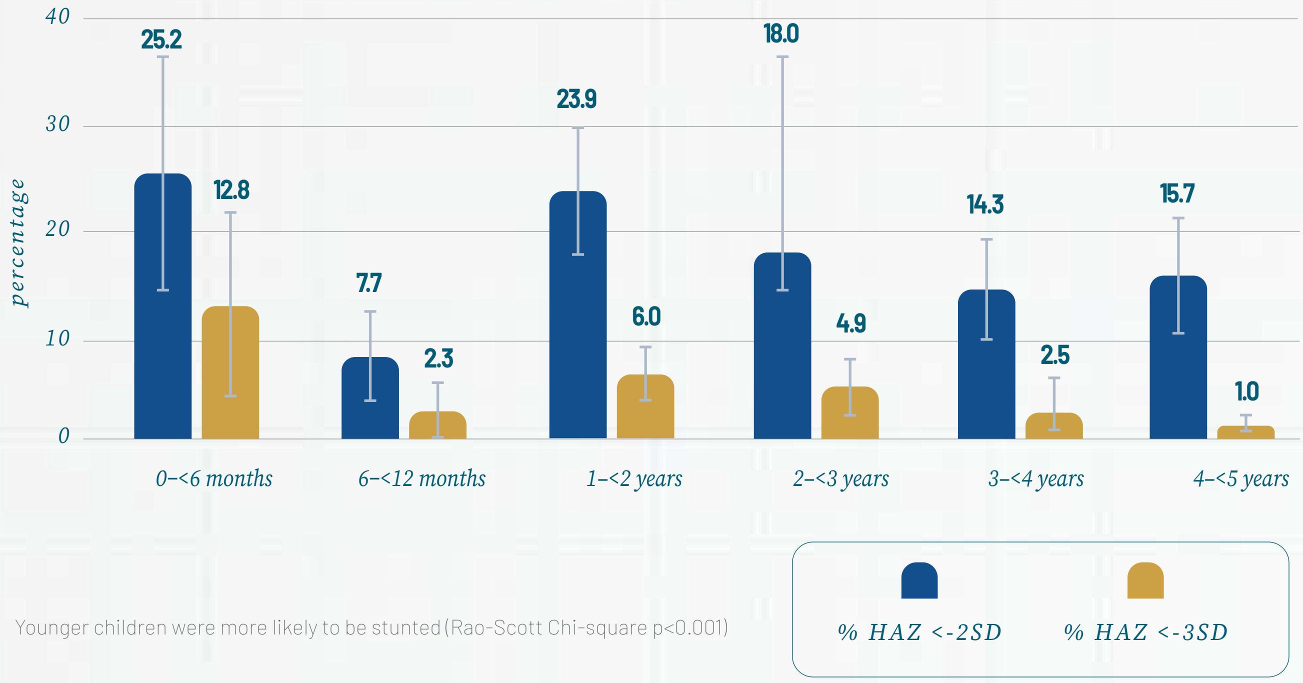
Table 5
Stunting, underweight and wasting prevalence in under-5-year-old children in the Western Cape

| | | HAZ<-2SD | WAZ<-2SD | BAZ<-2SD | BAZ<-3SD |
|---|---|---|---|---|---|
| **Age group** | **N** | **Stunted** | **Underweight** | **Wasted (MAM)** | **Severely wasted (SAM)** |
| **0–<6 months** | 69 | 25.2 (13.5–36.8) | 11.4 (2.6–20.2) | 8.8 (3.1–14.5) | 3.1 (0.0–7.5) |
| **6–<12 months (1 year)** | 127 | 7.7 (3.0–12.5) | 7.9 (2.1–13.7) | 9.0 (3.7–14.4) | 3.2 (0.1–6.3) |
| **1–<2 years** | 271 | 23.9 (17.4–30.3) | 4.2 (1.5–6.9) | 2.4 (0.6–4.3) | 0.9 (0.0–2.1) |
| **2–<3 years** | 315 | 18.0 (13.9–22.0) | 5.6 (2.8–8.4) | 3.2 (1.0–5.4) | 1.3 (0.1–2.5) |
| **3–<4 years** | 245 | 14.3 (9.7–18.9) | 3.6 (0.9–6.3) | 2.1 (0.2–3.9) | 0.5 (0.0–1.4) |
| **4–<5 years** | 187 | 15.7 (10.2–21.3) | 6.8 (2.6–11.0) | 1.1 (0.0–2.7) | 0.0 – |
| **Rao-Scott Chi-square** | | P=0.005 | P=0.089 | P=0.002 | P=0.051 |
| **0–<2 years** | 467 | 19.7 (15.2–24.2) | 6.3 (3.4–9.1) | 5.2 (3.1–7.3) | 1.9 (0.7–3.1) |
| **2–<5 years** | 745 | 16.0 (13.0–19.1) | 5.2 (3.4–7.1) | 2.2 (1.2–3.3) | 0.6 (0.1–1.2) |
| **Rao-Scott Chi-square** | | P=0.103 | P=0.500 | P=0.005 | P=0.043T |
| **Total group** | ***1** | **17.5 (14.8–20.2)** | **5.6 (3.8–7.4)** | **3.4 (2.4–4.5)** | **1.1 (0.5–1.7)** |

HAZ=height-for-age Z-score, WAZ=weight-for-age Z-score, BAZ=BMI-for-age Z-score, MAM=moderate acute malnutrition, SAM=severe acute malnutrition

***1** HAZ: N=1 202, WAZ: N=1 209, BAZ: N=1 199

Figure 4
Stunting prevalence (HAZ) in under-5-year-old children in the Western Cape (N=1 202)




Younger children were more likely to be stunted (Rao-Scott Chi-square p<0.001)

Stunting prevalence was significantly associated with EA-type, with stunting being most common in the RT EA-type (25.8%) and least common in the UF (16.5%) EA-type, with the prevalence in the UI EA-type being 20.5% (Table 6).

**Table 6**
Stunting prevalence by EA-type in under-5-year-old children in the Western Cape

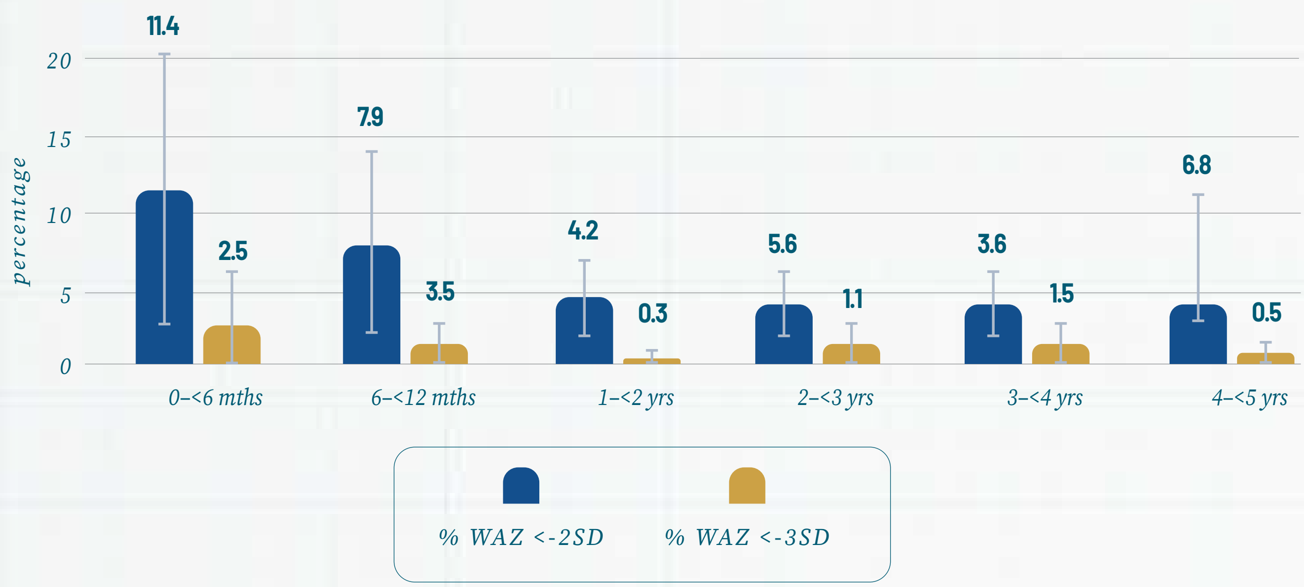
| | TOTAL GROUP N=1 202 | URBAN FORMAL N=883 | URBAN INFORMAL N=162 | RURAL TOWNS N=157 | RAO-SCOTT CHI-SQUARE |
|---|---|---|---|---|---|
| Stunting | Column % (CI) | Column % (CI) | Column % (CI) | Column % (CI) | |
| **Stunted & severely stunted HAZ<-2SD** | 17.5 (14.7–20.2) | 16.5 (13.4–19.5) | 20.5 (14.9–26.2) | 25.8 (19.9–31.8) | P=0.006 |
| **Not stunted HAZ≥-2SD** | 82.5 (79.8–85.2) | 83.5 (80.5–86.6) | 79.5 (73.8–85.1) | 74.2 (68.2–80.1) | |

HAZ=height-for-age Z-score, SD=standard deviation, CI=95% confidence interval

## 4.2.2 Underweight

Underweight prevalence was 5.6% in the total study sample (Table 5). It was 11.4% in the <6-month-old infants, dropped to 7.9% in 6-month–<1-year-olds, 4.2% in 1–<2-year-olds, 5.6% in 2–<3-year-olds, 3.6% in 3–<4-year-olds and then increased to 6.8% in 4–<5-year-olds. Difference between age groups was not significant (Table 5, Figure 5).

**Figure 5**
Underweight prevalence (WAZ) in under-5-year-old children in the Western Cape (N=1 209)

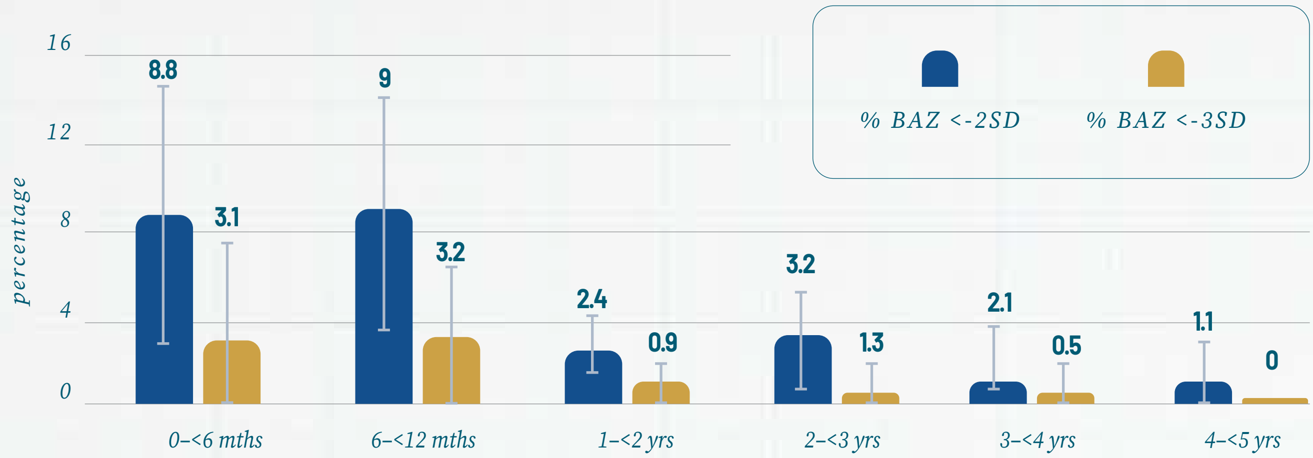



No association between underweight prevalence and age (Rao-Scott Chi-square p>0.05)

### 4.2.3 Wasting and severe acute malnutrition (SAM)

Wasting prevalence (BAZ<–2SD) in the total sample was 3.4% and SAM (BAZ<–3SD) 1.1% (Table 5). Under-1-year-olds were most likely to be wasted (almost 10% in under-1-year-olds versus <4% in the other age groups) and there was a non-significant trend for under-1-year-olds to be more likely to have SAM (3.1% for <6 month-olds; 3.2% for 6-month–<1-year-olds versus <1.4% in the older groups (Table 5 and Figure 6).

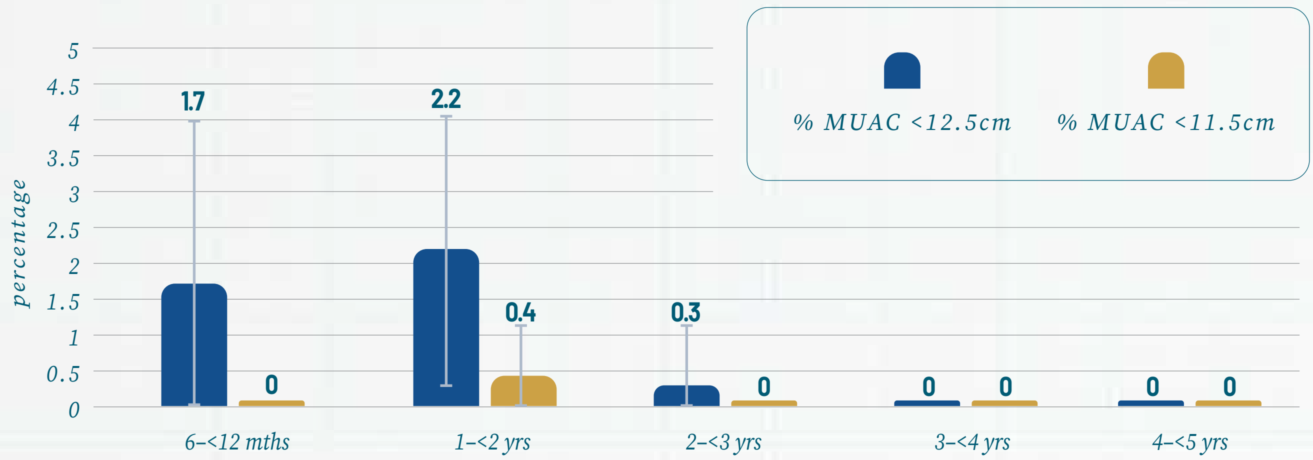
**Figure 6**
Wasting prevalence (BAZ)
in under-5-year-old children in the Western Cape (N=1 199)




Significant association between wasting prevalence (BAZ<–2SD) and age (Rao-Scott Chi-square p<0.001), but not with severe wasting (SAM)

Results for MUAC also indicate that the younger age groups may be more prone to wasting and SAM than older children (Figure 7 and Table S3.21).

**Figure 7**
Wasting prevalence (BAZ)
in under-5-year-old children in the Western Cape (N=1 199)



### 4.2.4 Overweight/obesity

Prevalence of overweight and obesity are presented in Table 7 and Figure 8. Overweight and obesity in the total sample were 9.8% and 5.3% respectively. The prevalence increased from birth to peak in the 1–<2-year-old group (26.2% for overweight and obesity combined) and then dropped to 7.8% (combined) in the 4–<5-year-olds (significant association). The combined prevalence of overweight and obesity also differed significantly between under-2-year-olds and 2–<5-year-olds (20.6% and 11.4% respectively) (Table 7).

The combined prevalence of stunting and overweight for the total group was 2.4%. The 1–<2-year-olds were most likely to be stunted-overweight (5.5%), followed by the 2–<3-year-olds (significant association). Prevalence of overweight/obesity was not associated with EA-type (Table S3.11).

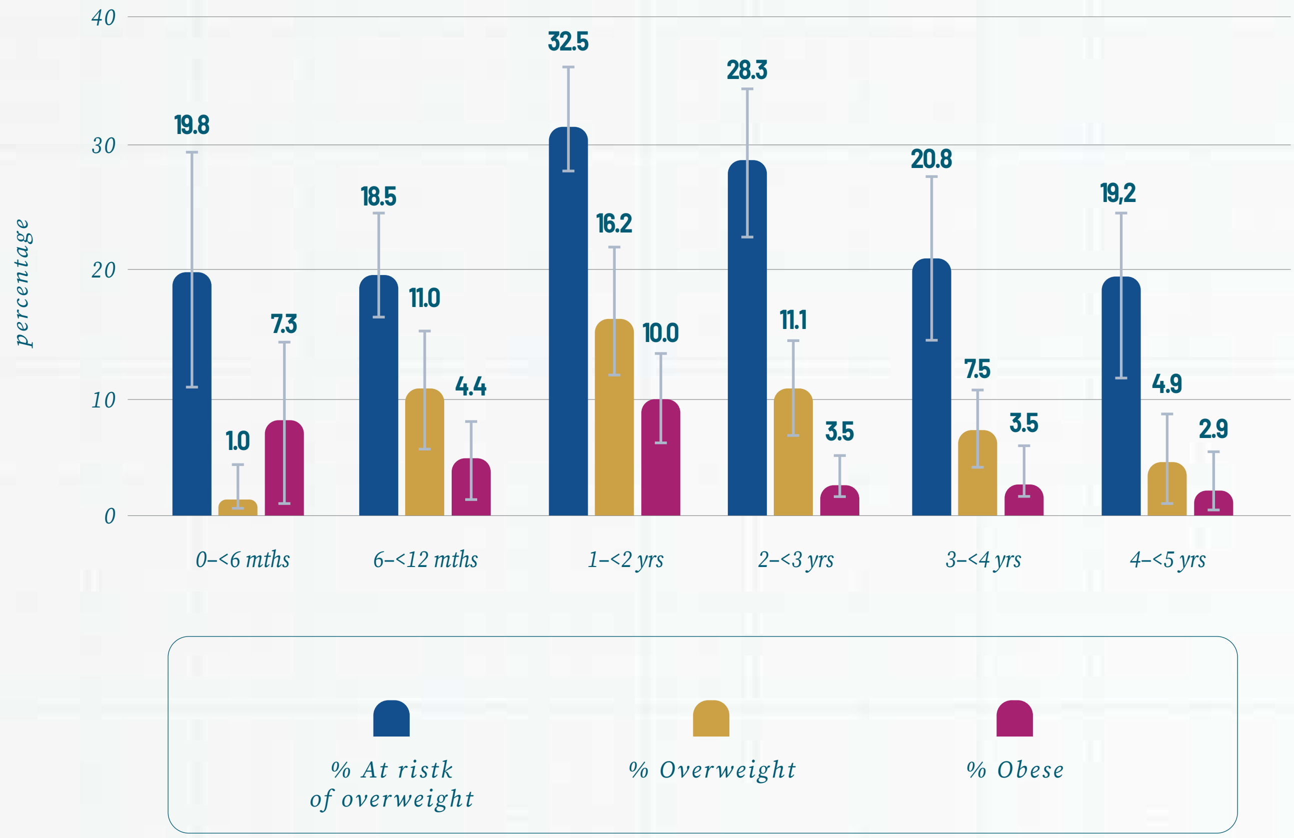
**Table 7**
Prevalence of overweight/obesity in under-5-year-old children in the Western Cape

| | | BAZ>1; ≤2SD | BAZ>2; ≤3SD | BAZ>3SD | BAZ>2 | HAZ<–2SD and BAZ>2SD |
|---|---|---|---|---|---|---|
| **Age group** | **N** | **At risk of overweight** | **Overweight** | **Obese** | **Overweight/ obese** | **Stunted-overweight** |
| **0–<6 months** | 69 | 19.8 (10.7–28.9) | 1.0 (0.0–3.0) | 7.3 (0.5–14.2) | 8.3 (1.0–15.5) | NA |
| **6–<12 months (1 year)** | 127 | 18.5 (11.0–26.1) | **11.0 (4.8–17.3)** | 4.4 (0.7–8.1) | 15.4 (7.9–23.0) | 0.9 (0.0–2.7) |
| **1–<2 years** | 271 | 32.5 (27.6–37.3) | **16.2 (11.6–20.9)** | **10.0 (6.6–13.5)** | 26.2 (20.8–31.6) | 5.5 (2.5–8.5) |
| **2–<3 years** | 315 | 28.3 (22.6–34.0) | **11.1 (7.6–14.7)** | **3.5 (1.6–5.5)** | 14.7 (10.7–18.6) | 2.1 (0.6–3.6) |
| **3–<4 years** | 245 | 20.8 (14.6–27.0) | **7.5 (4.0–11.0)** | 3.5 (1.1–5.9) | 11.0 (7.2–14.8) | 1.4 (0.0–3.0) |
| **4–<5 years** | 187 | 19.2 (11.6–26.8) | **4.9 (1.3–8.5)** | 2.9 (0.3–5.4) | 7.8 (3.6–12.0) | 0.6 (0.0–1.8) |
| ***p-value*** | | P>0.05 | P<0.001 | P>0.05 | P<0.001 | P<0.006 |
| **0–<2 years** | 467 | 26.7 (22.9–30.6) | 12.5 (8.8–16.2) | 8.1 (5.6–10.6) | 20.6 (16.1–25.1) | 3.9 (2.0–5.8) |
| **2–<5 years** | 745 | 23.1 (18.9–27.2) | **8.0 (6.1–10.0)** | 3.4 (2.0–4.7) | 11.4 (9.1–13.7) | 1.4 (0.5–2.4) |
| ***p-value*** | | P>0.05 | P<0.001 | P>0.05 | P<0.001 | P=0.008 |
| **1–<5 years** | 1 018 | 25.7 (22.0–29.3) | 10.4 (8.2–12.4) | 5.2 (4.0–6.4) | 15.6 (13.2–17.9) | 2.6 (1.5–3.6) |
| **Total group** | ***1** | **24.5 (21.5–27.50** | **9.8 (7.8–11.9)** | **5.3 (4.1–6.5)** | **15.1 (12.7–17.5)** | **2.4 (1.5–3.4)** |

HAZ=height-for-age Z-score, BAZ=BMI-for-age Z-score, SD=standard deviation

***1** HAZ: N=1 202; BAZ: N=1 199

Figure 8
Prevalence of risk of overweight (BAZ>1, ≤2SD), overweight (BAZ>2, ≤3SD) and obesity (BAS>3SD) in under-5-year-old children in the Western Cape (N=1 199)




Significant association between wasting prevalence (BAZ<-2) and age (Rao-Scott Chi-square p<0.001)

## 4.3 SOCIODEMOGRAPHIC AND ECONOMIC CHARACTERISTICS OF HOUSEHOLDS AND CAREGIVER PROFILES

### 4.3.1 Household member profile

In the majority of HHs the person interviewed was the mother of the index child (71.6%), with others interviewed (n=320) being mostly the grandmother and then the father, aunt, older sibling, grandfather, uncle or a non-related person. The mother was significantly more likely to have been the interviewee in the UI than in the UF and RT EA-types (p=0.021) (Table S3.1). Most mothers (93.2%) and 54.1% of fathers lived in the HH four or more nights a week, with no difference between EA-type profiles (Table S3.1).

A third of mothers were legally married (31.2%), 52.7% had never been married, 13.6% were living together and 2.5% indicated other options. EA-type profiles differed significantly for marital status of the mother (p=0.014). Having never been married was more common in the UI and RT EA-types, with the percentage living together being lower in these areas than in the UF area (Table S3.1).

Fifty-one per cent of HHs were male headed (father: 38.9%, grandfather: 11.3%, uncle 2.6% or mother's male partner: 0.6%), 43% female headed (grandmother: 24.2%, mother: 16.4%, or aunt: 2.3%) and 5.6% indicated other options. There were no significant differences between EA-type profiles (Table S3.1).

Languages spoken in HHs were Afrikaans (47.4%), isiXhosa (26.7%), English (20.6%) and 5.3% indicated another language (e.g. Shona, Sotho, Chewa, being bilingual, and some others). EA-type profiles differed significantly for language spoken in HHs ($p<0.001$). IsiXhosa was most spoken in UI (75.1%) and Afrikaans in RT (89.3%). Another language (14.9%) and isiXhosa (7.0%) were the second most commonly spoken languages in UI and RT respectively. Afrikaans was also more commonly spoken in the UF areas (48.3%), with isiXhosa being spoken in 23.1% and English in 24% of HHs in this area (Table S3.1).

As far as educational status is concerned, half of the mothers did not complete Grade 12, with 6.3% having completed primary school or less, 44.5% some high school, 30% Grade 12, 16.4% tertiary training and 2.7% indicating other options (mostly do not know). A third of fathers had not completed Grade 12, with 5.1% having completed primary school or less, 28.7% some high school, 27.9% Grade 12 and 14.3% tertiary training. The educational status of 23.9% of fathers was not known. EA-type profiles differed significantly for educational status of mothers and fathers of index children (Rao-Scott Chi-square $p=0.001$ and $p<0.001$ respectively). Most prominent was that having completed a tertiary training was more common in the UF EA-type and having completed some high school in the UI and RT EA-types (Table S3.2).

Just more than half of mothers were at home not working (54.3%), 30.1% were working full-time, 6.8% were working part-time and 8.8% indicated other options (mostly do not know). There were 21.5% of fathers at home not working, 53.7% were working full-time, 8.2% were working part-time and 16.5% indicated other options (mostly do not know). EA-type profiles differed significantly for the employment status of mothers as well as fathers of index children (Rao-Scott Chi-square $p=0.001$ and $p=0.001$ respectively). The percentage of mothers at home and not working was the highest, and working full-time the lowest, in the UI EA-type. For fathers the percentage at home not working was almost a quarter across all three EA-types, while working full-time was lowest and working part-time highest in the UI EA-type (Table S3.2).

### 4.3.2 Dwelling characteristics

More than 80% (82.8%) of dwellings were classified as formal and 17.2% as informal, with 86.9% of the dwellings in UI, 31.3% of the dwellings in RT and 8.5% in UF EA-types classified as informal (profiles significantly different between EA-types Rao-Scott Chi-square $p<0.001$).

The median (95% CI) number of rooms in dwellings in the total sample was 4.5(4.2–4.8), which was significantly lower in dwellings in UI EA-types [2.5(1.9–3.1)] than in dwellings in UF and RT EA-types ($p<0.001$). The majority of dwellings had one or more bedrooms (95.1%), a kitchen (89.2%; HHs in UF EA-types were most likely to have a kitchen in UF EA-types, while those in UI EA-types were least likely to have one; Rao-Scott Chi-square $p=0.006$), and a bathroom (80%; most likely to have a bathroom in UF and least likely in UI EA-types $p<0.001$). An open-plan living-dining room was also common (63.2%; most likely in UF areas). The median (95% CI) number of people living in dwellings in the total sample was 4.4 (4.1–4.6). This number was significantly lower for HHs in UI [3.6(3.2–4.0)] than HHs in UF [4.4(4.2–4.7)] and HHs in RT [4.4(4.0–4.8)] EA-types (Bonferroni MC $p<0.05$) (Table S3.5).

The main energy source for cooking was electricity in 85.8% of HHs, with the main other option being gas. There were no significant associations between EA-type and energy source for cooking. Almost 80% of HHs had access to the Internet, either via a cell phone (48.8%) or a home Internet connection (30.3%). Having no access tended to be higher in RT EA-types, but significance could not be tested due to a 0 value in one cell (Table S3.3).

The main sources of drinking water and water for other uses in HHs were piped water in the dwelling (81.3% and 81.4% respectively), with the most common alternative option being piped water through an on-site tap (11.2% and 11.4% respectively). Other options were mentioned by 7.5% of interviewees, including a public or neighbour's tap. EA-type was significantly associated with a main source of drinking water and water for other uses (Rao-Scott Chi-square $p<0.001$ for both variables). Use of piped water (in-dwelling or on-site) was less common and the other options more common in the UI EA-type. Most of all the HHs (96.5%) across the three EA-types indicated that they always had sufficient water (Table S3.3).

Most HHs had access to a flush toilet connected to a public sewerage system/septic tank (79.6%), 5.2% had either a bucket or chemical toilet system and 0.1% had no toilet facility. The majority also had the toilet facility in their own dwelling (79.6%), 14.6% had the toilet in their own yard/plot and 5.9% elsewhere. HHs in the UI EA-type tended to be less likely to have access to a flush toilet (64% versus 98.9% in UF and 83.8% in RT EA-types), but significance could not be tested due to a 0 value in one cell. On the other hand, EA-type was significantly associated with location of the toilet facility (Rao-Scott Chi-square p<0.001). Toilet location was elsewhere for 49.1% of HHs in the UI EA-type versus 1.2% in the UF and 5.5% in the RT EA-types. Sharing of toilet facilities was prevalent in 18.1% of all HHs, with HHs in the UI EA-type being significantly more likely to be sharing (Rao-Scott Chi-square p<0.001; UF 12.8%, UI 65.5% and RT 19.9%) (Table S3.3).

Availability of a handwashing facility in the dwelling was 65.6%, a fixed facility in the yard 10.1%, none 3.5% and other (not observed, interview elsewhere) 20.8% in the total group of HHs. Not having a facility or a fixed facility in the yard was more common in the UI than UF and RT EA-types (Rao-Scott Chi-square p<0.001). Handwashing results show that 24.3% of interviewees washed their hands before handling food, 60% before feeding the child and 88.2% after going to the toilet. EA-type was significantly associated with handwashing before handling food and before feeding the child (Rao-Scott Chi-square p<0.001 for both associations). Washing hands before handling food was least common in the UI EA-type (67.9%) and most common in the UF and RT EA-types (85.6% and 90.8% respectively). Washing hands before feeding the child was also least common in the UI EA-types (28.2%) and more common in the UF and RT EA-types (65.6% and 52.6% respectively) (Table S3.4).

Refuse collection was done by a local authority from HH premises for 86.9%, collected from a communal collection point for 10.9% and elsewhere for 2.2% of HHs (0.75% dump refuse anywhere). Refuse collection from premises by local authorities was most common in the UF EA-types (Rao-Scott Chi-square p<0.001) (Table S3.3).

Observation of the cleanliness of dwelling floors showed that 4.4% were classified as very dirty, 14.6% as dirty, 64.8% as clean and 16.2% as very clean. The clothes of the child were classified as very dirty for 3.9%, dirty for 11.2%, clean for 68.9% and very clean for 16.0% of children. EA-type was significantly associated with the cleanliness of the child's clothes (Rao-Scott Chi-square p=0.011), but not the floor of dwellings. The very clean clothes category was least common and the dirty and very dirty categories most common in the UI EA-type (Table S3.4).

### 4.3.3 Household socio-economic indicators and food security

Sources of HH income included salaries/wages/commissions (74%), business income (6.8%), grants of all types (71%) and other options (7.2%). There were no associations between EA-type and sources of income (Table S3.6). Two thirds of HHs received child-support grants, 15.4% old-age grants, 5.6% disability grants, 4.5% social relief of distress grants, 3.3% Covid-19 relief of distress grants, 1% foster-care grants, 0.1% care-dependency grants and 0% war-veteran's grant or a grant-in-aid. Significant differences between EA-type profiles for grants received were evident for the child-support grant (HHs in the RT EA-type were most likely and HHs in UF EA-types least likely to have received a child grant), old-age grant (HHs in UI EA-types were least likely to have received this grant) and social relief of distress grant (HHs the UI EA-type were most likely to have received this grant) (Table S3.6).

The estimated total monthly income of HHs was R0–R3 200 for 41.9%, R3 201–R25 600 for 42.7% and more than R25 600 for 9.4%. None of the HHs in the UI or RT EA-types had a total income of more than R25 600, with just more than half of these HHs having an income in the lowest bracket (Table S3.6).

Forty-one per cent of HHs ran out of money to buy food in the month preceding the study, 9.4% reported that a HH member and 5.5% that a child in the HH had gone hungry at least 1–2 days in the week preceding the study (Figures 9 and 10). EA-type was significantly associated with having run out of money for food in the past month (those living in the UI and RT EA-types were more likely to run out of money; Rao-Scott Chi-square p=0.012) (Table S3.8).

**Figure 9**
Summary of results for the three food security questions in households of under-5-year-old children in the Western Cape by EA-type (UF=urban formal, UI=urban informal, RT=rural town)

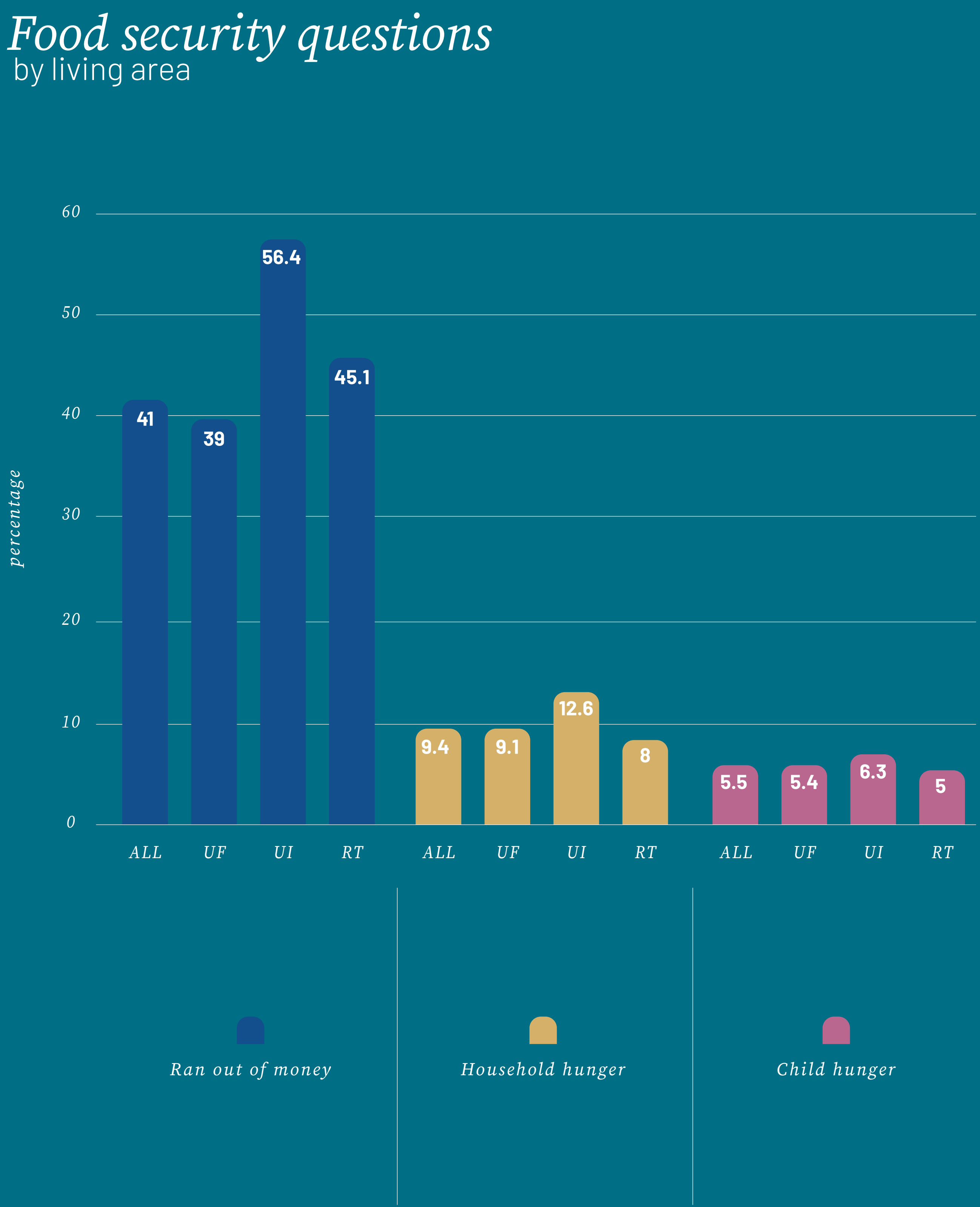
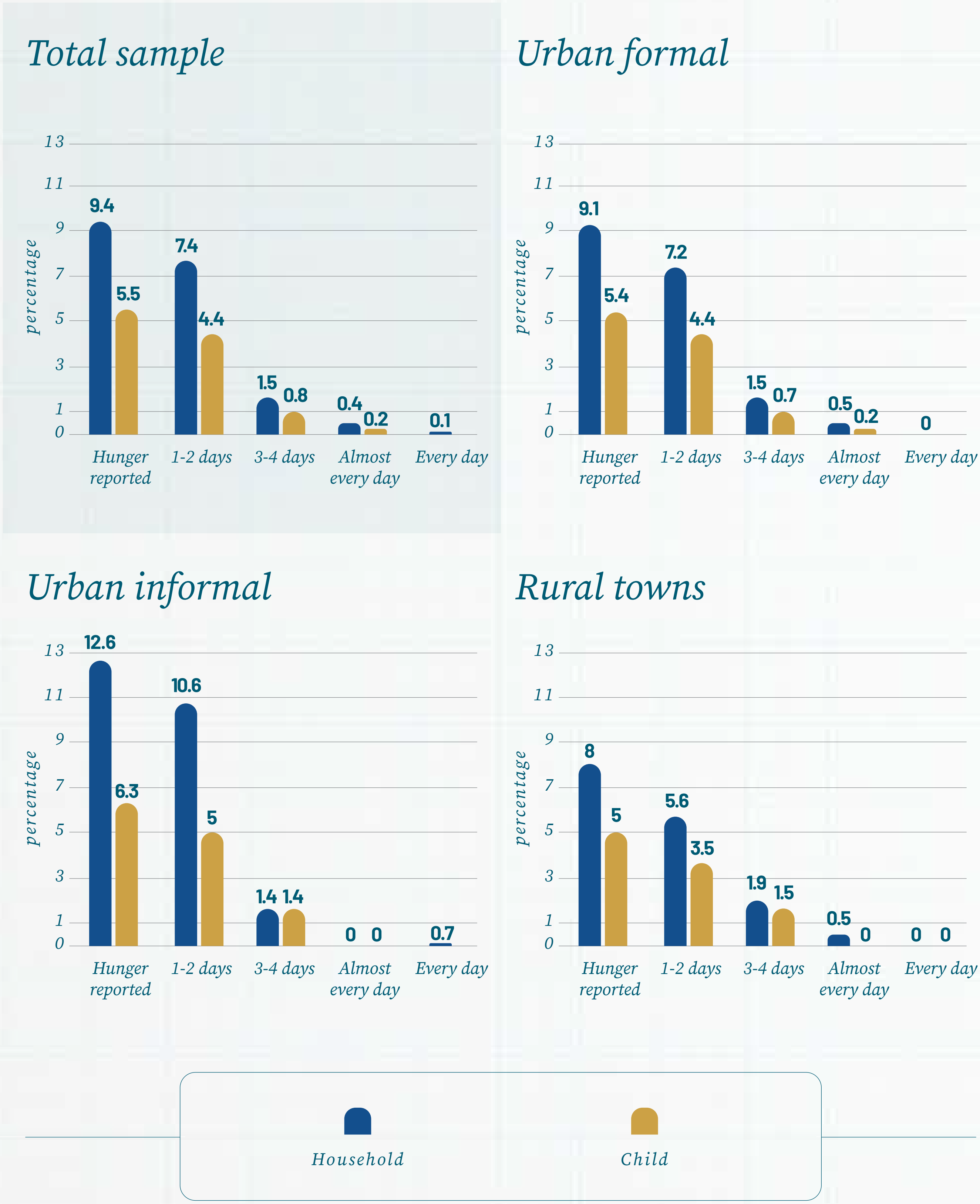


Figure 10
Number of days someone in the household and any child was hungry in the past week in households of under-5-year-old children in the Western Cape by EA-type (N=1 214)



### 4.3.4 Characteristics of mothers of index children

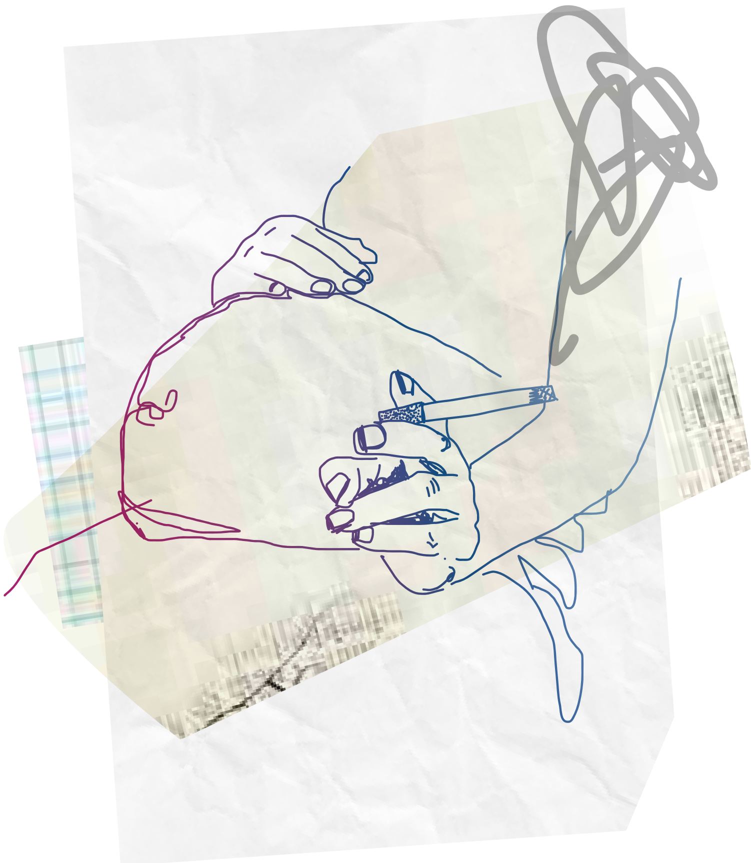
The mean (95% CI) age of mothers was 30.1 (29.4–30.9) years. Less than 1% (0.8%) were under 18 years old, 47.6% were 18–<30 years old, 41.9% 30–<40 years old and 9.7% 40 years and older. There was no association between EA-type and mother's age (Table S3.9).

The mean (95% CI) age of mothers at the birth of the index child was 27.8 (27.1–28.6); 5.6% were younger than 18 years old when the child was born. There was a strong trend for mothers living in the UF EA-type to be more likely to have been younger than 18 years old at this point (Bonferroni MC p=0.04). The mean (95% CI) age of mothers at the birth of their first child was 22.2 (21.3–23.2) years, with 17.3% having been younger than 18 years old at this point (similar across EA-types). Only 2.6% of mothers were pregnant at the time of the study and there was no association with EA-type (Table S3.9).

The majority (94.9%) of mothers received antenatal care when they were pregnant with the index child. Only 6.5% were visited at home by a healthcare worker during their pregnancy and only 9% were visited after the birth of the index child. There were no associations between EA-type and these variables (Table S3.9). Thirty per cent of mothers were employed at the time of birth of the index child. Duration of maternity leave for employed mothers was less than four months for 63.4% and four months or more for 36.6% (Table S3.9).

The mean (95% CI) BMI of mothers was 28.1 (27.3–28.8) with 6.9% underweight, 34.0% normal weight, 22.3% overweight and 36.8% obese. EA-type was significantly associated with mothers' BMI, with BMI being significantly higher in UI EA-types than in UF or RT EA-types (Bonferroni MC p<0.05). Obesity was most common among mothers in the UI EA-type (55.5%) compared to the UF (34.4%) and the RT (36.4) EA-types (Rao-Scott Chi-square p<0.001) (Table S3.10).

Self-reported diabetes was present in 2.3% of mothers, high blood pressure in 5.2%, heart problems in 0.5%, HIV/AIDS in 6.2%, tuberculosis in 0.3%, while 2.7% indicated other options, including epilepsy. There were 14.6% of mothers classified as being at risk of depression. Physical abuse from husband/partner was suffered by 1.6% of mothers (0% in the RT EA-type). There were no associations between EA-type and these physical or mental disease indicators (Table S3.10).



Smoking during pregnancy with the index child was prevalent in 25.2%, alcohol use in 14.4% and drug use in 2.8% of mothers. EA-type was significantly associated with smoking during pregnancy, but not with alcohol or drug use. There were 37.8% of mothers in the RT EA-type who smoked during pregnancy, 26.3% in UF and 6.6% in UI EA-types (Rao-Scott Chi-square p<0.001). Mothers living in the UI EA-type tended to be more likely to use alcohol (UI=18.2%, UF=14.2% and RT=12%) but this was not significant (Table S3.10).

The BMI and depression risk profile of primary caregivers other than the mother was similar to that of the mother (Table S3.11). The mean (95% CI) BMI was 29.2 (28.1–30.3) with 6.8% classified as underweight, 30.4% as normal weight, 21.2% as overweight and 41.2% as obese. There were 14.7% who were found to be at risk of depression. There were no associations between EA-type and any of these variables (Table S3.11).

## 4.4 INDEXES REFLECTING UNDERLYING CAUSES OF MALNUTRITION

### 4.4.1 Wealth Index

Eighteen indicator variables were considered for calculation of the Wealth Index (Supplementary materials S3.1). The 12 variables that were retained after completion of the development steps using internationally recognised methods (Filmer & Pritchett, 2001) (Supplementary materials S2.1) include:

- household possessions: refrigerator, vacuum cleaner, washing machine, computer or laptop, satellite television, motor car, television;
- Internet access with a connection at home in the dwelling, using a cell phone or any other mobile device;
- the type of dwelling, indicated as a formal brick/concrete structure OR an informal dwelling such as a shack in a backyard/not in a backyard in an informal settlement; and
- a count variable representing the total number of rooms in the house.

A score in the lowest tertile was defined as a potential risk for stunting, overweight/obesity, as well as poor dietary diversity, low birthweight and incomplete immunisation status.

Tertile distributions for the total group and by EA-type are presented in Table 8. EA-type was significantly associated with the Wealth Index tertile distribution. Being in the lowest tertile was most common in the UI EA-type (80.6%) and least common in the UF EA-type (26.3%).

**Table 8**
Wealth, Care and WASH Index tertile distributions for under-5-year-old children in the Western Cape by EA-type

| TERTILES | | TOTAL GROUP N=1 214 | URBAN FORMAL N=892 | URBAN INFORMAL N=163 | RURAL TOWNS N=159 | P-VALUE |
|---|---|---|---|---|---|---|
| | | Column % (CI) | Column % (CI) | Column % (CI) | Column % (CI) | Rao-Scott Chi-square |
| Wealth Index | One | 32.1 (26.1–38.1) | 26.3 (20.9–31.7) | 80.6 (66.6–94.6) | 39.0 (23.6–54.3) | P<0.001 |
| | Two | 34.7 (29.6–39.9) | 36.3 (30.6–42.0) | 16.4 5.1–27.7) | 39.8 (26.8–52.8) | |
| | Three | 33.2 (25.1–41.3) | 37.4 (28.2–46.6) | 3.0 (0.0–6.6) | 21.2 (9.6–32.9) | |
| Care Index | One | 32.8 (28.1–37.5) | 30.1 (25.0–35.3) | 52.9 (44.0–61.9) | 38.1 (31.6–44.6) | P<0.001 |
| | Two | 34.0 (29.8–38.1) | 34.0 (29.1–38.9) | 33.9 (27.6–40.3) | 33.8 (29.5–38.1) | |
| | Three | 33.3 (25.8–40.7) | 35.9 (27.2–44.5) | 13.1 (4.9–21.4) | 28.1 (22.4–33.8) | |
| WASH Index | One | 33.0 (25.7–40.2) | 31.8 (23.4–40.1) | 51.5 (40.8–62.2) | 23.4 (10.5–36.2) | P<0.001 |
| | Two | 33.7 (28.9–38.4) | 32.2 (26.7–37.7) | 40.0 (31.5–48.4) | 43.0 (35.7–50.3) | |
| | Three | 33.3 (27.2–39.4) | 36.0 (29.2–42.8) | 8.5 (2.9–14.2) | 33.6 (19.1–48.1) | |

### 4.4.2 Care Index

Twenty-five variables were considered for calculation of the Care Index (Supplementary materials S2.2). The ten variables retained after completion of the development steps using internationally recognised methods (Filmer & Pritchett, 2001) (Supplementary materials S2.2), include:

- mother: marital status, educational level, current employment, employment status when the child was born, age when the child was born;
- father: educational level and current employment; and
- child-development opportunities: attendance of ECCE programmes and availability of children's books in the HH.

A score in the lowest tertile was defined as a potential risk for stunting, overweight/obesity, as well as poor dietary diversity, low birthweight and incomplete immunisation status.

Tertile distribution for the total group and by EA-type are presented in Table 8. EA-type was significantly associated with the Care Index. Being in the lowest tertile was most common in the UI EA-type (52.9%) and least common in the UF EA-type (30.1%).

### 4.4.3 WASH Index

Twenty indicator variables were considered for calculation of the WASH Index (Supplementary materials S2.3). The thirteen variables that were retained after completion of the development steps using internationally recognised methods (Filmer & Pritchett, 2001) (Supplementary materials S2.3), include:

- water availability: piped water inside the dwelling, piped water in the yard, water from a neighbour's/public tap;
- handwashing facility: handwashing facility available in the dwelling, handwashing facility available in the yard, soap/detergent available for handwashing, water available for handwashing;
- toilet facility: flush toilet, toilet inside dwelling, toilet shared, bucket toilet; and
- HH and child hygiene: house with clean floors and child with clean clothes.

A score in the lowest tertile was defined as a potential risk for stunting, overweight/obesity, as well as poor dietary diversity, low birthweight and incomplete immunisation status.

Tertile distribution for the WASH index in the total group and by EA-type are presented in Table 8. EA-type was significantly associated with the WASH Index. Being in the lowest tertile was most common in the UI EA-type (51.5%) and least common in the UF EA-type (33.6%).

## 4.5 INDEX CHILD HEALTH AND EARLY DEVELOPMENT INDICATORS

### 4.5.1 General health indicators

The majority (85.3%) of interviewees could present the index child's Road-to-health booklet (RtHB) at the time of the interview (UF=83.8%, UI=93.7% and RT=91.1%). Fourteen per cent indicated that the child had a RtHB but did not have it with them at the time of the interview, with the reason being either that it was with another person or that the child was recruited using alternative strategies, e.g. swim schools, play groups, pre-schools and community markets where parents did not necessarily have the booklet with them. Less than 1% did not have a RtHB, with the most common reason for not having one being that the child was not South African (Table S3.12).

Presence of fast, short and rapid breathing (potential respiratory tract infection) in the past two weeks was reported for 3.9% and presence of diarrhoea for 5.4% of children. EA-type was significantly associated with the presence of a respiratory tract infection, with it being most common in the UF EA-type (UF=4.4%, UI=1.8% and RT=1.5%) (Rao-Scott Chi-square p<0.029). There was no association between living area and presence of diarrhoea.

### 4.5.2 Birthweight and predictors thereof

The mean (95% CI) gestational age of mothers was 38.5 (38.3–38.7) weeks, which did not differ between EA-types. The mean (95% CI) birthweight was 3.0 (2.9–3.0) kg, with birthweight of children living in the RT EA-types [2.8(2.7–2.8)] being significantly lower than that of children living in UF [3.0(3.0–3.1)] and UI EA-types [3.2(3.1–3.3)] (Bonferroni MC p<0.001). Prevalence of very low birthweight (<1.5kg) was 2%, low birthweight (≥1.5kg, <2.5kg) 15.8% and normal birthweight (≥2.5kg) 82.3%. Low birthweight (low and very low combined) was more common in the RT EA-type than the other two EA-types (RT=24.4%, UF 17.8% and UI 12.4%) (Rao-Scott Chi-square p<0.001) (Table S3.12).

Predictors of low birthweight for 6-month–<5-year-old children are presented in Table 9. The following increased the risk of a low birthweight: having a Care Index in the lowest tertile in the 2–<3-year-old age grouping; having a low income in 2–<5-year-old and 3–<5-year-old age groupings; having a mother who smoked while pregnant with the index child in all age groupings except the 2–3-year-old age groupings; and a gestational age of <37 weeks in all age groupings (strongest predictor). A protector against a low birthweight was having an overweight/obese caregiver in all age groupings except the 6-month–<2-year-old grouping. Variables included in the model that were not significant predictors of birthweight are listed in the footnote to Table 9.

**Table 9**

Predictors of low birthweight (<2 500g) in 6-month–<5-year-old children in the Western Cape in various age groupings[1]

| Significant predictor[2] | 6 months–<5 years N=1 145 | 2–<5 years N=747 | 6 months–<2 years N=398 | 2–<3 years N=315 | 3–<5 years N=432 |
|---|---|---|---|---|---|
| | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) |
| Low Care Index (lowest tertile) | | | | 3.16** (1.34–7.44) | |
| Low income | | 1.74* (1.04–2.91) | | | 1.99* (1.08–3.66) |
| Caregiver BMI ≥ 25 | 0.64* (0.42–0.99) | 0.48** (0.31–0.75) | | 0.37** (0.16–0.87) | 0.49** (0.29–0.81) |
| Mother smoked during pregnancy | 1.73* (1.14–2.65) | 1.54* (1.04–2.27) | 2.30* (1.10–4.79) | | 1.78* (1.09–2.92) |
| Gestational age <37 weeks | 3.81*** (2.42–5.96) | 3.93*** (2.34–6.60) | 3.81*** (1.97–7.38) | 3.94*** (1.84–8.44) | 4.48*** (2.29–8.77) |

CI=95% confidence interval, BMI=body mass index

**1** Multiple logistic regression

**2** Variables included in the model that were not significant predictors: RT EA-type, UI EA-type, low Wealth Index, received child grant, no money for food past month, low WASH score, mother used drugs during pregnancy, older age, and ran out of money for food

*,**,*** Maximum likelihood estimates, t-distribution, p<0.05, p<0.01, p<0.001

## 4.5.3 Immunisation status and predictors thereof

Immunisations were complete in 72.3% of the sample, incomplete in 13% and 0.7% were not immunised (did not have a RtHB). Immunisation data was not obtained in 14% of the sample as the RtHB was not available to be checked. EA-type was significantly associated with immunisation status. Complete immunisation status was most common in the RT EA-type (RT=83.5%, UF=71.3% and UI=73.5%) (Table S3.12).

Predictors of incomplete immunisation status for 6-month–<5-year-old children are presented in Table 10. The following increased the risk of incomplete immunisation in respective age groups: caregivers ran out of money for food in the past month and HH in an UF EA-type in the 6-month–<5-year-old, 2–<5-year-old and 3–<5-year-old age groupings, child hungry in the past week in the 6-month–<5-year-old and 2–<3-year-old age groupings, not ever breastfed in the 2–<5-year-old and 4–<5-year-old age groupings and living in the UF EA-type in 6-month–<5-year-old, 2–<5-year-old and 4–<5-year-old age groupings. Protectors against incomplete immunisation were having an overweight/obese caregiver in the 6-month–<5-year-old and 6-month–<2-year-old age groupings; mother used alcohol during pregnancy and HH in a RT EA-type in the 6-month–<2-year-old age grouping; as well as children being older. Variables included in the model that were not significant predictors of immunisation status are listed in the footnote to Table 10.

**Table 10**

Predictors for incomplete immunisation in 6-month–<5-year-old children in the Western Cape in various age groupings[1]

| Significant predictor[2] | 6 month–<5 years N=1 145 | 2–<5 years N=747 | 6 months–<2 years N=398 | 2–<3 years N=315 | 3–<5 years N=432 |
|---|---|---|---|---|---|
| | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) |
| **Ran out of money for food** | 1.96** (1.25–3.08) | 3.71*** (2.01–6.85) | | | 6.12*** (2.69–13.93) |
| **Child hungry in past week** | 2.01* (1.15–3.52) | | | 3.02* (1.14–7.99) | |
| **Caregiver BMI ≥ 25** | 0.64* (0.44–0.93) | | 0.47* (0.24–0.91) | | |
| **Mother used alcohol during pregnancy** | | | 0.30* (0.11–0.82) | | |
| **UI EA-type** | 2.17** (1.26–3.73) | 2.33* (1.11–4.89) | | | 4.37* (1.43–13.37) |
| **RT EA-type** | | | 0.44* (0.22–0.89) | | |
| **Not ever breastfed** | | 2.60** (1.33–5.12) | | | 3.18* (1.24–8.18) |
| **Older age** | 0.66*** (0.57–0.77) | | | | |

CI=95% confidence interval, BMI=body mass index

**1** Multiple logistic regression

**2** Predictors included but not significant: low Care Index, low income, low Wealth Index, received child grant, low WASH Index, mother smoked during pregnancy, mother used drugs during pregnancy, low dietary diversity score

*,**,*** Maximum likelihood estimates, t-distribution, p<0.05, p<0.01, p<0.001

### 4.5.4 ECD indicators

Attendance of a care facility outside the HHs by children was 11.4% for a crèche/educare centre; 3.6% for a preschool, nursery school/Grade 00/000 or Grade R; 2.5% for a day mother/*gogo*/child minder; 1.3% for a home/community play group; 0.7% indicated other options; while 82.3% did not go to any of these facilities. EA-type was not associated with attendance of particular care facilities (Table S3.13). Sixty-five per cent of the HHs did not have children's books in the HH (story or picture books), 21% had between one and nine books and 13.8% had 10 or more books. EA-type was significantly associated with availability of children's books (Rao-Scott Chi-square p<0.001). Having no books was most common in the UI EA-type (92.1%), compared to 61.1% in the UF and 77.2% in the RT EA-types (Table S3.13).

Toys children played with included homemade (50.9%), store-bought (90.2%), household objects (70.3%) and objects found outside (71.5%). There were no associations between EA-type and the type of toys children played with (Table S3.13).

Results on development indicators for 3–<5-year-old children showed that 24.3% were attending organised learning or early childhood education programmes, 49.4% could identify 10 or more letters of the alphabet; 22.7% could read three or more simple, popular words; 68.9% knew the name and recognised the symbol of numbers 1 to 10; 97.6% could pick up a small object with two fingers; 22.1% were sometimes too sick to play; 95.3% could follow simple directions on how to do something correctly; 94.4%, if given something to do, could do it independently; 96.4% got along with other children; and 35.1% got distracted easily. EA-type was associated with five of these indicators. Being too sick sometimes to play was most common in the UI EA-type (37%) and least common in the UF EA-type (16.7%) (Rao-Scott Chi-square p=0.018). Being able to follow simple directions on how to do something correctly was less common in the UI EA-type (84.8%) than in the UF and RT EA-types (96.5% and 93.9% respectively) (Rao-Scott Chi-square p=0.001). Being able to do something independently was less common in the UI EA-type (77.8%) than in the UF and RT EA-types (96.2% and 93.9% respectively) (Rao-Scott Chi-square p<0.001). Being able to pick up a small object with two fingers was less common in the UI EA-type (91.3%) than in the UF and RT EA-types (98.4% and 95.5% respectively) (Rao-Scott Chi-square p=0.001) (Table S3.14).

Stunting was significantly associated with three of the developmental indicators in this age group. Stunted children were more likely to not have attended organised learning or early childhood education programmes, not knowing the name and recognising the numbers 1 to 10, and not being able to follow simple directions on how to do something correctly (Table S3.15). Further results on early childhood learning in the 3–<5-year-olds show that for 31.6% of children, no one in the HH read books to/looked at picture books with them; for 21.6% no one told them stories; for 19.5% no one sang for or with them; for 12.4% no one took them outside the house/compound/yard; for 10.2% no one played with them; and for 21.9% no one drew with them. EA-type was associated with two of these indicators. Not reading with the child was least common in the UF EA-type (28.8%) and most common in the UI area (56.5%), while it was 34.8% in the RT EA-type (Rao-Scott Chi-square p=0.008). Not drawing with the child was least common in the UF and RT EA-types (19.2% and 18.8% respectively) and most common in the UI EA-type (50%), while it was 34.8% in the RT EA-type (Rao-Scott Chi-square p=0.001) (Table S3.14).

## 4.6 DIETARY INTAKE OF CHILDREN

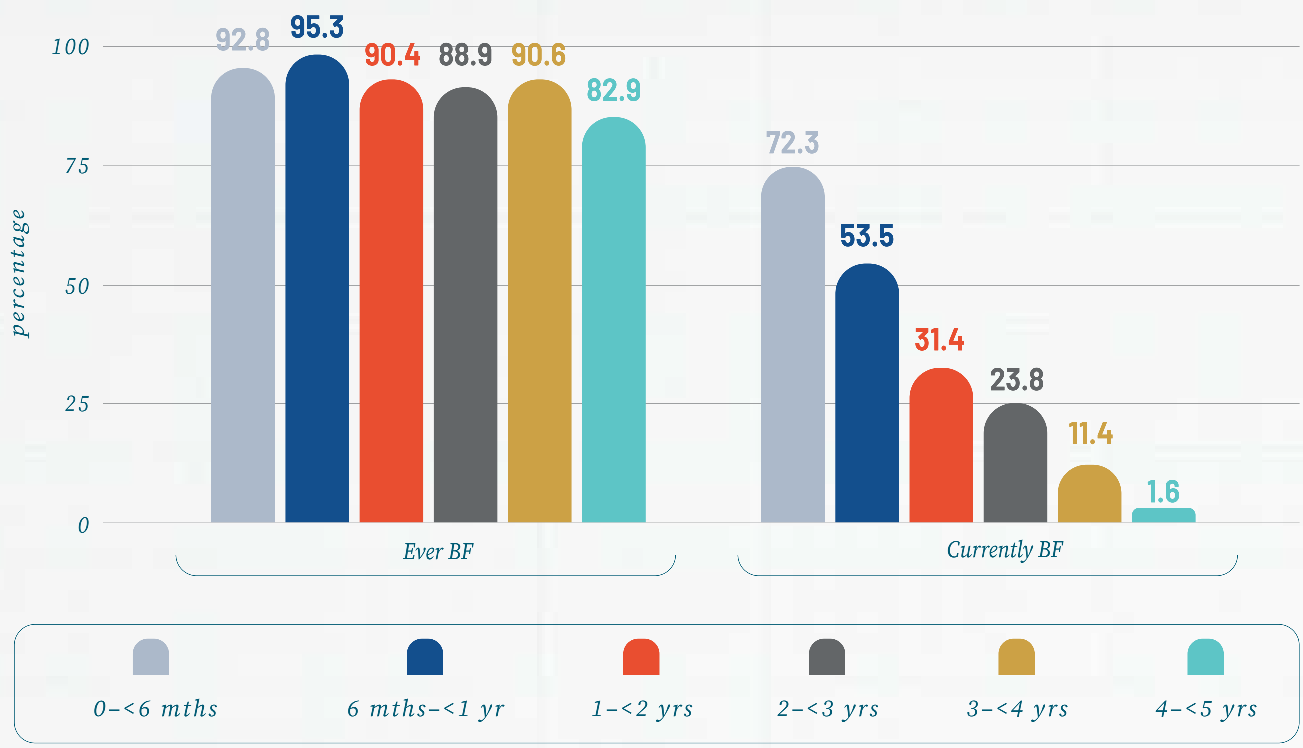
### 4.6.1 Milk feeding practices

At the time of the study, 72% of mothers of younger than 6-month-old infants BF their infant. Exclusive BF was practised by 18.8% of mothers, 20.3% practised mixed milk feeding (breastmilk combined with formula/ cow's milk), and the balance received either breastmilk or formula/cow's milk combined with complementary foods (Figure 11, Table S3.16). Of the <6-month-old infants, 7.2% had never been breastfed. The three most common reasons given for not BF a child was not having enough milk (27.7%), the baby not wanting to take breastmilk (20.2%) and being advised not to BF by a health worker (14.3%).

Having ever been breastfed was 89.5% for the total sample and was similar across the age groups (Figure 11). Figure 11 shows that more than half of the

6-month–<1-year-olds, almost a third of 1–<2-year-olds, almost a quarter of 2–<3-year-olds, 11.4% of 3–<4-year-olds, and 1.6% of 4–<5-year-olds were being BF at the time of the study. Of children who had ever been BF, but were not being BF anymore, 31% had been BF longer than 6 months. The three most common reasons given for discontinuation of BF was that the baby did not want to take breastmilk anymore (26.5%), that the baby is old enough to no longer BF (23.1%), not having enough milk (15.9%) and having to go back to work (11.9%) (Table S3.16).

**Figure 11**
Prevalence of "ever BF and currently BF" in 6-month–<5-year-old children in the Western Cape (N=1 145)




A multiple logistic regression model was constructed to identify predictors of "child not ever BF" (dependant variable) and the following independent variables: low Wealth Index, low income, no money for food in the past month, child hungry in the past week, receives child grant, low Wash-Index, low Care Index, mother smoked during pregnancy, mother used alcohol during pregnancy, mother used drugs during pregnancy, caregiver overweight/obese, child low birthweight, child incomplete immunisation status, child low DDS, and EA-type. ***None of these variables were associated with not ever having been BF.***

The percentage of non-BF children who had received two or more milk feeds during the previous 24 hours was 23.6% for 6-month–<1-year-olds, 35% for 1–<2-year-olds, 31.8% for 2–<3-year-olds, 34.3% for 3–<4-year-olds, and 28.3% for 4–<5-year-olds (Table S3.16).

### 4.6.2 Fluids other than breastmilk and solid foods given to infants younger than 6 months old

The most frequently given fluids other than infant formula were traditional herbal fluids, followed by plain water, very thin, runny porridge in a bottle/cup/spoon/syringe, sugar water, fruit juice and tea without milk, *mageu* and clear broth/soup (Figure 12). The most frequently given solid food was baby cereal, with a small percentage receiving a vegetable (pumpkin/butternut/other), a fruit (apple/pear/banana), sweet biscuits, potatoes and one infant each received sugar in tea, cooked porridge, plant oil (in cooking) and margarine (on bread) (Figure 13).

Figure 12
Fluids given to non-exclusively breastfed infants younger than 6 months old in the Western Cape

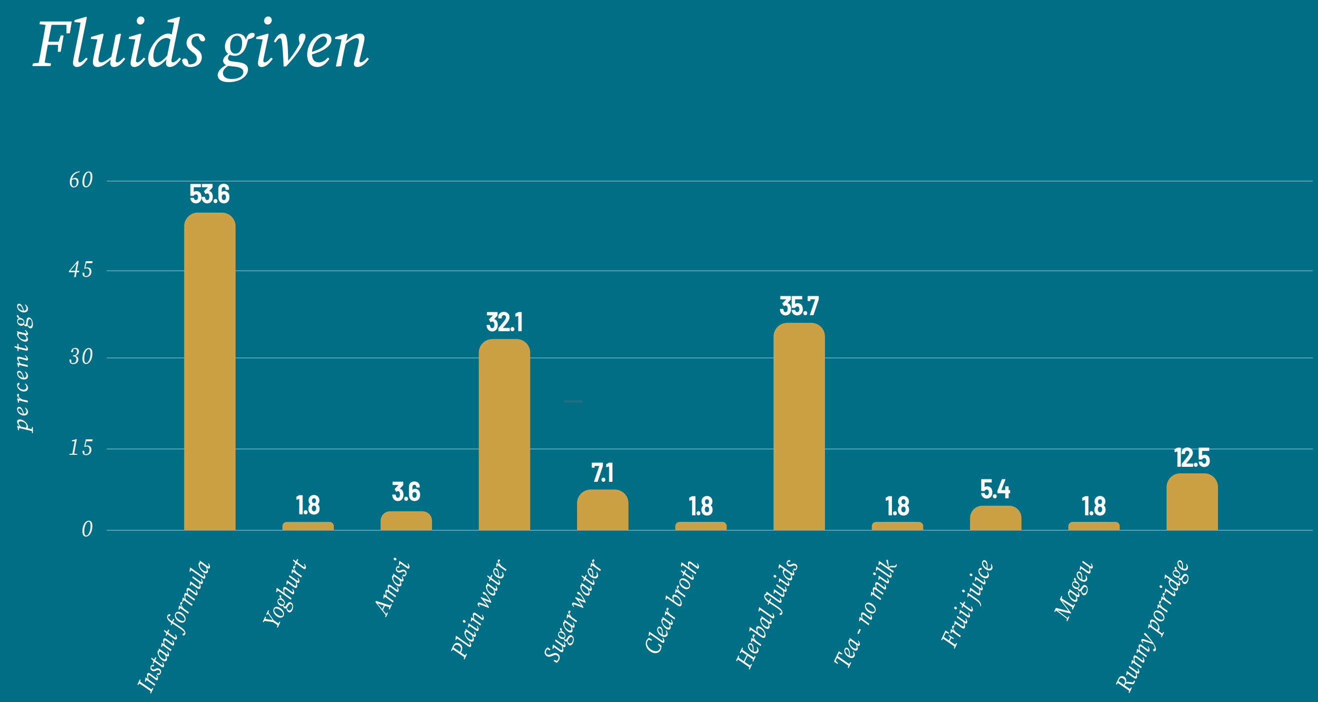
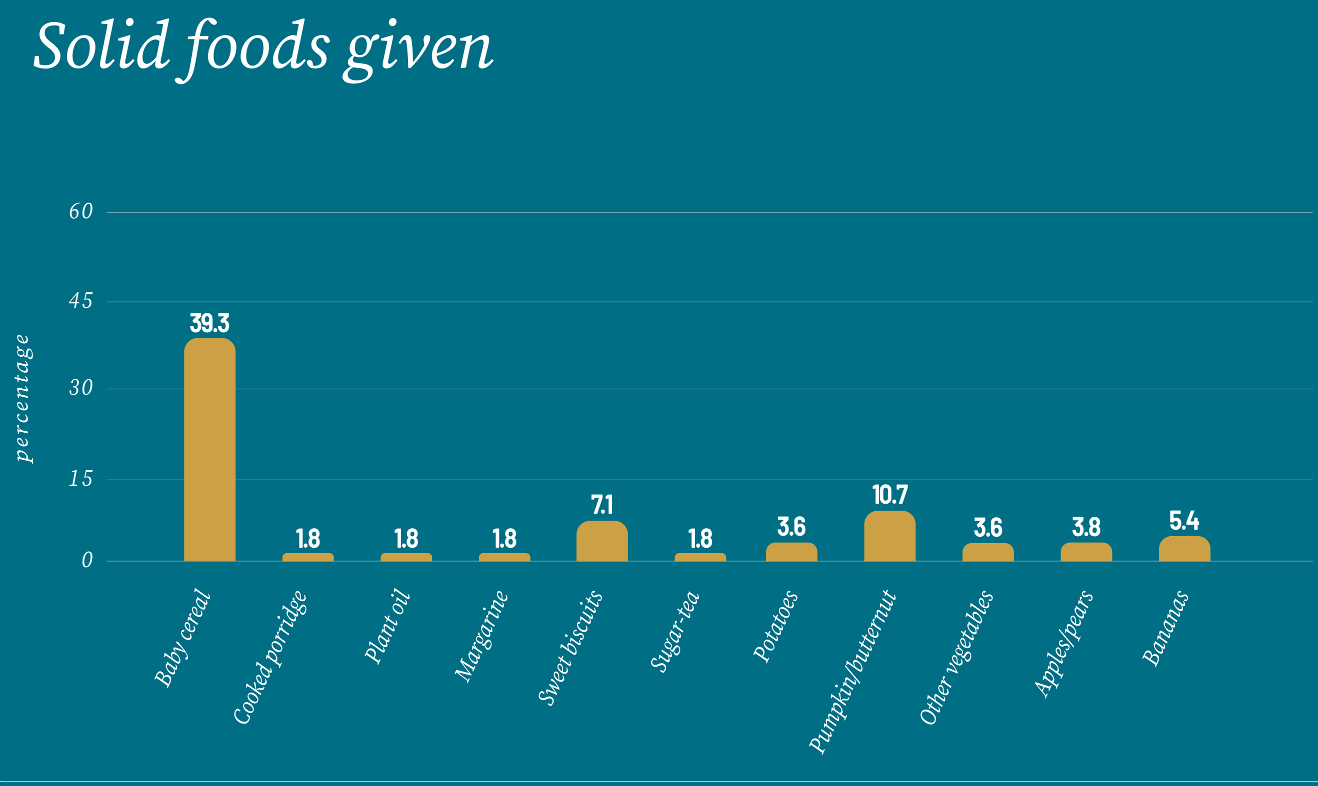



Figure 13
Solid foods given to non-exclusively breastfed infants younger than 6 months old in the Western Cape



### 4.6.3 Dietary diversity and predictors thereof

Dietary diversity scores based on the WHO/UNICEF infant and young child eight food groups (WHO/UNICEF, 2021) is presented in Table 11 and Figure 14 (based on dietary intake over the past 24 hours). It is evident that the median score is below the cut-off of 4 in all age groups. The DDS increased significantly from 6–<12 months, after which it tended to decrease in the 3–<4 and 4–<5-year-old groups. More than half of children in all age groups had a poor DDS (<4). In children 1 year and older the highest prevalence of a poor dietary diversity was in the 4–<5-year-old age group (62.8%) (Table 12). When categorised into the 6-month–<2-year-old and 2–<5-year-old groups, it is evident that more than half of the children in both age groups had poor dietary diversity (58.2% and 58.8% respectively). Results for the WHO/FAO minimum diversity score for adult females (10 food groups) are included in Table S3.18.

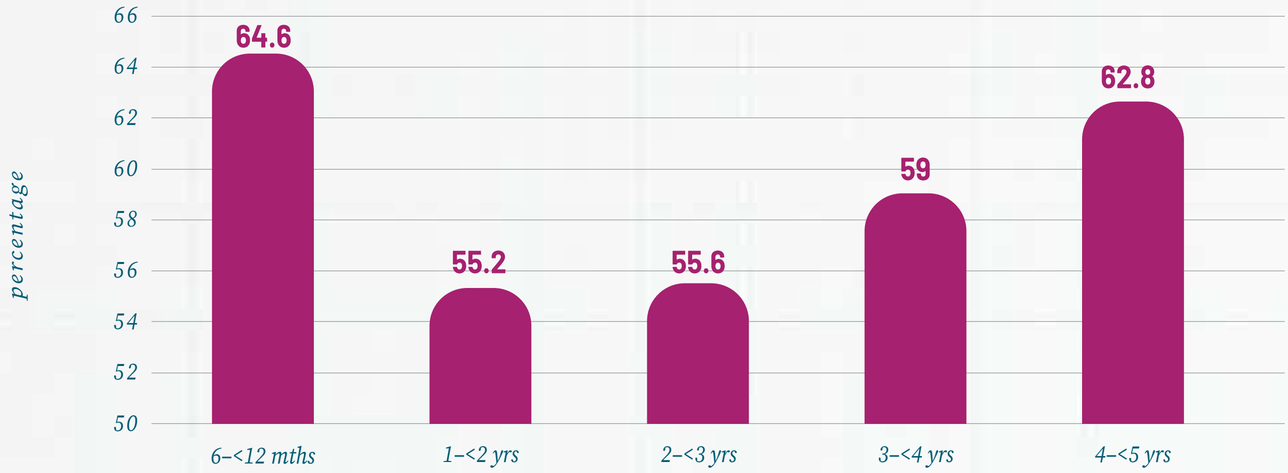
**Table 11**

Mean (95% CI) and median (95% CI) WHO/UNICEF DDS and prevalence of a low DDS for 6-month–<5-year-old children in the Western Cape

| | | WHO/UNICEF DDS score based on eight food groups[1] | | | | |
|---|---|---|---|---|---|---|
| **Age group[2]** | **N** | **Mean (95% CI)** | | **Median (95% CI)** | | **<4 out of 8 groups** |
| **6–<12 months (1 year)** | 127 | 4.0 [b] | (3.7–4.3) | 3.4 | (3.0–3.8) | 64.6 (54.3–74.8) |
| **1–<2 years** | 271 | 4.4 [a] | (4.1–4.6) | 3.8 | (3.5–4.2) | 55.2 (46.6–63.8) |
| **2–<3 years** | 315 | 4.3 [a][b] | (4.1–4.5) | 3.8 | (3.6–4.1) | 55.6 (48.4–62.7) |
| **3–<4 years** | 245 | 4.3 [a][b] | (4.1–4.6) | 3.7 | (3.5–4.0) | 59.0 (49.9–68.1) |
| **4–<5 years** | 187 | 4.2 [a][b] | (4.0–4.4) | 3.7 | (3.2–4.1) | 62.8 (54.8–70.9) |
| ***p-value*** | | Bonferroni MC P<0.05 | | Kruskal-Wallis P=0.029 | | Chi-square P=0.214 |
| **6 months–<2 years** | 398 | 4.3 | (4.0–4.5) | 3.7 | (3.4–4.0) | 58.2 (51.7–64.6) |
| **2–<5 years** | 745 | 4.3 | (4.1–4.5) | 3.7 | (3.5–4.0) | 58.8 (52.6–64.9) |
| ***Kruskal-Wallis p-value*** | | NS: Bonferroni | | Kruskal-Wallis P=0.558 | | Chi-square P=0.8444 |
| **Total group** | **1 145** | **4.3** | **(4.1–4.4)** | **3.7** | **(3.5–3.9)** | **58.6 (53.6–63.7)** |

1 WHO/UNICEF infant and young child eight food groups (WHO/UNICEF, 2021a)
2 Detail for other age groupings included in Table S3.18
3 Excluding <6-month-olds as per the WHO/UNICEF guidance

**Figure 14**
Prevalence of DDS <4 in 6-month–<5-year-old children in the Western Cape (N=1 145)




Predictors of poor dietary diversity for 6-month–<5-year-old children are presented in Table 12. A low Wealth Index increased the risk in all age groupings, while "the child having been hungry in the past week" was a risk in the 2–<5-year-old and 4–<5-year-old groupings. Having an overweight/obese caregiver protected against a poor dietary diversity in the ≥6-month–<2-year-old age groupings. Greater age was also protective. Variables included in the model that were not significant predictors of DDS are listed in the footnote to Table 12.

**Table 12**
Predictors of poor dietary diversity (consume <4 out of a possible 8 groups) in 6-month–<5-year-old children in the Western Cape in various age groupings[1]

| Significant predictor[2] | ≥6-months –<5 years N=1 14 | ≥2–<5 years N=747 | ≥6 months –<2 years N=398 | ≥2–<3 years N=315 | ≥3–<5 years N=432 |
|---|---|---|---|---|---|
| | Odds ratio (95% CI) | Odds ratio (95% CI) | Odds ratio (95% CI) | Odds ratio (95% CI) | Odds ratio (95% CI) |
| **Child hungry past week** | 1.86* (1.06–3.27) | 2.90** (1.36–6.15) | | 3.03* (1.12–8.19) | 3.32* (1.09–10.14) |
| **Low Wealth Index (lowest tertile)** | 2.23*** (1.59–3.12) | 2.68*** (1.73–4.16) | 1.87** (1.11–3.13) | 2.26* (1.10–4.70) | 3.07*** (1.90–5.00) |
| **Caregiver BMI ≥ 25** | | | 1.69** (1.12–2.54) | | |
| **Greater child age (year intervals)** | 0.78** (0.67–0.90) | | | | |

DDS=dietary diversity score, CI=95% confidence interval

**1** Multiple logistic regression
**2** Predictors included but not significant: low income, no money for food in the past month, received child grant, low Wash-Index, low Care Index, mother smoked during pregnancy, mother used alcohol during pregnancy, mother used drugs during pregnancy, child low birthweight, child incomplete immunisation status, child low dietary diversity, and EA-type.
*,**,***Maximum likelihood estimates, t-distribution, p<0.05, p<0.01, p<0.001

### 4.6.4 Other dietary indicators

WHO/UNICEF indicators for healthy and unhealthy eating for children other than DDS are depicted in Figure 15 and more detail in Table S3.19 (based on dietary intake over the past 24 hours). More than 80% of children 2 years old and older consumed egg and/or flesh foods in the past 24 hours. Consumption of no fruits and/or vegetables was evident in approximately a fifth of all age groups. Intake of sweet foods, e.g. sweet biscuits, cake and sugar, increased with age (Rao-Scott Chi-square p<0.001), with 75% or more of 1-year-old and older children having consumed one or more of these foods. Intake of salty/fatty foods such as crisps also increased with age, with 50% or more of 1-year and older children having consumed one or more of these foods. In the 2-year-old and older age group, 50–60% consumed one or more sugar-sweetened beverage (SSB), e.g. fizzy drinks, cooldrink concentrates and fruit juice. Age was significantly associated with all these dietary indicators except zero fruit and/or vegetable intake, with older children being more likely to exhibit the mentioned dietary behaviours.

*The prevalence of overweight (15.1%) in the Western Cape is in the very high public-health-concern category of ≥15%.*

To illustrate changes in dietary patterns across all age groups in children younger than 5 years old in the Western Cape, the pie charts presented in Figure 16 were constructed.

**Figure 15**
WHO/UNICEF indicators for healthy and unhealthy dietary food choices other than DDS in 6-month–<5-year-old children in the Western Cape (N=1 145)

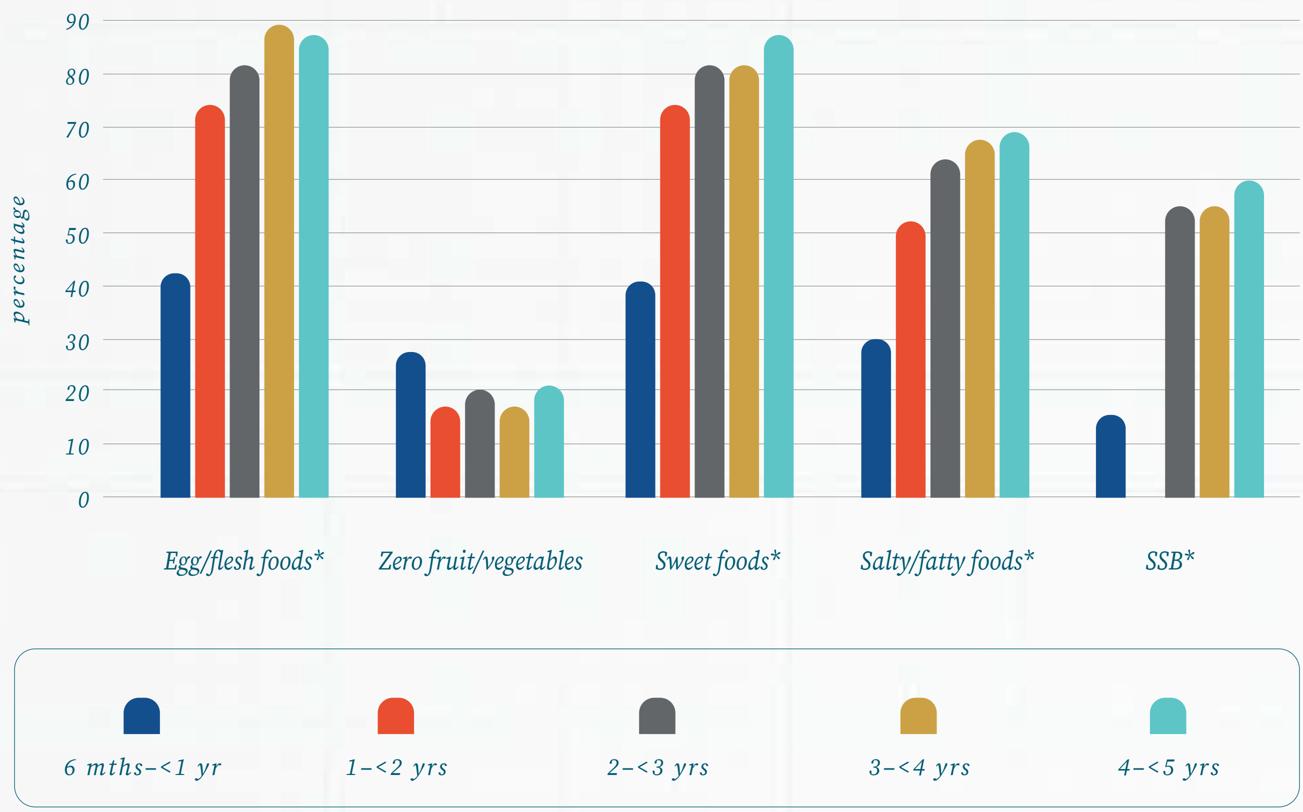
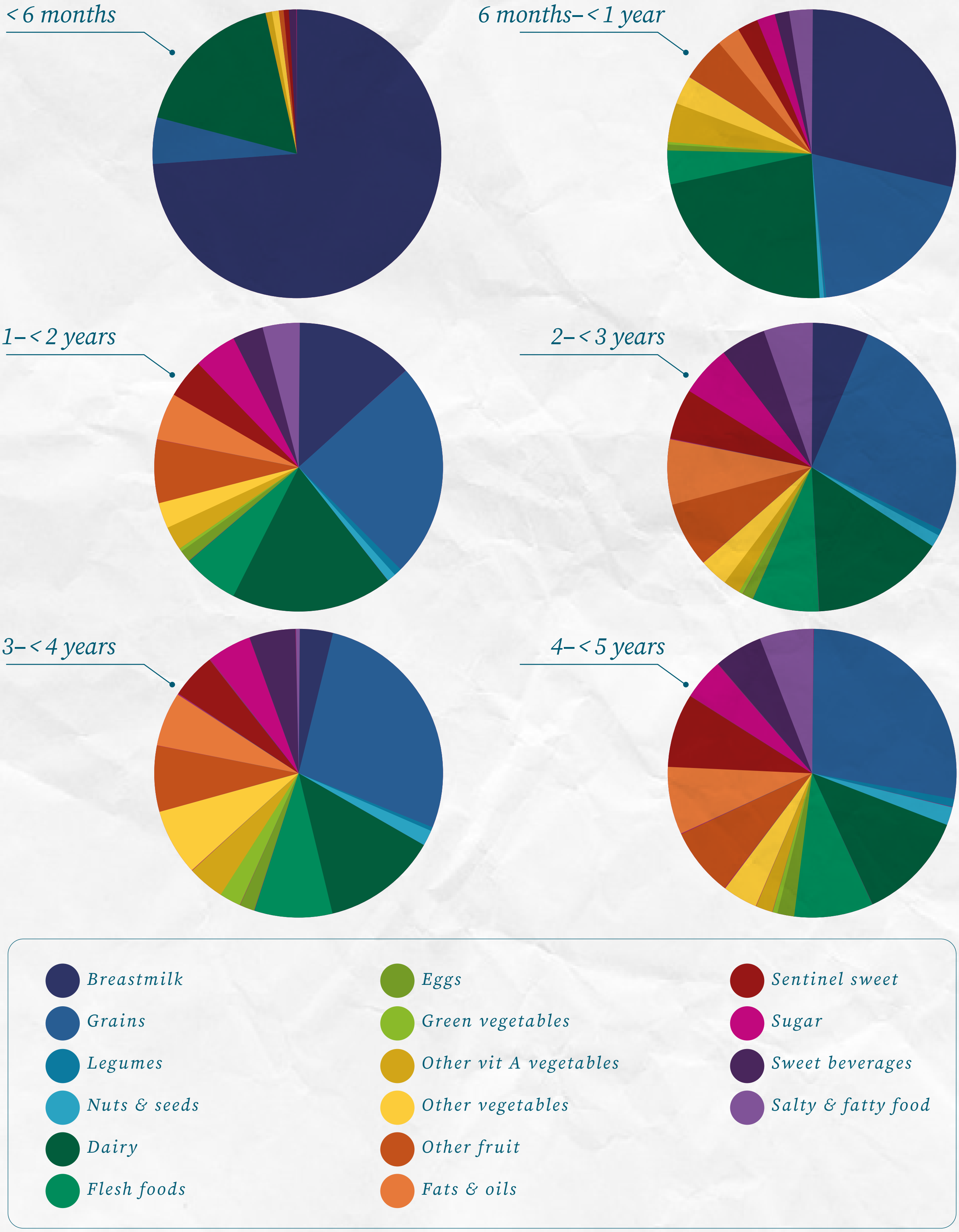


**Figure 16**
Dietary patterns for under-5-year-old children
in the Western Cape (N=1 145)

# *Dietary patterns*
for under-5-year-old children in the Western Cape



## 4.6.5 Most commonly consumed foods

The ten most consumed foods in 6-month–<5-year-old children are presented in Figure 17 (the top 15 are presented in Table S3.20). Milk items (blue tones), namely breastmilk, formula milk and yoghurt, made up three out of the top four items in the 6-month–<1-year-olds. This changed to only *amasi* and yoghurt in the 1–<2-year-olds, and only dairy milk in tea/coffee in the 2–<5-year-olds. The number of starchy items (green tones) in the top ten list increased from two (breakfast cereal and maize porridge) in the 6-month–<1-year-olds to five in the 1–<2-year-olds and 2–<3-year-olds (bread, maize porridge, rice, noodles and breakfast cereal), four in the 3–<4-year-olds (bread, noodles, rice and breakfast cereal), and three in the 4–<5-year-olds (bread, noodles and rice), with bread being number one in the last three age groups.

The youngest age group had pumpkin (orange tone) in sixth position and banana (yellow tone) in the eighth positions. The middle three age groups (1–<4-year-olds) did not have a fruit or vegetable in the top 10 most consumed foods, while the 4–<5-year-olds had oranges (turquoise tone) at number 10. Crisps were number 7 in the 6-month–<1-year-old group, while it was at number two for all four of the older groups. Sugar in tea/coffee appeared on the top ten list of all five age groups, while sweets were included in the four older groups (unhealthy food choices are depicted in red-pink tones).

**Figure 17**
Top ten most frequently consumed items
in 6-month–<5-year-old children in the Western Cape

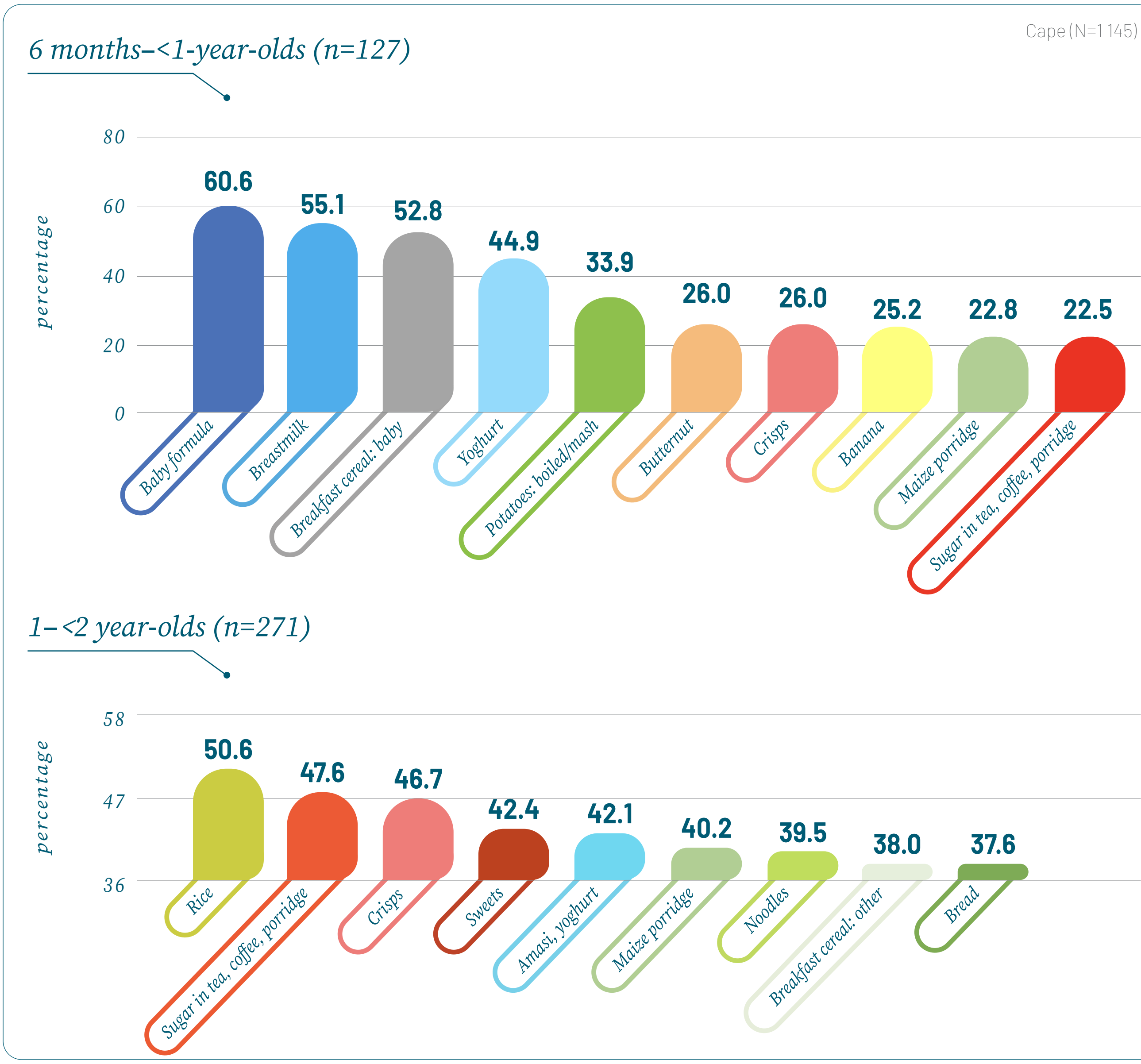
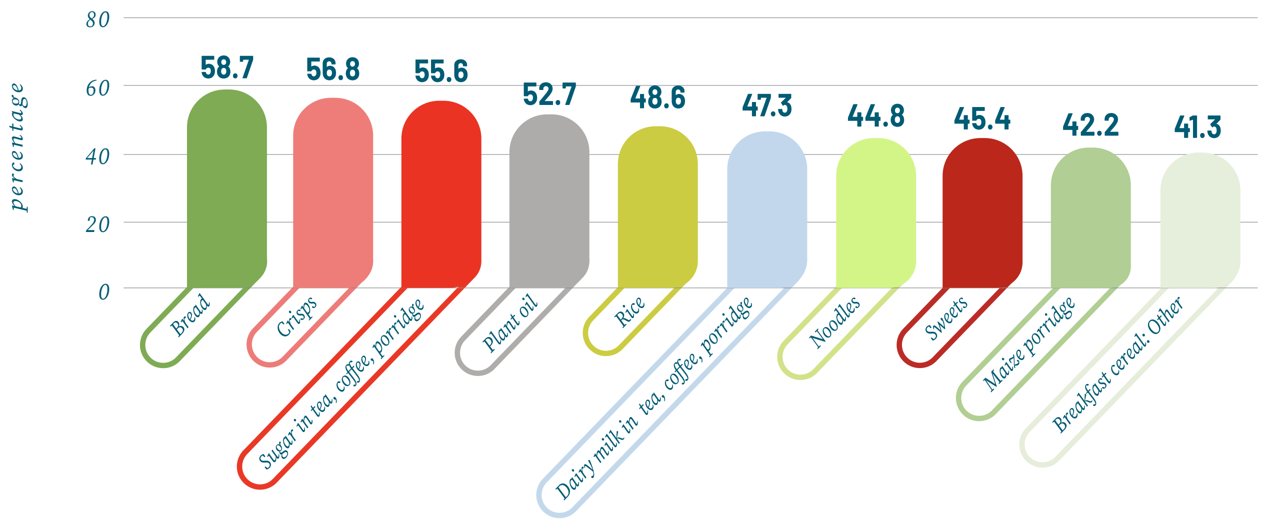
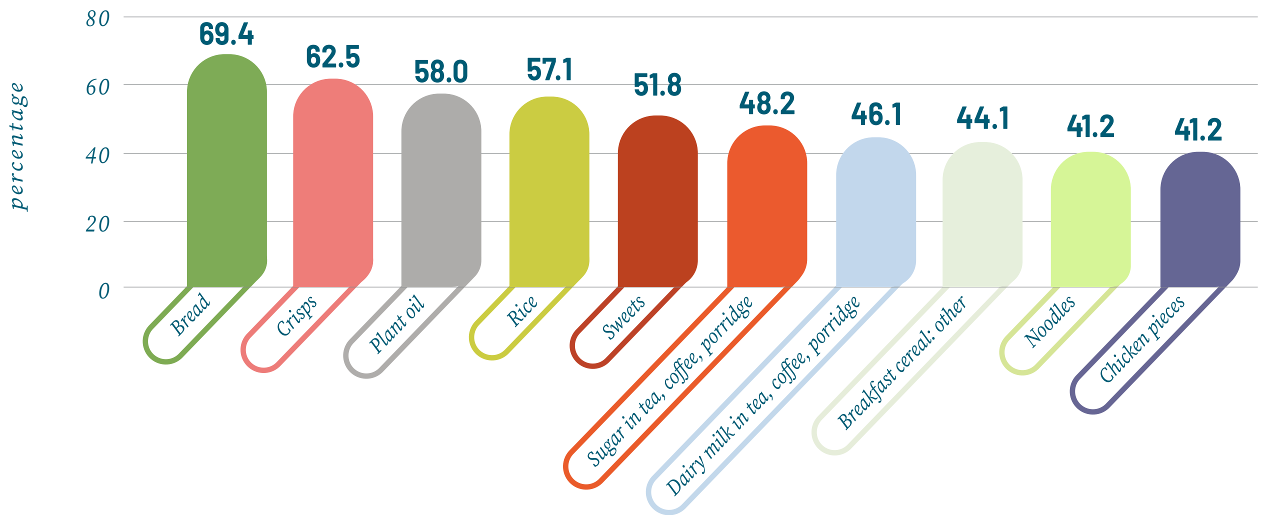


Figure 17: cont.

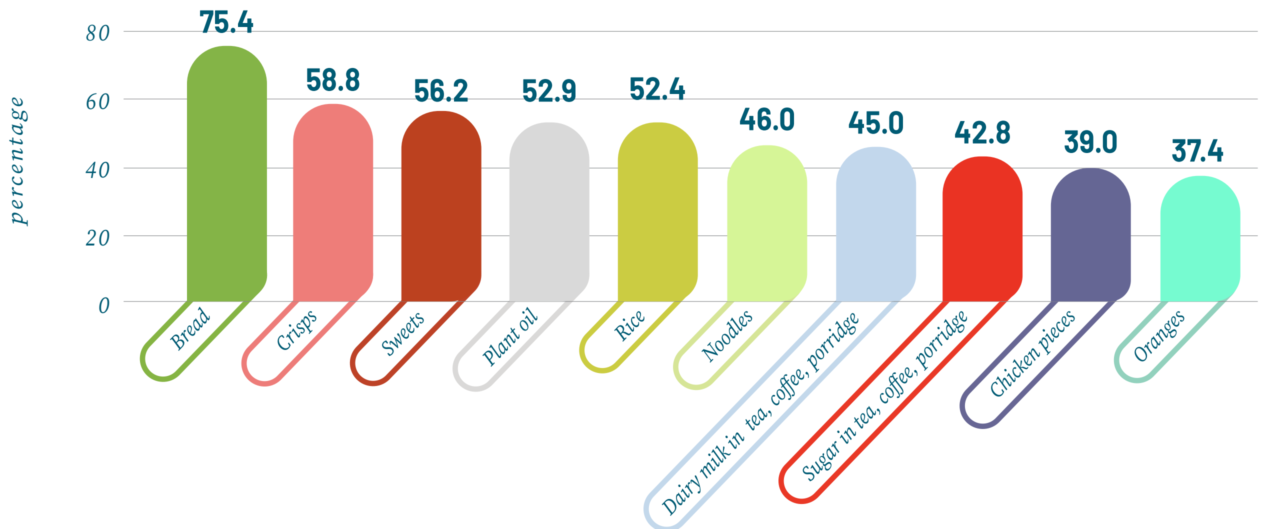
*2–<3-year-olds (n=315)*




*3–<4-year olds (n=245)*




*4–<5-year olds (n=187)*



## 4.7 PREDICTORS OF STUNTING AND OVERWEIGHT

### 4.7.1 Stunting

Results for significant predictors of stunting in 6-month–<5-year-olds are set out in Table 13. The following increased the risk of stunting: low Wealth Index in all age groupings, with the exception of the 6-month–<2-year-old age grouping; low WASH Index in the 2–<3-year-old age grouping; low Care Index in the 6-month–<5-year-old and 6-month–<2-year-old age groupings; mother smoked during pregnancy in the 6-month–<5-year-old and 2–<5-year-old groupings; mother used alcohol and mother used drugs during pregnancy in the >6-month–<5-year-old, 2–<5-year-old and the 3–<5-year-old age groupings; low birthweight in all age groupings, incomplete immunisation status in the >6-month–<5-year-old, 2–<5-year-old and the 3–<5-year-old age groupings. In the 2–<3-year-old group, having consumed sweet foods in the past 24 hours also increased stunting risk; and RT EA-type in the >6-month–<5-year-old age group. There were no protectors against stunting. Variables included in the model that were not significant predictors of stunting are listed in the footnote to Table 13.

**Table 13**

Predictors for stunting (HAZ<–2SD) in 6-month–<5-year-old children in the Western Cape in various age groupings[1]

| Significant predictor[2] | 6 month–<5 years N=1 145 | 2–<5 years N=747 | 6 months–<2 years N=398 | 2–<3 years N=315 | 3–<5 years N=432 |
|---|---|---|---|---|---|
| | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) |
| **Low Wealth Index (lowest tertile)** | 1.74* (1.13–2.67) | 2.36** (1.36–4.09) | | 2.86* (1.19–6.86) | 2.40* (1.18–4.90) |
| **Low WASH score (lowest tertile)** | | | | 2.54* (1.21–5.34) | |
| **Low Care Index (lowest tertile)** | **1.58* (1.06–2.35)** | | 2.08* (1.05–4.14) | | |
| **Mother smoked during pregnancy** | 1.60* (1.07–2.41) | 1.89** (1.18–3.04) | | | |
| **Mother used alcohol during pregnancy** | 1.79** (1.19–2.69) | 1.66* (1.04–2.67) | | | 2.09* (1.18–3.68) |
| **Mother used drugs during pregnancy** | **1.59* (1.05–2.40)** | 1.94* (1.10–3.42 | | | 2.34* (1.20–4.56) |
| **Child low birthweight (<2 500g)** | **2.47*** (1.65–3.71)** | 2.27** (1.31–3.94) | 3.06** (1.58–5.92) | 2.45* (1.01–5.97) | 2.25* (1.06–4.79) |
| **Incomplete immunisation** | 1.89** (1.19–2.99) | 2.54** (1.32–4.87) | | | 3.51** (1.56–7.92) |
| **RT EA-type** | 1.73* (1.04–2.87) | | | | |

HAZ=height-for-age Z-score, SD=standard deviation, CI=95% confidence interval

1 Multiple logistic regression (OR)

2 Predictors included but not significant: UI EA-type, low income, no money for food in the past month, child hungry in the past week, received child grant, caregiver overweight/obese, child not ever breastfed, child low dietary diversity[3], child consumed sugar[3], child consumed sweetened items[3], child consumed SSB[3], child consumed salty/fatty items[3]

3 Based on 24-hour recall of frequency of foods consumed

*,**,*** Maximum likelihood estimates, t-distribution, p<0.05, p<0.01, p<0.001

### 4.7.2 Overweight

Results for significant predictors of overweight/obesity in 6-month–<5-year-olds from multiple logistic regression analysis are presented in Table 14. Predictors of overweight/obesity were having an overweight/obese caregiver in the 6-month–<5-year-old and the 6-month–<2-year-old age groupings, as well as "child not ever breasted" and "child consumed sugar" in 6-month–<2-year-olds. Protectors against overweight/obesity were low birthweight in the 6-month–<5-year-old and 2–<5-year-old age groupings, RT EA-type in the 4–<5-year-old grouping and older age.

**Table 14**
Predictors of overweight/obesity (BAZ>2SD) in 6-month–<5-year-old children in the Western Cape in various age groupings[1]

| Significant predictor[2] | 6 month–<5 years N=1 145 | 2–<5 years N=747 | 6 months–<2 years N=398 | 2–<3 years N=315 | 3–<5 years N=432 |
|---|---|---|---|---|---|
| | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) | Odds ratio (CI) |
| **Caregiver BMI≥25** | 1.88** (1.21–2.91) | | 2.21** (1.31–3.71) | | |
| **Child low birthweight (<2 500g)** | 0.38** (0.19–0.78) | 0.30* (0.10–0.89) | | | |
| **Incomplete immunisation** | | | | | |
| **Child not ever breastfed** | | | 2.95** (1.36–6.40) | | |
| **Child consumed sugar[3]** | | | 2.21** (1.23–3.95) | | |
| **RT EA-type** | | | | | <0.001*** (<0.001–<0.001) |
| **Older age** | 0.71*** (0.61–0.83) | | | | |

BAZ=BMI-for-age Z-score, SD=standard deviation, CI=95% confidence interval

**1** Multiple logistic regression
**2** Predictors included but not significant: UI EA-type, low WASH score, low income, low Wealth Index, no money for food in the past month, child hungry in the past week, received child grant, low Care Index, mother smoked during pregnancy, mother used alcohol during pregnancy, mother used drugs during pregnancy, incomplete immunisation, child low dietary diversity[3], child consumed sweetened foods[3], child consumed SSB[3], child consumed sentinel salt/fatty items[3]
**3** Based on 24-hour recall of frequency of foods consumed
***, **, ***** Maximum likelihood estimates, t-distribution, p<0.05, p<0.01, p<0.001

# 5. DISCUSSION

## 5.1 OVERARCHING PERSPECTIVES

The WCSBS was commissioned to determine the current (2022) malnutrition profile in under-5-year-old children in the Western Cape province and identify drivers of stunting and overweight/obesity. The first section of this discussion provides a brief overview of the sociodemographic profile of the children included in the sample (Section 5.2). The malnutrition profile of the study sample is discussed in Section 5.3. This is followed by sections on the three underlying drivers of malnutrition: (1) household socio-economic indicators, food security and Wealth Index (Section 5.4); (2) mother and childcare indicators and Care Index (Section 5.5); and (3) water availability, sanitation and hygiene indicators and the WASH Index (Section 5.6). Sections on the two direct drivers of malnutrition follow, which include (1) dietary intake: breastfeeding, dietary diversity (and predictors thereof) and healthfulness of food choices (Section 5.7); and (2) child health indicators: birthweight (and predictors thereof), immunisation status (and predictors thereof) and infectious disease (Section 5.8). In the final section the underlying and direct drivers, of stunting and overweight/obesity, are discussed (Section in 5.9).

For Sections 5.4 to 5.8 integrated snapshots of characteristics were compiled based on overarching trends in the total sample. Any significant divergence from these overarching snapshots in any one of the three EA-types are delineated. Literature was integrated into these sections to provide local context to the results as available. However, a detailed discussion of each characteristic was beyond the scope of this report.

## 5.2 SOCIODEMOGRAPHIC CHARACTERISTICS OF CHILDREN IN THE WCSBS SAMPLE

The age profile of children in the study reflects a good representation of under-5-year-old children in the Western Cape. The mean age was 2.5 years and 17.5% of the total sample were 0–<1 years old, 23.4% were 1–<2 years old, 20.7% were 2–<3 years old, 21.6% were 3–<4 years old and 16.6% were 4–<5 years old. Furthermore, gender was equally represented (49.6% males and 50.4% females). Almost 40% of the children were the first-born child, 30.6% the second-born, 18.4% the third-born, 7.5% the fourth-born, and 3.5% fifth, sixth, seventh or eighth-born. These profiles did not differ between UF, UI and RT EA-types.

The race of the total sample of children as indicated by the interviewee was 33.6% black African, 57.4% coloured, 7.8% white, 0.6% Indian and 0.6% other. This compares well with the profile for the Western Cape reported in the 2016 Community Survey (2016 WC-CBS) (Statistics SA, 2018) where 35.9% of the sample were black African, 47.2%, coloured, 16% white, 0.8% Indian and 0.1% other. Results on languages spoken in HHs indicated that Afrikaans was most commonly spoken (47.4%), followed by isiXhosa (26.7%), English (20.6%) and then other languages (5.3%; e.g. Shona, Sotho, Chewa, being bilingual and some others). This is also in line with the language profile sketched in the 2016 WC-CBS, namely 46.6% Afrikaans, 30.1% isiXhosa and 19.6% English (Statistics SA, 2018). The WCSBS sample thus seems more representative of the province's racial profile than the PDIS, where 68% of the 1–<10-year-old participants were coloured, 27.6% black African and 4% other, including Indian, Asian and white children (Senekal et al., 2019).

## 5.3 MALNUTRITION PROFILE OF UNDER-5-YEAR-OLD CHILDREN IN THE WESTERN CAPE

### 5.3.1 Stunting, underweight and wasting

Findings show that the prevalence of stunting in the total sample (17.5%) of under-5-year-old children in the Western Cape was close to the upper cut-off of the medium public-health-concern category for 0–59-month-old children (10–19%). Stunting in the <2-year-old age group was 19.7%, pushing it into the high public-health-concern category in this age group. In their investigation of malnutrition in children across 36 LMICs between 1990 and 2012, Tzioumis et al. (2016) also showed that children younger than 2 years old were worse off in terms of stunting than those who were older.

Compared to national statistics for stunting in <5-year-olds, the prevalence in the Western Cape is substantially lower. National surveys show that 33.4% of <5-year-olds were stunted in 2003 (SADHS) (Dhansay et al., 2018), 26.4% of 1–<5-year-olds in 2005 (NFCS-Baseline Survey) (Dhansay et al., 2018), 28.2% of <5-year-olds in 2008 (NIDS) (Amusa et al., 2022), 26.5% of 1–<5-year-olds in 2012 (SANHANES) (Dhansay et al., 2018), and 27.4% of <5-year-olds in 2016 (SADHS) (NDoH et al., 2018). Moreover, stunting prevalence in the Western Cape may be on the decrease as the prevalence was 20.8% of 1–<5-year-olds in the 2018 PDIS-WC (Senekal et al., 2019), compared to the 18.2% recorded for the 1–<5-year-old subgroup in the present study (WCSBS). The WCSBS further confirms the notion that stunting prevalence decreases as children get older (Senekal et al., 2019; Harper et al., 2022).

At this point in time there is a paucity of information on stunting in <6-month-old infants. Only the 2016 SADHS reported on stunting in this age group, where it was found that 32.3% of the sample was stunted at the time (provincial level results were not included in the report) (NDoH et al., 2018). In the WCSBS the prevalence was 25.2%, thus 7.1% lower than the 2016 national prevalence.

The 2022 "Thrive by Five Index" reported stunting rates of children aged 50–59 months (between 4 and 5 years old) who were enrolled in Early Learning Programmes (ELPs) in South Africa. The national prevalence was 6% and in the Western Cape 5.2% (Henry & Griese, 2022). Stunting prevalence in 4–<5-year-olds in the PDIS-WC was 11.9% (Senekal et al., 2019) and 15.7% in the current WCSBS. Of note is that Henry and Griese (2022) warned that their sample did not include the 45–55% of children aged 50–59 months who were not enrolled in an ELP, and who were deemed to be at greatest risk of malnutrition. The WCSBS provides a more valid picture of malnutrition problems in this age group, as a structured sampling strategy was implemented to ensure representativeness of the sample were of EA-type and the target age groups. Only 24.3% of 3–<5-year-olds in our representative sample were attending an organised learning institution outside their homes.

The prevalence of underweight (5.6%) was just above the lower cut-off of the medium (5–9%) and wasting (3.4%) in the low (2.5–<5%) public-health-concern categories for 0–59-month-old children. Underweight in the current survey was most common in 0–<6-month-old children at 11.4%, but then decreased to below

9% in all other age groups (prevalence of 5.6% in the total group). This is somewhat higher than the 3.4% reported in the 2018 PDIS-WC (Senekal et al., 2019).

Wasting prevalence was close to 10% in under-1-year-olds and then dropped to below 3% in 2–<5-year-old children in the WCSBS. This profile is in line with results from the PDIS-WC, where wasting prevalence was also recorded to be 3% in 1–<5-year-olds (Senekal et al., 2019). National studies in this age group confirm that wasting has not been of public health concern over the years, except possibly in <1-year-olds (Dhansay et al., 2018).

### 5.3.2 Overweight, obesity and stunting-overweight

National and provincial studies conducted in South Africa since 1999 show an increasing trend in the prevalence of overweight and obesity in young children up to 2008, after which a decrease is evident. Prevalence of overweight and obesity combined was 7.4% of 1–3-year-olds and 5.9% of 4–6-year olds in 1999 (WHZ)(Steyn et al., 2005), 11.3% of <5-year-olds in 2003 (BAZ) (Dhansay et al., 2018), 12.8% of 1–<5-year-olds in 2005 (BAZ) (ibid.), 18.1% of 6-month–4-year-olds in 2008 (BAZ) (Casale et al., 2016), and 16% of 1–<5-year-olds in 2012 (BAZ) (Dhansay et al., 2018). The 2018 PDIS results showed that 14.8% of 1<5-year-olds in Gauteng and 21.3% in the Western Cape were overweight/ obese, compared to the 15.6% of <5-year-olds in the WCSBS, which is more in line with national trends. Interpretation of these trends needs to be done with caution, as sampling frames, indicators used, and age grouping vary across the surveys.

As was evident from the PDIS-WC (Senekal et al., 2019), the highest prevalence of overweight and obesity in the WCSBS was recorded for the 1–<2-year-olds (16.2% and 10.0% respectively). However, the prevalence in the PDIS (total sample) was much higher at 23.3% and 14.2% respectively. However, importantly, the WHO warns that classification of young children as overweight or obese needs to be done with great caution as children in this group are still growing. Placing young children on energy-restricted diets may contribute to other forms of malnutrition and associated health risks (de Onis, 2010).

Stunting-overweight in the WCSBS sample was not common at 2.4%, which is lower than found in the PDIS-WC (5.4%) and in line with the 3.1% reported for South African under-5-year-olds in the 2022 Country Specific Nutrition Profile (https://globalnutritionreport.org/resources/nutrition-profiles/africa/southern-africa/).

It could be argued that implementation of some of the strategies outlined in the 2015–2020 Strategy for the Prevention and Control of Obesity in South Africa, such as the taxation on SSB, contributed to the decreasing trend in overweight/obesity in the under-5 age group (NDoH, 2016). However, the prevalence of overweight and obesity combined (BAZ>2SD) in the WCSBS (15.1%) still falls in the very high public-health-concern category (≥15%) (Cashin & Oot, 2018), indicating that it remains a malnutrition problem of serious concern in the Western Cape.

## 5.4 UNDERLYING CAUSES OF MALNUTRITION IN UNDER-5-YEAR-OLD CHILDREN IN THE WESTERN CAPE: HOUSEHOLD SOCIO-ECONOMIC INDICATORS, FOOD SECURITY AND WEALTH INDEX

### 5.4.1 Household socio-economic indicators and food security

The overarching snapshot of current living circumstance that emerged for the total sample of <5-year-old children in the WCSBS shows that they lived in a formal dwelling (82.8%) that had four to five rooms, including a kitchen, bathroom, very likely an open-plan living-dining room and one or more bedrooms; used electricity as the main energy source for cooking (85.8%); accessed the Internet either via a cell phone or a home connection; with between four to five people living in the dwelling. There was divergence from this snapshot in the UI EA-type where children typically lived in an informal dwelling that had two to three rooms (a separate kitchen and/or bathroom less common), with two to three people living in the dwelling. Of note is that access to electricity and the Internet was similar between the three EA-types. In comparison, the 2016 WC-CBS reported that 82.4% of respondents lived in formal dwellings, with the HH size being 3.2 people (Statistics SA, 2018). In the PDIS-WC 79.7% of HHs lived in a formal dwelling, with 5.8 people sleeping in the dwelling and the number of rooms per house, excluding the bathroom/toilet, being 2.9.

*Interventions targeting children living in rural towns and urban informal areas may need specific attention when considering intervention strategies.*

HHs in the WCSBS typically had a monthly income of below R25 600 (either R0–R3 200 or R3 201–R25 600) (the 2022 poverty line in South Africa was R945 per month – Statista, 2022), which was mostly derived from salaries and receiving one or more government grant (71%). They either did (41%) or did not (59%) run out of money to buy food in the past month, with 1 in 10 HHs experiencing hunger at HH level and 1 in 20 children experiencing hunger. There were 46.2% of HHs in the PDIS-WC who indicated that they "did ever" run out of money to buy food using the "Community Child Hunger Identification Project" food security assessment instrument (Wehler et al., 1992). The question in the CCHP, "Do any of your children ever go to bed hungry because there is not enough money to buy food?" was answered yes by 5.6% in the PDIS-WC. This is in line with the 5.5% of children who reportedly went hungry at least once during the past week in the WCSBS. The results of the NIDS-CRAM study showed that the proportion of HHs that had run out of money for food in the past month declined from 47% in 2020 to 35% in 2021. The proportion of children in NIDS-CRAM reported to have been hungry at least once in the past week declined from 15% to 14% respectively (van der Berg et al., 2022). In the 2016 WC-CBS it was reported that 13.2% of HHs in the Western Cape had run out of money to buy food in the last year, compared to 27.6% in the Northern Cape, 26.3% in the Eastern Cape and 25.1% in the North-West (Statistics SA, 2018). The WCSBS results may thus reflect a decline in HH-level food security.

### 5.4.2 Wealth Index

Many studies that investigate associations between socio-economic indicators and health behaviours and disease outcomes develop a Wealth Index as suggested by the World Bank (Filmer & Pritchett, 2001) and applied in the 2016 SADHS (NDoH et al., 2018). As mentioned in the methods section above, and Supplementary materials S2.1, 12 out of 18 variables considered were retained after iterated principal factor analysis. These included several household assets, type of dwelling and the number of rooms in the home. The index provides a "summary score" that reflects these variables and can be included in association analyses. Wealth Index results cannot be compared between studies, as it is data driven and variables will thus not load similarly in different studies.

## 5.5 UNDERLYING CAUSES OF MALNUTRITION IN UNDER-5-YEAR-OLD CHILDREN IN THE WESTERN CAPE: MOTHER AND CHILDCARE INDICATORS AND CARE INDEX

### 5.5.1 Mother and childcare indicators

The overarching profile that emerged for the total sample of <5-year-old children in the Western Cape shows that they lived in a HH that received a child-support grant (66.8%) and that was either male (51.4%) or female headed (43%); in which the mother was the primary caregiver, lived in the dwelling at least four nights a week, and was either married/living with the father (44.8%) or had never married (52.7%); had either some high school or less education (51.8%) or Grade 12 or more education (46.6%); and was either at home (54.3%) or employed part-time/full-time during the day (36.9%). The grandmother was second most likely to be the caregiver. The children typically had a father who lived (54.1%) in the dwelling at least four nights a week, had achieved either some high school or less education (33.8%) or Grade 12 or more education (42.2%) and was employed full-time (75.2%). This profile diverged in the RT EA-type where HHs were more likely to receive a child grant (85%) and mothers were more likely to have never been married (61.2%). In the UI EA-type mothers were less likely to be employed (73.3%).

This profile is mostly in line with the sociodemographic profile described for the PDIS-WC sample, where the mother was the primary caregiver of the index child in 72.7% of cases, followed by a grandparent (21.1%). HHs in the PDIS-WC were also either male or female headed, only 41.2% of the mothers were married, 59.8% of mothers had not completed high school and only a third of mothers were employed compared to two thirds of the fathers (Senekal et al., 2019). The 2016 WC-CBS community profile showed that 62% of HHs were male headed and that 56.1% of persons aged 20 years and older had achieved only some high school or less education (Statistics SA, 2018).

Further characteristics of mothers in the total sample show that they were on average 30 years old at the time of the study; were 22 years old at the birth of their first child (17.3% had been younger than 18 years old at this point; the youngest age at the birth of a first child reported was 10 years); typically did not have diabetes, high blood pressure, heart problems, HIV/AIDS, tuberculosis or other health conditions (<7% for all these conditions respectively); were likely to be overweight or obese (59.1%); had a low risk of depression (<15%) and had not reported physical abuse from a husband/partner (1.2%). The only divergence was that obesity was more common among mothers in the UI EA-type.

The 2016 WC-CBS (Statistics SA, 2018) reported that 12.1% of births recorded were from mothers younger than 19 years old. The NCD and infectious disease profile found in the WCSBS shows a much lower prevalence for these conditions than reported for women in the 2016 SADHS (NDoH et al., 2018). The majority of mothers measured in the PDIS-WC were found to be overweight or obese (71.1%), which is more in line with the national prevalence of 68% reported for females 15 years and older in the 2016 SADHS (ibid.) than the 59.1% in the WCSBS. The 2016 SADHS also showed that 40% of young women aged 15–24 years were overweight or obese (ibid.). The prevalence of mothers who had been physically abused by a partner in the WCSBS was very much lower than the 21% reported by ever-partnered women aged 18+ in the 2016 SADHS (ibid.), but may have been underreported in the WCSBS. Underreporting of abuse is not uncommon, with possible reasons including fieldworker discomfort asking the question, an environment judged to be inappropriate, as well as the educational level and vulnerability of interviewees (Davis et al., 2003; Cullen, 2022). Depression prevalence amongst mothers of <5-year-olds in the NIDS was 16.1%, thus just more than that found in the WCSBS (Harper et al., 2022).

Of note is that exposure to violent crime or related stressful situations seemed to have been uncommon (<5%) in all three EA-types, compared to 9.5% reported in the 2016 WC-CBS (Statistics SA, 2016). The lower levels found in the WCSBS are supported to some extent by results of the South African Governance, Public Safety, and Justice Survey 2021/2022 (Maluleke, 2022), where it was reported that 81.3% of the population felt safe walking alone in their neighbourhood during the day, although only 36% felt safe walking alone in their neighbourhood during the night. Anecdotally, the research team witnessed a few serious crimes including hijackings, and one team member was held up at gun point by three gun-wielding men, compelling us to put an extra layer of security in place to protect the teams. A comment made by Stein et al. (2015) (Drakenstein study) is worth mentioning: "here is some evidence of social capital in this cohort (e.g. many consider their partners a support), and a considerable number do not show evidence of psychological distress or depression. While clinical and public mental health interventions should be made available to those in need, it is also important to emphasise the resilience of the community and its members".

The perinatal care and behaviour profile of mothers in the WCSBS while pregnant with the index child shows that almost all of them had attended antenatal care clinics (the number of visits was not asked). However, they did not receive perinatal care in the form of home visits by a healthcare worker. In the 2016 SADHS almost all (94%) women aged 15–49 who had a live birth in the five years before the survey received antenatal care from a skilled provider (doctor, nurse or midwife) (NDoH et al., 2018). A third of the mothers in the WCSBS were employed at the time of the birth of the index child, which is slightly less than the employment rate of caregivers at the time of the study. These mothers typically received less than four months maternity leave (63.4%).

Results on risky lifestyle behaviours among mothers in the WCSBS during their pregnancy with the index child show that 25.2% had smoked, 14.5% had used alcohol and 2.8% had used drugs. Mothers in the RT EA-type were most likely to have smoked (37.8%) and those living in the UI EA-type least likely to do so (6.5%). No provincial or national-level statistics are available for smoking, drinking and drug use during pregnancy. In a localised survey in the Drakenstein sub-district in the Western Cape on pregnant mothers attending either a public clinic serving a black African population or a public clinic serving a mixed-race population in a peri-urban area, it was found that their self-reported lifetime use of tobacco was 37%, alcohol 41%, and cannabis 10% (Stein et al., 2015). In a study on risk factors for foetal alcohol syndrome in rural areas in the Western Cape, 20% of control mothers drank during pregnancy, which declined to 12.7% by the third trimester (87% of those who had a child with foetal alcohol syndrome had drunk during pregnancy). Moreover, smoking during pregnancy was higher for case versus control mothers (75.5% vs 30.3%) (May et al., 2005). Localised studies in other provinces confirm this trend. There were 18.7% of mothers of infants aged ≤12 months attending select health facilities in Gauteng who used tobacco and 3% who used alcohol during pregnancy (Modjadji & Pitso, 2021). Van Stuijvenberg et al. (2015) reported that 22.7% of mothers in a sample of 2–5-year-old children in a Northern Cape town (500 km from Cape Town) smoked during pregnancy, 2.7% used alcohol and 13.3% both smoked and used alcohol during pregnancy. Although these studies are not representative of the Western Cape population per se, it does support the notion that the presence of these risky behaviours among pregnant women is a major concern.

ECD opportunities provided to children at the HH level reflect an element of childcaring capacity/attitude (Engle et al., 1999). ECD indicators assessed in the total sample of children in the WCSBS showed that most children (82.3%) were not attending an ECCE facility and that 65% lived in HHs that did not own any children's books (story or picture books). There was a divergence in the UI EA-type where the greater majority of HHs did not own a single children's book (92.1%). In the 2016 WC-CBS it was recorded that 38.5% of children were attending an ECCE facility (Statsitics SA, 2016). Results from the NIDS-CRAM telephonic survey showed 39% of adult respondents in their national sample who were living with 6-year-old or younger children had at least one child in the HH who had attended an ECCE facility in February 2020. This fell to 7% in July/August 2020, purportedly as a result of ECCE programme closures and lockdowns, but increased again to 28% in November/December 2020. In early February 2021 it dropped down to 7% again, after which it recovered significantly to 36% by April/May 2021 (Wills & Kika-Mistry, 2022). The recovery in the Western Cape under-5-year-olds (17.7% attended an ECCE facility) seems to have lagged behind.

### 5.5.2 Care Index

Care has been defined as provision in the household and the community of time, attention and support (Engle et al., 1999). These researchers further indicated that the significance of care is best articulated in the UNICEF Framework for malnutrition (ibid.), supporting the value of investigating the determinants of malnutrition along the paths of the framework. Engle et al. (1999) listed the following resources that contribute to care: caregiver education, knowledge and beliefs (represents the capacity of the caregiver to provide appropriate care); caregiver physical health and nutritional status; caregiver mental health and self-confidence (represents self-confidence, and lack of stress and depression); autonomy and control of resources; workload and time availability; and family and community social support (facilitating conditions in the family and community). They conclude: "The concept of 'care' as an analytical construct is still new to many outside the nutrition field. Moreover, for those in the field, care is problematic from the measurement point of view" (Engle et al., 1999).

In the WCSBS we set out to use a *completely novel approach* by developing a Care Index to generate a "summary score" that reflects the integrated effects of care variables assessed. We retained 10 out of 25 indicators considered as potential care indicators after iterated PC analysis for the calculation of the Care Index (Supplementary materials S2.2). These were: maternal marital status, educational level, current employment, employment status, and age when the child was born; paternal educational level and current employment; child attendance of an ECCE facility and availability of children's books in the household. Importantly, each of the retained variables contributed to the score, and thus to any associations found with dependent variables in regression analyses.

Care indicators that were considered, but were discarded in the iterated PG analysis process, include: head of household was male, received a child grant, one of the parents did not live in the house for at least four nights of the week, father was not employed, mother was unemployed, mother's current age was less than 18 years, type of toys – homemade toys or toys from a shop, and the mother is currently pregnant.

*Only 18% of infants in the study were exclusively breastfed, although most mothers did initiate breastfeeding at birth. This is well below the global target of increasing the exclusive breastfeeding to at least 50% during the first six months.*

## 5.6 UNDERLYING CAUSES OF MALNUTRITION IN UNDER-5-YEAR-OLD CHILDREN IN THE WESTERN CAPE: WATER AVAILABILITY, SANITATION AND HYGIENE INDICATORS AND WASH INDEX

### 5.6.1 Water availability, sanitation and hygiene indicators

Overarchingly, the total sample of <5-year-old children in the Western Cape lived in a HH with piped water used for drinking and other purposes (92.5%), a flush toilet connected to a public sewerage system/septic tank (94.6%) and a fixed handwashing facility in the dwelling (75.7%); always had sufficient water (96.5%), and refuse was collected from the premises by a local authority (86.9%). There were a number of divergences for HHs in UI EA-types where children were more likely to not have access to piped water in the dwelling/on site (47.7%), although they always seemed to have access to sufficient water; were more likely to have a toilet facility elsewhere; were more likely to be sharing this facility; and were more likely to dispose of refuse in other ways, e.g. communal refuse dump/container.

The water and sanitation profile that emerged from the WCSBS results is very much in line with that documented in the 2016 WC-CBS, where 93.2% had access to safe drinking water, only 7.1% experienced water interruptions and 93.4% had a flush toilet (Statistics SA, 2016).

As far as the hygiene indicators are concerned, children lived in HHs where the caregiver washed their hands before handling food (84.3%), before feeding the child (60.9%) and after going to the toilet (88.2%); the floor of the dwelling was clean (81%) and the clothes of the children themselves were clean (84.9%). HHs in UI EA-types diverged from this in that handwashing before handling food and feeding the child was less common, but the clothes of the child were most likely to be clean.

### 5.6.2 WASH INDEX

Since 1990 the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene have produced regular estimates of national, regional and global progress on drinking water, sanitation and hygiene (WASH), and have been instrumental in developing global norms to benchmark progress. In the WCSBS we used the WASH questions included in the Census 2022 questionnaire, but added questions on handwashing practices of the caregiver and cleanliness of the dwelling floor and clothes of the child on the day of the survey. As the present study was a baseline survey, assessment of progress in access to particular services/amenities was not an aim.

For the investigation of contributions of water availability, sanitation and hygiene to malnutrition in the Western Cape, we set out to use a *novel approach by developing a WASH Index* to generate a "summary score" that reflects the integrated effects of water availability, sanitation and hygiene variables assessed (Filmer & Pritchett, 2001). We retained 13 out of 22 variables considered as potential WASH indicators after iterated PC analysis for the calculation of the WASH Index (Supplementary materials S2.3).

Variables retained to calculate the WASH Index include: piped water inside the dwelling, piped water in the yard, handwashing facility available in the dwelling, handwashing facility available in the yard, soap/detergent available for handwashing, water available for handwashing, flush toilet, toilet inside dwelling, toilet shared, bucket toilet, house floor clean, child's clothes clean, main source of water from a neighbour's/public tap. Importantly, each of the retained variables contribute to the score and thus to any associations found with dependant variables in further analyses. Variables considered but not used were handwashing behaviours of caregiver (before handling food, before feeding the child, after changing a nappy, after going to the toilet), and refuse removed at least once a week by local authorities.

## 5.7 DIRECT CAUSES OF MALNUTRITION IN UNDER-5-YEAR-OLD CHILDREN IN THE WESTERN CAPE: DIETARY INTAKE

### 5.7.1 Breastfeeding

The BF picture that emerged for 0–<6-month-olds (n=69) is one of low prevalence of exclusive BF (18%), although 92.8% of these mothers had initiated BF and 72% were still BF at the time of the study. This is well below the global target of increasing the exclusive breastfeeding rate up to at least 50% during the first six months (2014 International Conference on Nutrition Rome Declaration on Nutrition and Post-2015 Development Agenda) (FAO/WHO, 2014), with only two more years to go to achieve the goal. Results from the SADHS 2016 showed that nationally 32% of children under 6 months old had been exclusively BF, with the average duration of exclusive BF being about 3 months (NDoH et al., 2018). Provincial-level information on exclusive BF is scarce. In a 2011 localised study in impoverished urban areas in Worcester, Western Cape, 6% (n=8) of the mothers BF exclusively at the time of the interview, while 94% (n=132) applied suboptimal breastfeeding practices (Goosen et al., 2014). In a later study in the same area 59% of mothers of <6-month-old infants (n=99) reported that the infant had received only breastmilk on the day of the interview (Mabaso et al., 2021a). However, this information does not necessarily reflect exclusive BF per se.

Mixed breastmilk and infant formula/animal milk feeding was practised by a fifth of mothers of 6-month-old infants in the WCSBS. The top five fluids other than breastmilk or infant formula given to non-exclusively BF infants were traditional herbal fluids (35.2%), plain water (32.1%), very thin, runny porridge (12.5%), sugar water (7.1%) and fruit juice (5.4%). The top five solid foods given were baby cereal (35.7%), butternut/pumpkin (10.7%), sweet biscuits (7.1%) banana (5.3%) and apples/pears, potatoes, and other cereal (each 3.6%). According to the SANHANES-1 Survey, the average age for the introduction of solid food in the country was 4.5 months at the time (2012) (Shisana et al., 2014). In the mentioned 2011 survey in Worcester, water, formula milk and commercial infant cereal were introduced at a young age. In addition, more than two thirds of children were given solid or semi-solid food before the age of 6 months.

The overarching profile for 6-month–<5-year-old children in the WCSBS shows that BF had been initiated in the majority (92%). For these children BF was quite likely to have continued beyond 6 months of age, and for more than a third of the children it continued beyond 2 years of age. National 2016 statistics show that 84% of children born in the 2 years before the survey were ever BF, and that BF continued on average for more than 12 months in 0–35-month-old children (NDoH et al., 2018). The proportion of children in the WCSBS that had "ever been BF" is higher than estimates from the 2016 WC-CBS, where 80.4% of women aged 12–50 reported having breastfed their last child (Statistics SA, 2018). All 6–8-month-old children in the WCSBS sample were receiving complementary foods as recommended. Over 80% of the 6–8-month-old children in the 2016 SADHS received complementary foods (NDoH , 2018).

Key reasons given in the WCSBS for not ever having BF the child was that the mother did not have enough milk, that the baby did not want to take breastmilk and, concerningly, that the mother was advised not to BF by a health worker (14.3%). Key reasons for discontinuation of BF if it had been initiated were that the baby did not want to take breastmilk anymore, that the baby was old enough to no longer BF, that the mother did not have enough milk, and that she had to go back to work. Although others have identified numerous predictors for poor breastfeeding practices (Goosen et al., 2014; Siziba et al., 2015; Goon et al., 2021), no significant predictors of "not ever having BF the index child" were identified in the WCSBS.

### 5.7.2 Dietary diversity and other food choice indicators

Dietary indicators other than BF assessed in the WCSBS in children 6 months and older include dietary diversity, additional WHO/UNICEF indicators of healthy and unhealthy food choices, as well as the top ten most consumed foods. Dietary quality assessments were based on a single semi-quantified recall of intake of items on a comprehensive food list over the past 24 hours. Results thus need to be interpreted bearing in mind that a single 24-hour recall does not necessarily reflect usual intake (Willett, 2013; UNICEF/WHO, 2021a).

Dietary diversity has been shown to be positively associated with micronutrient adequacy and is thus deemed to be a good indicator of dietary quality (Molani-Gol et al., 2023). The overarching profile of dietary quality that emerged for 6-month–<5-year-old children is that it may not be sufficiently diverse (57.8% had a DDS<4). This is a worse situation than was found in the later localised survey in Worcester where a third of 6–23-month-olds had an inadequate dietary diversity score (Mabaso et al., 2021a). Further food choice indicators show that 1 in 4 may not be consuming sufficient egg and/or flesh foods, 1 in 5 may not be consuming sufficient fruits/vegetables, and 7 in 10 may not be consuming sufficient milk products to meet calcium needs. Considering that a child should be consuming at least 320 g of vegetables and fruit every day (four servings of 80 g) (Naude, 2013), intake of this food group is most probably inadequate in 6-month–<5-year-old children in the Western Cape. This possibility is supported by dietary results from the PDIS-WC (calculated from an adjusted quantified 24-hour recall), which showed that fruit and vegetable intake was approximately 100 g/day in the 1–<6-year-old age range (Senekal et al., 2020). The per capita intake of dairy in the PDIS-WC was also low and decreased from 250g in 1–<3-year-olds to 83g in 3–<6-year-olds (ibid.).

Indicators reflecting poor food choices which are, per WHO/UNICEF (2021a) definition, not considered in the DDS show that 4 in 5 of 6-month–<5-year-old children consumed sweet food items, 3 in 5 salty/fatty food items and 1 in 2 a SSB (fruit juice, cooldrink concentrate, fizzy drink) in the 24 hours preceding the study. This profile is confirmed by results on the top five foods most consumed by the children. These included salty/fatty crisps, e.g. Simba chips; sugar in tea/coffee or on porridge; and sweets or sweetened foods, e.g. sweet biscuits. Healthy foods such as eggs, flesh foods, dairy products, fruit and vegetables did not feature in the top five. Older children were more likely to exhibit poor dietary behaviours. The top five foods consumed by 1–<6-year-old children in the PDIS (Western Cape and Gauteng combined) also included three unhealthy options, namely granulated sugar, fatty/salty crisps and SSB (Steyn et al., 2020).

Predictors of poor dietary diversity in the total group of 6-month–<5-year-olds in the WCSBS included a Wealth Index in the lowest tertile [OR(CI) 2.23(1.59–3.12)], and a child that had been hungry in the past week [OR(CI) 1.86(1.06–3.27)]. These two predictors were strongest in the 4–<5-year-old age group, with odds ratios being 3.07(1.90–5.00) and 3.32(1.09–10.14) respectively. Having an overweight/obese caregiver also increased the risk of poor dietary diversity [OR(CI) 1.69(1.12–2.45)]. Older age in the total group of 6-month–<5-year-old children protected against a poor dietary diversity [OR(CI) 0.78(0.67–0.90)]. Faber et al. (2017) reported that food secure HHs in resource-poor peri-urban areas of South Africa had a higher mean DDS and ate more vegetables. Interestingly, they also found that HHs that were receiving social grants were less likely to be food secure – no association between DDS and receiving a child grant was apparent in the WCSBS. Faber et al. (2016) found that less than 25% of 6–24-month-old infants in low socio-economic areas of KwaZulu-Natal consumed four or more different food groups, with no urban-rural differences (Faber et al., 2016). The phenomenon of having an undernourished child – including a poor dietary diversity, in a HH where the mother is obese – has been well documented in South Africa and elsewhere (Modjadji & Madiba, 2019; Popkin et al., 2020).

## 5.8 DIRECT CAUSES OF MALNUTRITION IN UNDER-5-YEAR-OLD CHILDREN IN THE WESTERN CAPE: CHILD HEALTH INDICATORS

### 5.8.1 Overarching profile

Health status indicators other than anthropometric measures included in the WCSBS were gestational age, birthweight and immunisation status obtained from the RtHB, as well as presence of diarrhoea and respiratory tract infections for two weeks preceding the interview.

*It could be feasible to reduce the stunting prevalence in the Western Cape by another 25% from 2022 to 2030 if current initiatives continue.*

The overarching health indicator profile for the total WCSBS sample shows that they were born at a gestational age of more than 38 weeks; had a birthweight above 3kg, although 17.8% were classified as having had a low birthweight; that their immunisation status was up to date for their age (72.3% of the sample); and that they did not have either diarrhoea (94.1%) or a respiratory tract infection (96.1%) during the two weeks preceding the study. This profile diverged in the RT EA-type where the child was most likely to have been classified as having had a low birthweight (24.4%). It is further important to note that 13.7% of children for whom immunisation information was available were incompletely immunised. National results from the 2016 SADHS for these indicators are as follows: 61% 1–<2-year-old children had received all basic vaccinations, while 5% had received no vaccines. In the 2 weeks before the SADHS interviews, 3% of children under 5 had symptoms of acute respiratory infection and 10% had diarrhoea. Similar provincial-level information could not be traced.

### 5.8.2 Predictors of low birthweight and immunisation status

Individuals who were born prematurely, with low birthweight, or small for gestational age are not only at risk of stunting, but have also been shown to present a set of permanent changes that make them more susceptible to develop chronic NCDs, specifically cardiometabolic and glucose metabolism disorders (de Mendonça et al., 2020). The strongest predictor of low birthweight in the WCSBS was a gestational age of <37 weeks in the 6-month–<5-year-olds [OR(CI) 3.81(2.42–5.96)]. Tobacco use, alcohol consumption and illicit drug abuse increased the risk of low birthweight, with smoking being the biggest risk (Negrato & Gomez, 2013; Quelhas et al., 2018). It is thus a major concern that smoking during pregnancy emerged as a significant risk for low birthweight in 6-month–<5-year-olds in the WCSBS [OR(CI) 1.73(1.14–2.65)]. Further risks for a low birthweight in the WCSBS were having a low income in 2–<5-year-olds [OR(CI) 1.74(1.04–2.91)] and in the 2–<3-year-olds a Care Index in the lowest tertile [OR(CI) 3.16(1.34–7.44)]. Associations between low-income – which may result in insufficient nutrition, maternal care and caring capacity – and low birthweight have been reported by others (Islam Pollob et al., 2022). A protector against both low birthweight and incomplete immunisation status in 6-month–<5-year-olds was having an overweight/obese caregiver, which was mostly the mother of the child [OR(CI) 0.64(0.42–0.99) and OR(CI) 0.64(0.44–0.93) respectively].

Predictors of incomplete immunisation status in 6-month–<5-year-olds were food insecurity, i.e. ran out of money for food [OR(CI) 1.96(1.25–3.08)], and a child went hungry in the past week [OR(CI) 2.05(1.15–3.52)], as well as a child who was never BF [OR(CI) 2.6(1.33–5.12) in 2–<5-year-olds] and living in an UI EA-type [OR(CI) 2.17(1.26–3.73)]. In a recent systematic review on reasons given for non-vaccination and under-vaccination of children and adolescents in sub-Saharan Africa, the most common reasons given were related to caregiver's time constraints, lack of knowledge regarding vaccination, the unavailability of vaccines/personnel in healthcare facilities, missed opportunities for vaccination, caregiver's fear of minor side effects, poor access to vaccination services and caregiver's vaccination beliefs (Périères et al., 2022).

## 5.9 UNDERLYING AND DIRECT CAUSES OF STUNTING AND OVERWEIGHT/OBESITY IN UNDER-5-YEAR-OLD CHILDREN IN THE WESTERN CAPE

### 5.9.1 Overarching perspectives

Investigation of potential causes (predictors of and protectors against) of malnutrition in under-5-year-old children in the WCSBS was conducted along the pathways depicted in the UNICEF Framework for the development of malnutrition (UNICEF, 1990), as well as the adapted version thereof by Black et al. (2020) (Conceptual Framework for surviving and thriving of children) using multiple logistic regression analysis. As dietary diversity cannot be calculated for infants under 6 months old, this age group was not included in these regression analyses. The calculated VIF were all below 2.0, confirming the absence of collinearity between variables included in the final regression models.

*Low birthweight is a predictor of stunting in under-5-year-old children.*

### 5.9.2 Stunting

Indicators included in the regression model for identifying drivers of stunting in 6-month–<5-year-old children in the Western Cape were total income; Wealth Index tertiles; food security questions (household run out of money during the past months and child experienced hunger during the past week); Care Index tertiles; receiving a child grant; maternal smoking, alcohol and drug use during pregnancy; WASH Index tertiles; birthweight; immunisation status; ever BF; poor DDS (<4) and unhealthy food choices not considered in the calculation of the DDS, i.e. sugar, sweet and salty/fatty foods. As significant differences between the three EA-types were evident for many of the variables, it was also included in the regression model. Results show that predictors were in play from all three underlying and the two direct causes as set out in the UNICEF model (UNICEF, 1990).

#### *Underlying drivers*

Poverty has long been associated with poor health outcomes for children in South Africa (Willey et al., 2009; Faber et al., 2016). A Wealth Index in the lowest tertile – which comprised a score calculated from 10 household possessions, dwelling type, main energy source for cooking, Internet access and number of rooms in the dwelling – increased the risk of stunting in 6-month–<5-year-olds [OR(CI) 1.74(1.13–2.67)]. Total income (R0–<R3 200) and food-security indicators (ran out of money for food in the past month and hunger at household or child level) were not found to be predictors of stunting. The lack of association with HH/child hunger, despite being predictors of dietary diversity, may be linked to the low prevalence thereof in the study sample (9.4% and 5.5% respectively). However, the association between stunting and the Wealth Index emphasises that poverty is still one of the drivers of stunting in the Western Cape. Living in the RT EA-type in the total groups of 6-month–<5-year-olds [OR(CI) 1.73(1.04–2.87)] was a predictor of stunting, indicating that interventions targeting small towns in rural areas may need specific attention when considering the way forward with intervention strategies.

Nurturing care comprises stable environments that promote children's health and nutrition, protect from threats, provide opportunities for learning, and responsive, emotionally supportive, developmentally enriching relationships (Engle et al., 1999; Black et al., 2021). A Care Index score in the lowest tertile was found to be a predictor of stunting in the WCSBS in the total group of 6-month–<5-year-olds [OR(CI) 1.58(1.06–2.35)] and, specifically, in the vulnerable 6-month–<2-year-olds [OR(CI) 2.08(1.05–4.14)] in the WCSBS. Children in the later age group are in the critical 1 000-day window of care and development and are highly dependent on adults for all their physical and emotional requirements (Black et al., 2021). Results from a case-control study by de Villiers and Senekal (2002) in 12–24-month-old children attending a day-hospital in an urban informal area in the Eastern Cape, South Africa, confirms the fact that a combination of caregiving influences need to be addressed to improve caring capacity. They reported that risks for growth failure were a mother who: was not the head of the household, was not involved in disciplining her children, was not born in a city, was not able to write or read isiXhosa, had a school education of level of less than Grade 9, had not received nutrition education, smoked and drank beer regularly, showed little interest in her child or had a poor caring attitude towards her child. A further risk was if the child's clothes were dirty. In the Birth to Twenty study in Johannesburg, protectors of stunting were found to be having an employed mother and having a father who had completed secondary school (Willey et al., 2009).

Indicators retained for calculation of the Care Index score include *maternal* marital status (not married), educational level (low), current employment (not employed), employment status at the birth of the child (unemployed) and mother's age when the child was born (>30 years); *paternal* education (low) and current employment (unemployed); child attendance of an ECCE facility (not attending) and availability of books for children in the household (none). Interventions should therefore aim to address all these risks to provide young children with optimal opportunity to grow and develop. Research shows that interventions which target responsive caregiving and learning among infants with early risks have benefits that extend into adulthood (Black et al., 2021). Improvements in stunting risk in Nigeria from 2011 to 2014 were linked to improvements in nine stunting determinants, including maternal BMI, maternal height, ≥4 antenatal care

*Dietary diversity of half of 6-month–<5-year-olds in the Western Cape is poor: 1 in 4 may not be consuming sufficient egg and/or a flesh food, 1 in 5 may not be consuming sufficient fruits/vegetables, and 7 in 10 may not be consuming sufficient milk products to meet calcium needs.*

visits, health facility delivery, reduced child illnesses, an asset (Wealth) index, maternal education, paternal education, and preceding birth interval (Adeyemi et al., 2022). Interventions should consider that parents and families rely on communities, services, policies, and laws to support their physical and mental health, safety, access to services and opportunities to obtain financial stability (Black et al., 2021).

The WCSBS results clearly illustrate the risk maternal smoking as well as alcohol and drug use during pregnancy hold for the growth of the foetus and beyond. All three behaviours increased the risk of stunting in the total group of 6-month–<5-year-olds [smoking: OR(CI) 1.60(1.07–2.14); alcohol use OR(CI) 1.79(1.19–2.69); drug use: OR(CI) 1.59(1.05–2.40)], reflecting a specific long-term risk beyond the first 1 000-day window. The association between smoking and stunting has been reported by many others, with a recent systematic review concluding that tobacco use during pregnancy may represent a major preventable cause of impaired child growth (Quelhas et al., 2018). It is important to note that risky behaviours (smoking, drinking and drug use) remained as independent predictors in the multiple regression analysis, even though they were also predictors of low birthweight (as indicated above, the VIF confirmed absence of collinearity). We speculate that the mentioned risky behaviours would be very likely to continue after the birth of the child, impacting childcaring capacity in various ways. In support of this contention, a recent meta-analysis found that children exposed to parents who consume alcohol (both dependent and non-dependent), tobacco, or other psychoactive drugs experience a detrimental long-term effect on their well-being (Kuppens et al., 2020). Identification of lifestyle correlates of exclusive breastfeeding practices among mothers on ART in the Eastern Cape, South Africa, showed that mothers who consumed alcohol were less likely to practice exclusive BF for 6 months [OR 0.54 (0.34–0.85)] (Goon et al., 2021).

It is well established that poor WASH conditions may contribute to child stunting, with pathways contributing to this association including promotion and maintenance of the infection-diarrhoea-malnutrition cycle diseases, poor socio-economic conditions and time constraints to childcare practices (Dominguez, 2017). In the WCSBS, WASH indicators reflected good coverage of water availability, access to a flush toilet, availability of water at all times, and hygiene practices in the majority of households (Section 4.6). However, it is evident that in households where the WASH Index score was in the lowest tertile, the risk of stunting was increased in the 2–<3-year-olds [OR(CI) 2.54(1.21–5.34)], which may have been the result of one or more of the above-mentioned mechanisms (Dominigue, 2017). This result illustrates that when WASH conditions are not optimal, it could be a driver of stunting.

### *Direct drivers*

Although key determinants of stunting, such as wealth quintiles, maternal age and educational level, the child's birthweight and place of residence, are well recognised, the relative contributions of these are influenced by contextual factors (Slemming et al., 2015). Low birthweight and incomplete immunisation status were confirmed as predictors of stunting in 6-month–<5-year-old children in the WCSBS [OR(CI) 2.47(1.65–3.71) and OR(CI) 1.89(1.19–2.99) respectively]. Multivariate regression analysis of data from the Birth to Twenty Plus longitudinal birth cohort study in Johannesburg, South Africa, showed that a higher birthweight was protective against stunting for both sexes. In their examination of stunting in 2-5-year-old children in an impoverished area in the Northern Cape, in South African, van Stuijvenberg et al. (2015) found that birthweight correlated significantly with height-for-age Z-scores.

Malnutrition stems from dietary patterns that are not diverse and nutrient dense, consequently resulting in energy and nutrient intakes that do not meet requirements/recommendations. However, neither having never been BF nor poor dietary diversity emerge as predictors of stunting in the WCSBS in any age grouping. This result could be linked to the methodology used to determine dietary diversity, which reflects intake of indicator food groups during the previous 24 hours (adapted WHO/UNICEF 2021 method for infants and young children). As mentioned, this information does not necessarily reflect the children's current usual intake, nor their intake since birth. However, in the recent localised study in Worcester, a DDS <4 was found to predict stunting in 6-23-month-old children [OR 2.0 (1.18–3.39)], using a similar but less comprehensive method than applied in the WCSBS.

Irrespective of the finding that dietary diversity per se did not predict stunting, the poor diversity in more than half of the 6-month–<5-year-olds is a major concern. The poor diversity can be explained by insufficient frequency of intake of flesh foods/eggs, fruit, vegetables and dairy, combined with frequent intake of unhealthy foods. Although fortification of bread and maize flour may address some of the micronutrient deficiencies inherent to this type of dietary pattern, it does not address the risk of micronutrient deficiencies not included in the fortification mix, for example calcium, vitamin C and other antioxidants present in fruit and vegetables (Senekal et al., 2020). Faber et al. (2016) came to a similar conclusion after investigating the association between stunting and dietary diversity in 6–24-month-old children in urban and rural KwaZulu-Natal. "Fewer than 25% of children consumed ≥4 food groups, with no urban/rural differences. Higher dietary diversity was associated with higher nutrient density for protein and several of the micronutrients including calcium, iron, and zinc. The poor nutrient density for key micronutrients can probably be ascribed to lack of dietary variety, and little impact of mandatory fortification of maize meal/wheat flour on infants/toddlers' diet." Improvement of dietary diversity and ensuring that healthy food choices appear in the top five most commonly consumed foods, must be placed on a priority agenda for prevention of stunting (and overweight/obesity) in under-5-year-old children in the Western Cape.

### 5.9.3 Overweight/obesity

Key obesity risk factors in the first 1 000 days that have been reported to be associated with later childhood obesity include higher maternal pre-pregnancy BMI, prenatal tobacco exposure, excess gestational weight gain, high infant birthweight, accelerated infant weight gain, childcare attendance, low strength of maternal–infant relationship, low socio-economic status, inappropriate bottle use, introduction of solid foods before 4 months of age, and infant antibiotic exposure (Woo & Martin, 2015).

In the WCSBS, the drivers of overweight/obesity in the 6-month–<5-year-olds included an overweight/obese caregiver [OR(CI) 1.88 (1.21–2.91)], specifically also in the 2–<3-year-olds [OR(CI) 2.21(1.31–3.71)]. Besides hereditary factors that may explain the link between childhood obesity and caregiver BMI (more than half of the majority of caregivers, whether a mother, father or grandmother were overweight or obese), it is also plausible that the unhealthy dietary patterns (energy dense and nutrient poor) of the adults resulted in similar patterns in the children. Results of unhealthy food choices (sugar, sweet and salty/fatty food items) and the most consumed foods in the study sample outlined in a previous section, support the presence of unhealthy dietary patterns.

The effect of BF practices on overweight/obesity risk in the WCSBS sample is evident from the finding that 6-month–<2-year-old children who had not ever been BF were at increased risk of overweight/obesity [OR(CI) 2.95(1.36–6.40)]. However, this association needs to be interpreted with caution, as evidence is still controversial and underlying mechanisms unclear (Marseglia et al., 2015). One possible explanation in our study may lie in the finding that in the same age group, having consumed sugar in tea/coffee or on porridge also increased the risk of overweight/obesity [OR(CI) 2.21 (1.23–3.95)]. This may reflect a feeding pattern where children are, for example, not receiving breastmilk, with one of the replacement drinks given being tea or coffee with sugar, contributing to higher energy but lower nutrient density.

Contrary to the notion that a low birthweight is a risk factor for childhood overweight/obesity (REFS), this indicator was protective against overweight/obesity in the WCSBS [OR(CI) 0.38(0.19–0.78)].

*Smoking, alcohol use and drug use during pregnancy reflects a specific long-term risk. These behaviours need urgent attention to reduce the risk of stunting in the Western Cape.*

6.

# KEY RESULTS AND CONCLUSIONS

The key conclusion of the WCSBS is that a double burden of malnutrition, stunting and overweight/obesity remains a concern in the province. The prevalence of stunting in the WCSBS (17.5%) was close to the upper cut-off of the medium public-health-concern category of 10–19% for 0–59-month-old children. Stunting in the very vulnerable <2-year-old age group was 19.7%, pushing it into the high public-health-concern category for this age group. The prevalence of underweight (5.6%) was just above the lower cut-off of the medium (5–9%) and wasting (3.4%) in the low (2.5–<5%) public-health-concern categories for 0–59-month-old children. The prevalence of overweight (15.1%) fell in the very high public-health-concern category of ≥15%. Stunting-overweight was not common at 2.4%.

The WHO/UNICEF's (2021) goal is to reduce stunting prevalence in under-5-year-olds by 50% by 2030 (WHO/UNICEF, 2021b). The prevalence of stunting in the Western Cape in the WCSBS (17.5%) is a considerable reduction from the 27.4% reported in the 2016 SADHS (NDoH et al., 2018). Moreover, the 2022 prevalence of stunting in the 1–<5-year-old children in the WCSBS was 18.2% compared to the 20.8% found in the 2018 PDIS in the same age group. To date only the 2016 SADHS reported on stunting in children under 6 months old, where it was found that 32.3% were stunted (NDoH et al., 2018). In the WCSBS the prevalence was 25.2%, thus 7.1% lower than the 2016 national prevalence. Stunting levels in the Western Cape therefore seem to be much lower than in the rest of the country and seem to have been decreasing in the province despite the Covid-19 pandemic that has gripped the country since early 2020. This could mean that the various interventions that have been put in place by the Western Cape Government, NGOs, NPOs and others have been making a difference. With a 12.5% reduction over a four-year period (September–November 2018 to June–October 2022), it could be feasible to reduce the stunting prevalence by another 25% from 2022 to 2030 if current initiatives continue. However, this will not yet be sufficient to achieve the goal of a 50% reduction by 2030.

**The value the WCSBS adds is not only a profile of stunting in under-5-year-old children, but also current predictors of the condition. These include:**

- A Wealth Index in the lowest tertile in the total group of 6-month–<5-year-olds [OR(CI) 1.74(1.13–2.67)]. The Wealth Index comprised a score that reflects 10 indicators covering household possessions, dwelling type, main energy source for cooking, Internet access and number of rooms in the dwelling. Initiatives to address poverty in the Western Cape should thus continue to reduce stunting prevalence.
- A Care Index score in the lowest tertile in the total group of 6-month–<5-year-olds [OR(CI) 1.58(1.06–2.35)], and specifically in the vulnerable 6-month–<2-year-olds [OR(CI) 2.08(1.05–4.14)]. This novel Care Index comprised a score that reflects maternal marital status, educational level, current employment, employment status and age when the child was born; paternal educational level and current employment; child attendance of an ECCE programme and availability of children's books in the household. Importantly, each of the retained variables contributed to the score, and should be addressed in stunting prevention initiatives.
- A WASH Index score in the lowest tertile in the 2–<3-year-olds [OR(CI) 2.54(1.21–5.34)]. This novel WASH Index score reflects indicators in the dwelling, inclusive of piped water inside the dwelling, piped water in the yard, handwashing facility available in the dwelling, handwashing facility available in the yard, soap/detergent available for handwashing, water available for handwashing, flush toilet, toilet inside dwelling, toilet shared, bucket toilet, house with clean floor, child with clean clothes, main source of water from a neighbour's/public tap. This particular risk may be more prominent in the UI EA-type.
- Smoking, alcohol use and drug use during pregnancy in the total sample of 6-month–<5-year-olds as reflected in the respective ORs [smoking OR(CI) 1.60(1.07–2.14); alcohol use OR(CI) 1.79(1.19–2.69); drug use: OR(CI) 1.59(1.05–2.40)]. This also reflects a specific long-term risk beyond the first 1 000-day window of these risky lifestyle behaviours. These behaviours need urgent attention to reduce the risk of stunting in the Western Cape.
- Low birthweight in the total group of 6-month–<5-year-olds [OR(CI) 2.47(1.65–3.71)]. Predictors of low birthweight were a gestational age of <37 weeks [OR(CI) 3.81(2.42–5.960], smoking during pregnancy [OR(CI) 1.73(1.14–2.65)], having a low income [OR(CI) 1.74(1.04–2.91)] and Care Index in the lowest tertile [OR(CI) 3.16(1.34–7.44)].
- Incomplete immunisation in the total group of 6-month–<5-year-olds [OR(CI) 1.89(1.19–2.99)]. Predictors of an incomplete immunisation status were: caregiver ran out of money for food [OR(CI) 1.96(1.25–3.08)], a child went hungry in the past week [OR(CI) 2.05(1.15–3.52)], a child who was never breastfed [OR(CI) 2.6(1.33–5.12)] and living in an UI EA-type [OR(CI) 2.17(1.26–3.73)].
- Living in the RT EA-type in the total groups of 6-month–<5-year-olds [OR(CI) 1.73(1.04–2.87)].

The latter two results may indicate that interventions targeting children living in RT and UI EA-types may need specific attention when considering the way forward with intervention strategies.

No dietary variables were found to be risks for stunting in the WCSBS. Only 18% were being exclusively BF, although most mothers did initiate BF at birth. Key reasons for not ever having BF the child was that the mother did not have enough milk, that the baby did not want to take breastmilk and, concerningly, that the mother was advised not to BF by a health worker. There were no predictors for "not ever having BF a child".

Dietary quality results show that the dietary diversity of 1 in 2 of the total group of 6-month-<5-year-olds is poor, that 1 in 4 may not be consuming sufficient egg and/or a flesh food, 1 in 5 may not be consuming sufficient fruits/vegetables, and 7 in 10 may not be consuming sufficient milk products to meet calcium needs. Furthermore 4 in 5 of 6-month-<5-year-old children consumed sweet food items, 3 in 5 consumed salty/fatty food items and 1 in 2 consumed an SSB in the 24 hours preceding their interview. Predictors of poor dietary diversity in 6-month-<5-year-olds included a Wealth Index in the lowest tertile [OR(CI) 2.23(1.59-3.12)], and a child that had been hungry in the past week [OR(CI) 1.86(1.06-3.27)].

Although the key focus of the WCSBS was on stunting, the WHO/UNICEF's (2021b) goal is also to reduce the prevalence of overweight/obesity in children to less than 3% by 2030 (WHO/UNICEF, 2021b). With the prevalence of overweight in the WCSBS sample in the very high public-health-concern category of ≥15%, it should not be ignored, especially as interventions focused on reducing stunting prevalence may inadvertently promote obesity risk in this target population (Tzioumis et al., 2016).

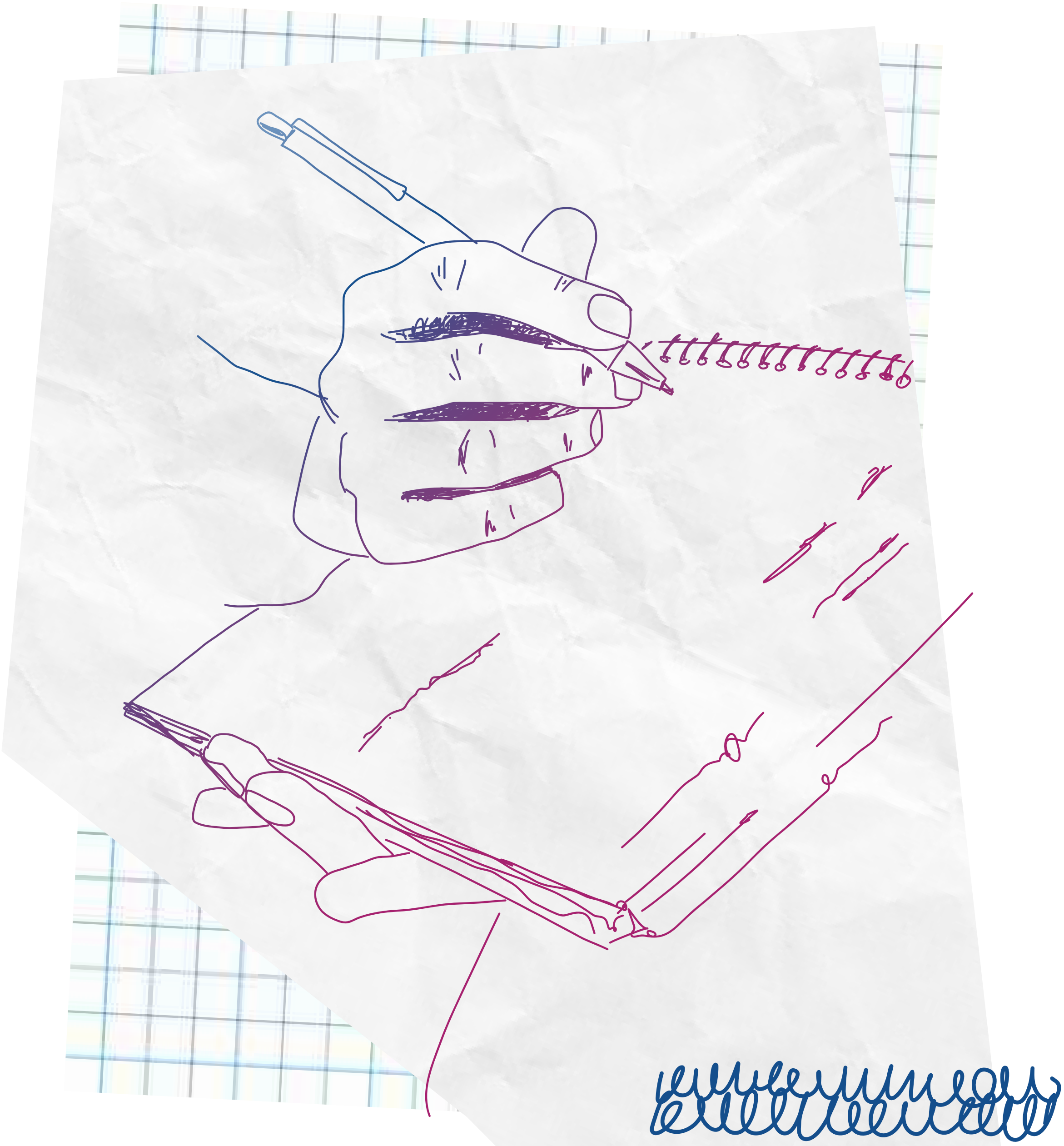
Current predictors of overweight/obesity identified using multiple logistic regression analyses in the study sample include:

- An overweight/obese caregiver [OR(CI) 1.88(1.21-2.91)], specifically also in the 2-<3-year-olds [OR(CI) 2.21(1.31-3.71)]. Caregivers were the mother (71%), grandmother, father or another family member, and more th an 50% were overweight or obese. The publication of the updated edition of the 2015-2020 Strategy for the Prevention and Control of Obesity in South Africa is a matter of urgency, as the target of reducing obesity by 10% by 2020 has clearly not been achieved, which, in turn, also impacts negatively on the prevention and control of obesity in children.
- Not ever BF in 6-month-<2-year-olds [OR(CI) 2.95(1.36-6.40)], reflecting the importance of initiatives to promote initiation of BF, excusive BF up to 6 months old and continued BF with the addition of healthy and age-appropriate complementary foods.
- Having consumed sugar in tea/coffee or on porridge in 6-month-<2-year-olds [OR(CI) 2.21(1.23-3.95)]. The fact that this risk factor remained as an independent risk in the multivariate regression model emphasises the gravity of this situation; sugar was given regularly to young children in the WCSBS, and it predicted overweight/obesity in under-2-year-olds.

*Initiatives to address poverty in the Western Cape should continue to reduce stunting prevalence.*

# 7. KEY STRENGTHS AND LIMITATIONS OF THE STUDY

**STRENGTHS** of this study include the rigorous sampling structure and execution thereof, resulting in a sample of under-5-year-old children that is representative of this target population. Results in terms of the malnutrition profile and predictors thereof that were identified using multivariate regression models are thus robust and a good baseline for monitoring changes in the malnutrition profile of children in the Western Cape, while also providing good insights in current predictors of both stunting and overweight/obesity that can advise critical assessment of current interventions and the need for, and nature of, additional measures that need to be put in place. A further strength is the richness of the data collected that enabled us to reflect on the drivers of malnutrition along the pathways of the UNICEF Framework for malnutrition. For these purposes we also developed indices to investigate the three underlying causes of malnutrition in children, namely a Wealth Index (assets and wealth status) and two novel indices, one that reflects mother and childcare/caregiving capacity (Care Index) and the other that reflects water availability, sanitation and hygiene in the household (WASH Index). The majority of questions included in the research questionnaire were from internationally standardised instruments for the target age group, which were adapted for use in South Africa as recommended, e.g. the WHO/UNICEF infant and young child feeding questionnaire, as well as the 2022 Census questionnaire.

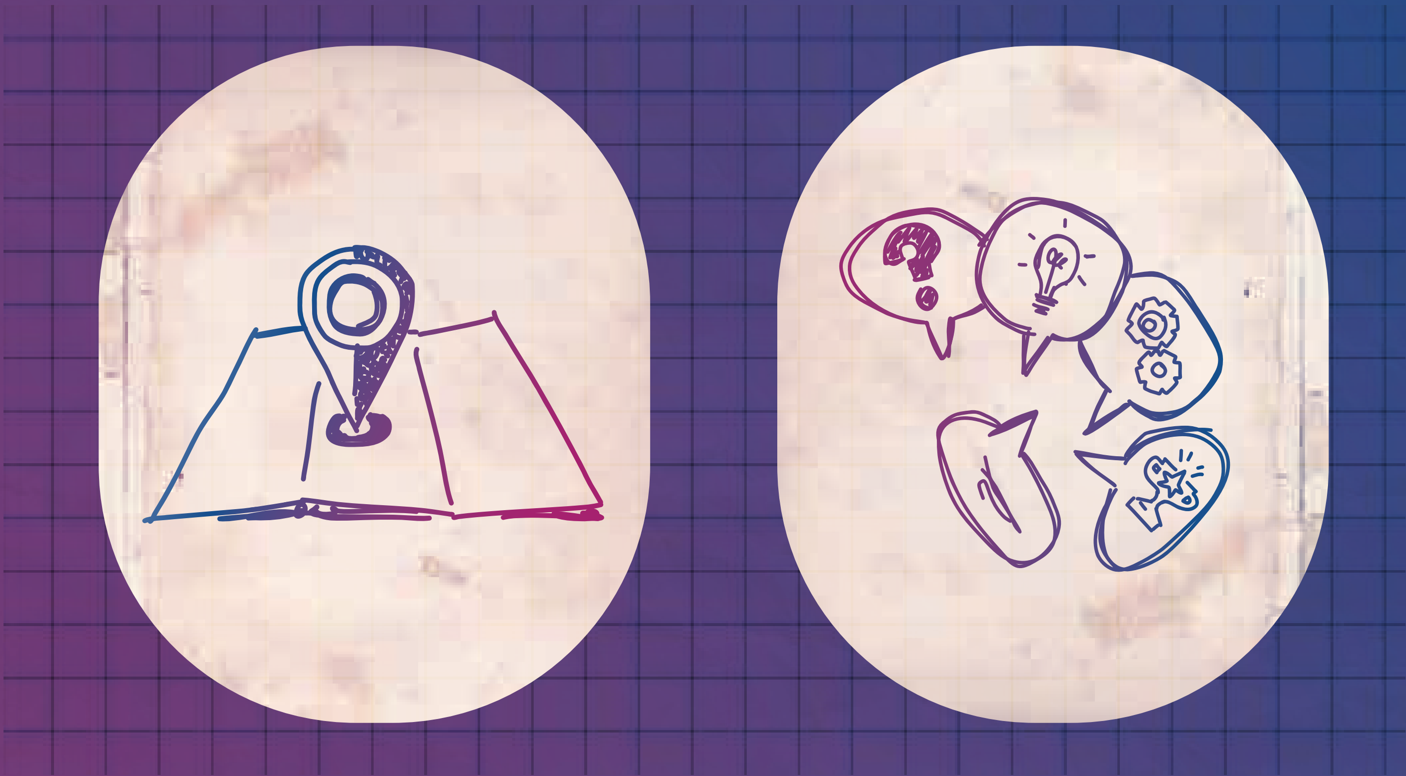


**LIMITATIONS** of the study include that two important childhood health intervention indicators, namely whether the vitamin A supplementation was on track and receival of deworming medications were up to date, were not assessed. Finally, as is the challenge in surveys that are dependent on self-reported information, a level of respondent bias may have been present. However, we attempted to minimise this limitation with rigorous training of fieldworkers and quality control measures.

# 8. RECOMMENDATIONS

Numerous interventions to prevent and control malnutrition in under-5-year-old children in the Western Cape are presently in place, and, as indicated in the conclusion section, may have resulted in reducing the prevalence of stunting, but not necessarily overweight/obesity.

**The two key recommendations for taking this work forward are:**



Build a current map of all initiatives/interventions – whether governmental, NPOs, NGOs, universities and research organisations such as the HSRC and SAMRC – that aim to improve the nutritional status, ECD and general well-being of under-5-year-old children, and capture the goals, strategies, ground-level actions, outcomes and lessons learnt for each of the initiatives.

Conduct a series of workshops with multisectoral stakeholders to consider the outcomes and recommendations of this research within the context of the current intervention map to plan the way forward to address the malnutrition risks for under-5-year-old children identified in the WCSBS.

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*To all the children in the Western Cape.*

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