COMPLEMENTARY FEEDING PRACTICES AND GROWTH STATUS OF CHILDREN AGED 6-23 MONTHS IN SOWETO

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MSc (Med) in the field of Child Health (Community Paediatrics)

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DECLARATION

I, Lumé Mari Morrow declare that this Research Report is my own, unaided work. It is being submitted for the Degree of MSc in Child Health (Community Paediatrics) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

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20 September 2021

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To my husband James who has been my unrelenting support, from start to finish, and my daughter Isla Seriti, who has made finishing this a little harder, but definitely worth it. I love you both dearly.

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To my fellow dietitian data collectors, Kamo, Nkume and Mbali. Thank you for being willing to start at the break of dawn and help me regardless of the cold winter mornings, crying babies and long hours. May we not lose hope in our profession and the contribution we have to offer our communities.

To all my other friends and family who have motivated me, helped by babysitting and encouraged me through prayers, thank you from the bottom of my heart.

PUBLICATIONS

This research report has not been published in any journal and is being presented in the submissible format.

I intend to submit the report to the South African Journal of Clinical Nutrition for publication. The submissible paper has been formatted to meet their submission criteria and is presented for examination with the study protocol (Appendix E).

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NOMENCLATURE

CF – Complementary feeding

WHO – World Health Organization

IYCF – Infant and young child

MMF – Minimum meal frequency

IDDS – Individual dietary diversity score

MDD – Minimum dietary diversity

MAD – Minimum acceptable diet

SADHS – South African Demographic and Health Survey

RTHB – Road to Health Booklet

MUAC – Mid Upper Arm Circumference

WAZ – Weight for age

HAZ – Height for age or length for age

WHZ – Weight for height or weight for length

BMI – Body Mass Index

BAZ – BMI for age

SAM – Severe acute malnutrition

MAM – Moderate acute malnutrition

BF – Breastfeeding

FF- Formula feeding

ABSTRACT

Objectives: To determine the associations between caregiver Complementary Feeding practices and the growth status of their children aged 6-23 months.

Design: A descriptive, cross-sectional study with analytical components.

Setting: The study was undertaken at Chiawelo Community Health Centre in Soweto, Johannesburg.

Subjects: A total of 168 primary caregiver-child pairs attending well-baby visits were included in the study.

Outcome measures: Anthropometric measures of the children were taken. Information regarding the characteristics of the sample and information, about the complementary feeding practices of the caregiver were also collected.

Results: The study found a Minimum Meal Frequency (MMF) of 91%, a Minimum Dietary Diversity with seven food groups (MDD-7) and a Minimum Dietary Diversity with eight food groups (MDD-8) of 56% and 48% respectively; and a Minimum Acceptable Diet with seven food groups (MAD-7) and Minimal Acceptable Diet with eight food groups (MAD-8) of 54% and 42% respectively. The growth status of the study sample was 13% wasted when considering the Mid-Upper Arm Circumference (MUAC) and Weight-for-length Z-score (WLZ) together; 3% underweight; 11.3% stunted; 17% overweight and 3% obese. The Infant and Young Child Feeding (IYCF) indicators were not significantly associated with the growth outcomes of this study sample of children.

Conclusions: The findings highlight the lack of diversity in the diets of young children in this study setting and mirrors the rest of South Africa with their low breastfeeding rates and early cessation of breastfeeding. The high prevalence of overweight children in this study is particularly concerning, and highlights a need for intervention. The intake of unhealthy foods needs to be closely monitored and assessed in future studies for associations with growth outcomes. Although the IYCF indicators had no significant associations with the growth outcomes in this study, they remain valuable as a broad evaluation of a child's diet and to establish trends within a community.

1. INTRODUCTION

Malnutrition continues to be of great concern, globally.[1,2] Numerous factors contribute to malnutrition in children including how they are fed.[3-6] It is well known that adequate nutrition from birth is critical for the optimal physical and cognitive development of an infant.[5,6] In the long term, malnutrition can hinder a child's ability to lead a productive life, affecting their earning capacity, contribute to poverty, as well as negatively affecting their health and reproductive outcomes as adults.[4,5,7,8] Even if children have been optimally breastfed in the first six months of life, not receiving adequate complementary feeding (CF) can lead to poor growth and contribute to declining growth trends in developing countries.[5,6,8]

CF is defined by the World Health Organization (WHO) as "the transition from exclusive breastfeeding to family foods". This transition is necessary because breast milk alone, no longer meets the needs of the growing infant. [9] Adequate CF practices are related to the timeliness (not early or delayed), adequacy (should meet a child's needs nutritionally) and appropriateness (proper variety, texture and quantity) of the foods.[10,11] Additional practices of importance include food safety (proper preparation, storage etc) and responsive feeding (food is given according to the child's signals). [9]

One way in which we can determine CF practices is by measuring the WHO Infant and Young Child Feeding (IYCF) indicators, which include (amongst others), the CF-specific indicators Minimum Meal Frequency (MMF) and the Minimum Dietary Diversity (MDD), which together indicate whether a child has a Minimally Acceptable Diet (MAD) or not.[11] The South African Demographic and Health Survey (SADHS) found that only 23% of children aged 6-23months, met the criteria for MAD, and reported no estimates for MDD and MMF.[12]

The latest SADHS found 27% of children under 5 were stunted and 10% severely stunted, with those aged 18-23 with the highest proportion of severe stunting (20%).[12] South Africa's stunting prevalence remains high and continues to persist at elevated levels.[13] The number of overweight children (13%) in South Africa is also of rising concern as this is more than double the global average of 6%.[12]

There is limited local research assessing CF practices of young children or the associations between CF practices and the growth of young children. This study sought to describe the CF practices of primary caregivers, the growth status of their children aged 6-23 months, and to determine any associations between the two. This research will provide a description of local CF practices and inform critical early interventions to promote adequate nutrition and growth in young children.

2. METHODS

2.1 Study design and setting

A descriptive, cross-sectional study with analytical components, was undertaken during May 2019. This study was conducted at Chiawelo Community Health Centre (CCHC), which is a provincial primary healthcare centre in Soweto, Johannesburg. Soweto, an acronym for South Western Townships, is considered an urban complex, home to majority black residents (99%). The township has a large working age population (15-64 years) (71%), with only 9% who have completed some form of higher education. The majority of homes are formal dwellings (84%) with access to electricity (93%), running water (55%) and flushing toilets (92%). Forty percent

of these households are female-headed.[14] The CCHC is situated in ward 11 of Soweto and cares for around 18 000 people. Services available include maternal health services (family planning, antenatal care and labour), child health services, dental, mental health and HIV/TB services. Other health practitioners on site include social workers, speech therapists, occupational therapists and physiotherapists. Twenty community health care workers service the area in which the CCHC is located.[15]

2.2 Study population and sampling

The study population included all primary caregivers and their children, between the ages of 6-23 months, attending routine/well-baby visits at Chiawelo CHC.

The sample size was estimated using Stata version 15.1 and was calculated to ensure 80% power to detect a 10% difference in MAD in the study context, compared to the 2016 SADHS MAD point estimate of 23%. The minimum number of participants required for the study sample was calculated as 123.

All eligible caregiver-child pairs who presented during the data collection time period, were approached in the well-baby clinic and invited to participate. Of those who gave the necessary informed consent, a total of 168 pairs were enrolled into the study. The minimum number of participants (123) were enrolled before the data collection period was over, and enrollment continued until the period was over. Participants were excluded if the caregivers were not their primary caregivers (the person mostly responsible for the child and feeding the child) or had no knowledge of the child's past and present eating habits and/or if the child had any disability that prevented typical growth and development.

2.3 Data collection procedures

Usual clinic procedures included caregiver-child pairs entering the clinic and placing their Road to Health Booklets (RTHB) on a pile at the front of the clinic. All booklets were numbered based on time of arrival. The study data collectors reviewed RTHBs to determine who was eligible for the study. When an eligible caregiver-child pair was identified, they were approached privately to provide information regarding the study. They were given time to consent to voluntary participation of themselves and their children. They were then moved from the queue, taken for anthropometric measurements in one room and then to a private room to complete an interview-administered questionnaire with a data collector.

The questionnaire used was compiled based on the previously validated WHO questionnaire[11], with all the necessary data needed for calculations, with added questions for additional information. The final questionnaire was not validated. Prior to the commencement of data collection, the questionnaire was pre-tested on four caregiver-child pairs who were not included in the sample. The questionnaire was adjusted based on the caregivers' feedback. The researcher trained three multilingual, qualified dietitians as data collectors to administer the questionnaire by interview. The primary researcher was responsible for taking all the anthropometric measurements, which allowed for consistency.

2.4 Measures

2.4.1 Maternal, child and household variables

Maternal information included maternal age at birth, mother's highest level of education completed and the number of antenatal visits attended. Child variables included sex, age, who is accompanying them to the clinic and whether their immunizations and deworming was up to date.

Household variables included access to electricity, drinking water, toilet facilities and the primary means/fuel used for cooking. Overcrowding in the home was defined as more than 3 people per room used for sleeping. A household asset score was calculated from a list of assets (cell phone, television, fridge, washing machine, car). Owning an asset in the household counted as 1, the lack of an asset counted as 0, with a total possible score of 5. An asset score has been validated as a proxy measure for socioeconomic status in previous studies.[16]

2.4.2 Feeding practices

Information included whether the child continued breastfeeding at one year and the time of introduction to solid and semi-solid or soft foods.

Information related to WHO IYCF indicators included: MDD, originally defined as the proportion of children 6-23 months of age who receive foods from ≥4 of the following seven food groups: grains roots and tubers, legumes and nuts, dairy products, flesh foods, eggs, vitamin A rich fruits and vegetables, other fruits and vegetables. We will refer to this as MDD-7. The MDD definition was recently changed to include breastmilk as an eighth group with a new threshold of ≥5 of the eight food groups.[17] We will refer to this as MDD-8. MMF, which is the proportion of breastfed and non-breastfed children aged 6–23 months who receive solid, semi-solid, or soft foods (but also includes milk feeds for non-breastfed children) the minimum number of times per day or more; and MAD, which refers to the proportion of children 6–23 months of age who meet both the MMF and MDD requirements the previous day.[11] We calculated a MAD using both the MDD-7 and MDD-8 definitions and refer to these results as MAD-7 and MAD-8 respectively.

Other feeding information collected include: who is responsible for what the child eats and who is responsible for feeding them; who does the caregiver turn to for advice regarding feeding the child, and where do they turn to for further advice (e.g. social media, the clinic etc.); did they receive information regarding feeding the child antenatally, postnatally and at their latest clinic visit; the age the child received their first fluid other than breastmilk or formula, and what this fluid was; the age the child received their first solid food and what this was; how many times a day the child receives soft, semi-solid or solid foods; the frequency certain unhealthy foods (salty snacks, juice, baked goods, processed meat and sugary snacks) were eaten in a 24-hour period and in the last 7 days.

An individual dietary diversity score (IDDS) was calculated for each child (this forms part of the calculation for MDD). A score out of seven and a score out of eight was calculated and referred to as IDDS-7 and IDDS-8 respectively.

2.4.3 Child growth measures

All measurements were completed using standardized techniques.[18] Measurements included weight, length and mid-upper-arm circumference (MUAC). Weight was taken with minimal clothing on and to the nearest 0.001kg on a digital paediatric scale (SECA 354), and repeated twice. Length was taken without any footwear or headgear on, to the nearest centimeter (cm) using a length board (SECA 417), and repeated three times. MUAC was measured to the nearest 0.1cm using the UNICEF field tapes for MUAC, and repeated three times. If a child

was identified with malnutrition as per the WHO cut-offs, the clinic nursing staff were informed and the child was referred for further assessment and management by a dietitian at Chris Hani Baragwanath Hospital.

2.5 Data management and analysis

All raw data were captured into a database on MS Excel.

Anthropometric data were used to determine current growth status by making use of the WHO AnthroPlus software (version 3.2.2). Z-scores were calculated and z-score cut-offs were used to determine the growth status of the participants.[19]. Weight-for-age (WAZ) was used to determine if a child was underweight; length-for-age (HAZ) was used to determine if a child was stunted; and weight-for-length (WHZ) and MUAC, was used to determine if a child was wasted. WHZ along with body mass index-for-age (BAZ) was used to determine if a child was overweight or obese. All z-score cut-offs used were as per the WHO growth standards (Table 2). [20]

Data were exported into STATA 15 (Stata Corporation, College Station, Texas, USA) for analysis.[21] Categorical variables are described using frequencies and proportions. Continuous variables are summarised using mean and standard deviation or median and interquartile range, depending on the normality of distribution.

Pearson's chi-square test was used to test associations between categorical variables (e.g., MAD and stunting). Student t-tests were used to assess differences between means of two groups, in the case of normally distributed continuous data. Where data were not normally distributed, the Wilcoxon Rank Sum test was used. Oneway ANOVA tests were used to assess for differences between means of more than two groups (e.g., IDDS and maternal education).If variables were found to be significantly associated with one another (based on a P-value of <0.05), simple logistic regression analysis was conducted to determine the odds ratios and 95% confidence intervals.

2.6 Ethics

Ethical approval was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (clearance certificate no. M180826). The study was registered on the National Health Research Database and permission to conduct research at the selected study site was obtained from the Johannesburg Health District committee (ref no. GP201901038) and from the site facility manager.

3. RESULTS

3.1 Description of the sample

A total of 168 caregiver-child pairs were included in the study with an almost equal number of male and female children. Just over half (51%) of the children were aged 6-11 months and the majority (90%) attended the clinic with their mothers. Most participants had access to electricity (98%), water (99%) and flushing toilets (99%) on their properties. A description of the study sample is provided in Table 1.

Table 1: Description of the study sample

Variable	**n (%)/Mean±SD/Median (IQR)**
Child variables	
Sex of child	
Male	81 (48)
Female	87 (52)
Age groups of children (months)	11 (9.0-16.0)
6-11	86 (51)
12-17	45 (27)
18-23	37 (22)
Caregiver accompanying child to clinic	
Mother	151 (90)
Father	7 (4)
Grandmother	5 (3)
Sister	2 (1)
Aunt	2 (1)
Nanny	1 (1)
Immunizations up to date	
Yes	164 (98)
No	3 (2)
Unknown	1 (1)
Deworming up to date	
Yes	72 (43)
No	7 (4)
NA (<12 months of age)	86 (51)
Unknown	3 (2)
Maternal variables	
Maternal Education (completed)	
None	1 (1)
Primary School	55 (33)
High school	75 (45)
Tertiary education	37 (22)
Maternal age at birth (years)	29 ±5.8
≤ 19	10 (6)
20-35	135 (80)
>35	23 (14)
Number of antenatal visits attended	6.0 ± 2.4
1-3	14 (8)
4-6	84 (50)
7-9	62 (37)
≥10	6 (4)
Unsure	3(2)
Household variables	
Electricity in household	
Yes	165 (98)
No	3 (2)
Drinking water source	
Piped into home	91 (54)
Piped into yard	76 (45)
Public source	1 (1)
Toilet facilities	
Flushing toilet in house	131 (78)
Flushing toilet outside house	35 (21)
Pit latrine outside	2 (1)
Primary means/fuel for cooking	
Electricity	162 (96)
Gas	3 (2)
Paraffin	3 (2)

Household assets in possession: Asset count	3.7 ±1.0
Cell phone	165 (98)
TV	161 (96)
Fridge	156 (93)
Washing machine	82 (49)
Car	56 (33)
House ownership	
Owns house	68 (40)
Renting	100 (60)
Crowding (people per room)	2.9 (1.7-3.0)
≤ 3	129 (77)
> 3	39 (23)

3.2 Growth status

The growth status of the study sample can be seen in Table 2. In this study the median weight was 9.5kg (8.5-11.0) and the median length was 72.6cm (69.2-76.8). When using the WHZ, only one child was wasted, but when considering MUAC, 22 (13%) children presented with wasting in this study. A small number of children (3%) were underweight. The WHZ and BAZ found approximately a quarter of the children were at risk of being overweight, a fifth of the children were overweight and 4% were obese. Stunting occurred in 11% of the children, of which 3% were severely stunted.

Table 2: Description of the anthropometric measures and growth status of the study sample (N=168)

Variable	**n (%)/Mean±SD/Median (IQR)**
Weight (kg)	9.5 (8.5-11.0)
6-11 months	9.7 (8.0-9.7)
12-17 months	9.8 (9.0-11.0)
18-23 months	10.8 (9.5-12.1)
Length (cm)	72.6 (69.2-76.8)
6-11 months	69.2 (67.5-71.1)
12-17 months	74.1 (73.1-76.1)
18-23 months	80.3 (76.8-82.3)
Mid-upper-arm-circumference (cm)	14 (13.2-14.9)
<11.5 (Severe acute malnutrition (SAM))	10 (6)
≥11.5-12.5 (Moderate acute malnutrition (MAM))	12 (7)
≥12.5 (Normal)	146 (87)
Weight-for-age (z-score)	0.3 ± 1.3
<-3 (Severely underweight)	1 (1)
≥-3 to <-2 (Underweight)	4 (2)
≥-2 to ≤ +1	113 (68)
>+1 to <+3	50 (30)
Length-for-age (z-score)	-0.5 ±1.3
<-3 (Severely stunted)	5 (3)
≥-3 to <-2 (Stunted)	14 (8)
≥-2 to ≤+3	148 (88)
>+3	1 (1)
Weight-for-Length (z-score)	0.8 (-1.4-1.7)
<-3 (Severely wasted)	0 (0)
≥-3 to <-2 (Wasted/MAM)	1 (1)
≥-2 to ≤ +1	96 (57)
≥ +1 to ≤+2 (Possible risk of overweight)	38 (23)
>+2 to ≤+3 (Overweight)	28 (17)
>+3 (Obese)	5 (3)
BMI-for-age (z-score)	0.9 ±1.2
<-3 (Severely wasted/SAM)	0 (0)

≥-3 to <-2 (Wasted/MAM)	0 (0)
≥-2 to +1	93 (55)
≥ +1 to ≤+2 (Possible risk of overweight)	45 (27)
>+2 to ≤+3 (Overweight)	24 (14)
>+3 (Obese)	6 (4)

3.3 Feeding practices

Table 3 describes the feeding practices and summarises the WHO IYCF indicators for this sample. Mothers are mostly responsible for deciding what the child eats (89%) and for feeding (85%) the child. Grandmothers (49%) were reported as the primary person providing feeding advice. Health facilities (51%) were the primary source of advice related to feeding, followed by the internet (19%).

The mean age for the introduction of fluids and solids was 6 months. The majority of children received water (84%) as their first additional fluid, and nearly 87% of children received a starch-based infant cereal or porridge as their first solid food. The 24-hour recall revealed that half of the children (50%) received salty snacks, 43% had fruit/other juice and 40% had baked goods such as cake and biscuits to eat. On average, children consumed these snacks on more than two days over a seven-day period.

The majority of infants aged 6-8 months (98%) received solid, semi-solid or soft foods the previous day. Forty-three percent of children aged 12-15 months still received breastmilk at one year of age; with 39% still receiving breastmilk between 12-23 months. However, no children in this sample were still breastfed at age two.

Table 3: Description of the feeding practices of the study participants (N=168)

Variable	**n (%)/Mean±SD/Median (IQR)**
Feeding variables	
Who is responsible for deciding what the child eats?	
Mother	150 (89)
Grandmother	15 (9)
Other family members	3 (2)
Who is responsible for feeding the child?	
Mother	142 (85)
Grandmother	11 (7)
Other family members	10 (6)
Nanny	4 (2)
Creche	1 (1)
Who do you turn to for advice regarding feeding your child?	
Grandmother	82 (49)
Health care workers	36 (21)
Other family members	22 (13)
No one	14 (18)
Friends	12 (7)
Other	2 (1)
Where do you get additional information regarding feeding your child?	
Health facility	85 (51)
Internet search	31 (19)
No Where	29 (17)
Road to health booklet	13 (8)
Media	10 (6)
Did you receive information regarding how to feed your child during antenatal visits?	
Yes	130 (77)
No	35 (21)

Unsure	3 (2)
Did you receive information regarding how to feed your child during postnatal visits?	
Yes	130 (78)
No	36 (21)
Unsure	2 (1)
Did you receive information on how to feed your child at your latest clinic visit?	
Yes	103 (61)
No	63 (38)
Unsure	2 (1)
Age first fluids (not BF or FF) were given (months) (n=167)	6 (3-6)
What was the first fluids given? *	
Water	156 (84)
Juice	19 (4)
Tea	9 (2)
Other	2 (1)
*Some children received more than one fluid	
Age first solid food was introduced (months)	6 (5-6)
What was the first solid food you gave your child?	
Commercial infant cereal	74 (46)
Soft maize porridge	59 (35)
Mabele porridge	13 (8)
Purity (fruit & veg)	7 (4)
Mashed potatoes	7 (4)
Orange vegetables	4 (2)
Eggs	1 (1)
Not yet started solids	2 (1)
Frequency of unhealthy foods: How many children ate this food item in the last 24 hours?	
Salty snacks e.g., crisps	84 (50)
Fruit juice/other juice	73 (43)
Baked goods e.g., pastries, vetkoek	68 (40)
Processed meat e.g., polony, viennas	33 (20)
Sugary snacks e.g., sweets	28 (17)
Frequency of unhealthy foods: How many days in the last 7 days were these food items eaten?	
Salty snacks e.g., crisps	2.54
Fruit juice/other juice	2.4
Baked goods e.g., pastries, vetkoek	2.05
Processed meat e.g., polony, viennas	1.07
Sugary snacks e.g., sweets	1.01
Was the child ever breastfed?	
Yes	140 (83)
No	28 (17)
Continued breastfeeding at one year	
Children aged 12-15 months (n=37)	16 (43)
Children aged 12-23 months (n=71)	28 (39)
Introduction of solid, semi-solid or soft foods	
Children 6-8 months (n=33)	31 (94)
IDDS-7 (n=166*)	3.8 ±1.9
1	24 (14)
2	20 (12)
3	27 (16)
4	35 (21)
5	23 (14)
6	27 (16)
7	10 (6)

*Two children in the sample did not yet start complementary feeding	
IDDS-8 (n=166*) 1 2 3 4 5 6 7 8 *Two children in the sample did not yet start complementary feeding	4.2 ±1.8 12 (7) 22 (13) 25 (15) 34 (20) 37 (16) 28 (17) 15 (9) 4 (2)

Children in this study sample had a mean IDDS-7 of 3.8 ±1.9 and an IDDS-8 of 4.2 ±1.8. The WHO IYCF indicator results are presented in Figure 1. Nearly two thirds (60%) of the children meeting the MMF criteria were non-breastfed children receiving formula milk, 36% were breastfed and 4% no longer received any type of milk. The MDD-7 had more children in the sample meeting the criteria (56%) than MDD-8 (45%). The same is true for MAD-7 (54%) and MAD-8 (42%).

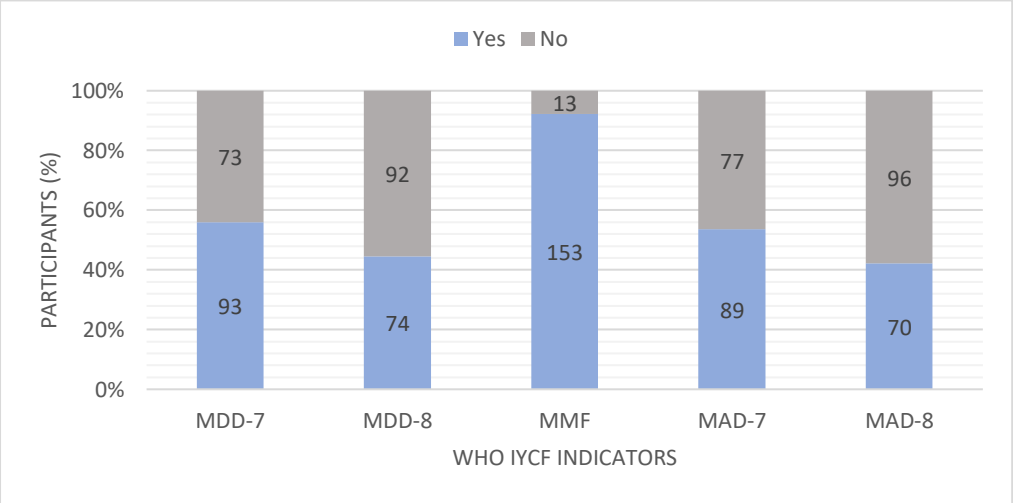

Figure 1: The WHO IYCF indicators of the study sample (n=166)

3.4 Feeding variables and WHO IYCF indicators associated with child growth

Table 4 depicts the associations between feeding variables, WHO feeding indicators and the growth outcomes of the children. None of the WHO IYCF indicators were significantly associated with the growth outcomes of children in this sample.

In this study, the age at which the first solid food was introduced, was significantly associated with being underweight (z=-2.64, p=0.008). An odds ratio of 0.49 [0.28-0.85] indicates that a child is more likely to be underweight if introduction to solids is delayed, rather than introduced early. Where feeding advice was received from (χ^2_4=9.90, p=0.042), if the child was currently being breastfed (χ^2_1=4.00, p=0.045) and if the child was currently receiving formula milk (χ^2_1=6.79, p=0.009), were significantly associated with being overweight. Children who were formula fed were three times more likely to be overweight than children who were breastfed

(OR 3.35, [1.30-8.63]. Breastfeeding decreased a child's likelihood of becoming overweight by 55% (OR 0.44, [0.20-0.99]).

The person responsible for deciding what the child eats was significantly associated with stunting (χ^2_1=9.75, p=0.002). A child was five times more likely to be stunted if the person responsible for what they eat, was not their mother (OR 5.27, [1.70-16.36]. Whether the child was still breastfeeding at age one (χ^2_1=4.41, p=0.036) was significantly associated with wasting. Due to the small sample size for this association, further meaningful analysis was not possible.

Table 4: Associations between feeding practices, WHO feeding indicators and growth outcomes

	Underweight (n=5)	**Overweight (n=33)**	**Stunted (n=19)**	**Wasted (n=22)**
WHO IYCF indicators				
MDD-7	χ^2_1=0.03	χ^2_1=0.17	χ^2_1=0.03	χ^2_1=0.37
MDD-8	χ^2_1=0.04	χ^2_1=0.00	χ^2_1=1.47	χ^2_1=1.67
MFF	χ^2_1=0.47	χ^2_1=1.62	χ^2_1=1.56	χ^2_1=0.02
MAD-7	χ^2_1=0.08	χ^2_1=0.01	χ^2_1=0.16	χ^2_1=0.13
MAD-8	χ^2_1=0.01	χ^2_1=0.07	χ^2_1=0.99	χ^2_1=1.11
Feeding practices				
Who is responsible for feeding the child? Mother Other family Other	χ^2_2=3.64	χ^2_2=0.02	χ^2_2=4.21	χ^2_2=0.26
Who decides what the child eats? Mother Other family	χ^2_1=0.47	χ^2_1=2.14	χ^2_1=9.75**	χ^2_1=0.23
Who do you ask for advice regarding feeding? Grandmother Other family Friends Health care workers No one Other	χ^2_5 =3.79	χ^2_5=2.30	χ^2_5=7.75	χ^2_5=5.53
Where else do you get feeding advice? No where Health facility Media Internet search RTHB	χ^2_4 =2.14	χ^2_4 =9.9*	χ^2_4 =3.86	χ^2_4 =2.33
Did you get information regarding feeding antenatally? Yes No	χ^2_1=0.89	χ^2_1=0.02	χ^2_1=0.17	χ^2_1=0.00
Did you get information regarding feeding postnatally? Yes No	χ^2_1=0.02	χ^2_1=0.60	χ^2_1=0.03	χ^2_1=0.00

Did you get information regarding feeding at your latest clinic visit? Yes No	χ^2_1=0.99	χ^2_1=1.55	χ^2_1=2.81	χ^2_1=0.05
Did the child ever breastfeed? Yes No	χ^2_1=1.03	χ^2_1=2.95	χ^2_1=0.01	χ^2_1=1.05
Is the child breastfeeding now? Yes No	χ^2_1=1.27	χ^2_1=4.00*	χ^2_1=1.52	χ^2_1=0.01
Are you receiving formula milk now? Yes No	χ^2_1=0.63	χ^2_1=6.79**	χ^2_1=2.28	χ^2_1=1.86
At what age did you start fluids other than breast or formula milk?	*z* =-0.74	*z* =-0.68	*z* =-0.96	*z* =-0.82
What was the first fluids given? Water Other	χ^2_1=2.16	χ^2_1=0.07	χ^2_1=0.00	χ^2_1=0.12
At what age were the first solids given?	*z* =-2.64*	*z* =1.09	*z* =-0.10	*z* =-0.08
What was the first solid given? Porridges & cereals Commercial fruit & veg Fruit & veg Eggs	χ^2_3 =0.67	χ^2_3=7.33	χ^2_3=1.70	χ^2_3=1.52
Still breastfeeding at one year Yes No	χ^2_1=1.61	χ^2_1=1.38	χ^2_1=1.35	χ^2_1=4.41*
Is the child currently receiving solid food (6-8months)? Yes No	χ^2_1=0.07	χ^2_1=0.38	χ^2_1=0.29	χ^2_1=0.47

† Pearson's chi-square test (χ^2) was used to test associations between categorical variables; Wilcoxon Ranksum test (*z)* was used to test associations between non-parametric continuous variables and the categorical outcome.
*P<0.05; **P<0.01; ***P<0.001

4. DISCUSSION

This study found more children aged 6-23 months to be overweight/obese, and less stunted children when compared to other surveys and previous studies conducted in South Africa among a similar age group. We found more girls than boys to be stunted and overweight in this sample (not significantly different), similar to the South African National Health and Nutrition Examination Survey (SANHANES) findings,[22] but contrary to the SADHS findings.[12] Children found to be wasted was greater when using MUAC, rather than WHZ. Most children met the MMF, more than half met the MDD-7 criteria, and just below half met the MDD-8 criteria, with similar results for MAD-7 and MAD-8. None of the WHO indicators were associated with

any of the growth outcomes in this sample. However, other feeding characteristics were significantly associated with the specified growth outcomes in this sample.

This study found 11% of the sample to be stunted. This is much lower than a Western Cape (WC) study, which found more than double the rates of stunting (29%)[23], and the SADHS, which reported 37% stunted children in the same age group.[12] The WC study does not divulge information regarding the socioeconomic status of its sample, but states that the study was conducted in a vulnerable community.[23] Causes of stunting are multi-factorial and the reason this study found less stunting could be due to factors such as the urban setting, well-equipped households, mothers being very involved in the feeding process of their children, the timeliness of the introduction of solid food, good rates of immunisation and deworming as well as relatively high rates of maternal education, all factors known to positively influence linear growth.[24,25]

This study identified 22 children (13%) as wasted when using MUAC and only one child (1%) when using the WHZ. The SADHS only made use of the WHZ when measuring wasting, and found a prevalence of 3% wasting in children under the age of five.[12] A recent Mozambican study by Zaba et al, seeked to determine if WHZ and MUAC agreed when identifying wasting, how they correlate with one another and possible reasons for any discrepancies between measures. They utilised nationwide survey data and found that MUAC diagnosed more children as wasted than WHZ in all provinces. When exploring possibilities for this discrepancy, they found the following: children under the age of 24 months were significantly more likely to be identified as wasted using MUAC rather than WHZ, along with females and children who are stunted.[26] When considering these three factors and the data from this study, it can be noted that this study sample only included children aged 6-23 months; the majority of wasted children identified by MUAC were female (55%); and nearly a third of the children identified as stunted were also identified as wasted when using MUAC.

The use of WHZ and MUAC to identify moderate and severe malnutrition in children, has been widely studied to determine their sensitivity and specificity. Mixed results have been produced with some studies finding a discrepancy in their outcomes, whilst others report similar results. Most studies agree that, in order to avoid missing any children with malnutrition, ideally, both should be used rather than as stand-alone measures.[26-28]

The high proportion of overweight children (17%) in this study is the same (17%) as that found in the SADHS when considering children aged 6-23 months of age.[12] Based on projections of overweight along the age continuum, without intervention, this sample of children are likely to remain overweight over time.[29] This study's WHZ, indicated that a further 23% of the sample were at risk of being overweight, and increased to 27% if the BAZ was used as a marker. The prevalence of overweight and obesity amongst children in South Africa is one of the highest in Africa, only surpassed by a few North African countries.[30] Current predictions state that these numbers will continue to increase if effective interventions are not implemented.[31]

This study, similar to most other studies conducted in South Africa, found children's first solid food to be starch/cereal-based, most commonly commercial infant cereal and soft maize porridge.[24,32-36] Contrary to other studies in South Africa, we found an appropriate mean age of 6 months for the introduction to other fluids and solids.[24,33-37] This may be due to a genuine improvement in this practice, but more likely due to social desirability bias.

The frequent consumption of unhealthy foods, such as salty snacks and juices, in this study is generally common practice amongst children aged 6-23 months in South Africa.[24] Budree et al, found the unhealthy snacks most consumed on a daily basis by children 6-23months,

included fruit juice at 6 months and processed meat, soft drinks and refined sugary foods at one year of age, consumed by over half their sample of children.[32] Rossouw et al observed that all children in their study had consumed snacks and drinks containing sugar and salt by one year.[38] The intake of these unhealthy foods is concerning for both under- and overnutrition. Excessive calorie intake may contribute to overweight and obesity and these foods may displace the intake of healthier foods, which can result in undernutrition and micronutrient deficiencies.[37]

The MMF of this study sample was 91%. A study by du Plessis et al, is the only other study to have calculated the IYCF indicators in South Africa and found a MMF of 71%.[23,24] The SADHS calculated the MAD using the MMF, but did not report on it.[12] Globally, the MMF prevalence varies; from a low 38% in Pakistan to 73% in Ethiopia.[39,40] This may be due to pre-established factors that influence CF, such as mothers' education, family size, household wealth and children's health status.[6,39-42] The high MMF prevalence in this study may indicate a more affluent community, as seen by the high mean asset score of 3.7 out of 5, as well as most children being up to date with their immunisation and deworming (98% and 91% respectively), an indication of general child health and frequent access to information via the health care system.

This study had a mean MDD-7 of 3.8 and a mean MDD-8 of 4.2, which are below the recommended groups of 4 and 5 respectively.[11] We found the proportion of children meeting the MDD-7 was much higher than the MDD-8. The MDD indicator has recently been updated by the WHO and UNICEF and is important to understand as it influences its interpretation.[17,43] A recent study by Heidkamp et al, calculated the MDD-8 using DHS data from 14 countries in Eastern and Southern Africa and compared the results to their MDD-7 results. All countries scored lower than before.[43] The main reason for the difference in these indicators is the variability of breastfeeding rates. In theory, the MDD should increase as the child's age increases, but it does not, because of the cessation of breastmilk with increasing age. Heidkamp et al, found South Africa to have the highest mean number of food groups, namely 3.5 for MDD-7 and 4.0 for MDD-8, but with the biggest difference between the two indicators (9%).[43] This is indicative of the low rates of breastfeeding in South Africa, especially during the second year of life.

The percentage of children meeting the MAD-7 (54%) in this study was more than double that found in the SADHS (23%) and higher than the findings of a study conducted in the WC (44%).[23] Compared to the MAD-7 rates of other countries like Pakistan (12%), Nepal (16%) and Uganda (12%), South Africa is doing relatively well; but only having just over half of our children meeting MAD-7 is still unacceptable.[39,40,42,44] The biggest reason for a low MAD seems to be the lack of dietary diversity rather than frequency and is a common occurrence in this age group across the globe.[45]

This study found none of the WHO IYCF indicators to be associated with growth outcomes among this sample of children. Due to the small study sample, the power may have been too low to determine associations between the WHO IYCF indicators and the children's growth status. However, due to the complex nature of complementary feeding, even larger multi-country studies have found inconsistencies in the associations between these variables.[45] The MMF indicator, was created to represent total energy intake. In theory, the greater energy intake, the greater the nutrient intake. However, for nutrient intake to be adequate, it is dependent on the nutrient density and the portion of the food given to a child. Thus, MMF may be over- or underestimated as an indicator and contribute to a lack of association with child

growth.[45] MDD is useful in determining the quality of a diet in terms of the density of micronutrients consumed (i.e., with increasing diversity you should find an increase in micronutrient intake). However, it was found that at the previously acceptable cut-off of 4 food groups, MDD had a low specificity for measuring micronutrient density (it would easily misclassify adequate diets as inadequate). Due to this, the indicator may not necessarily be helpful to determine causal pathways between diversity and child growth, and likewise affect the MAD indicator.[45]

Stunting among children in this sample was significantly associated with whom feeding advice was received from. Most caregivers received advice from the child's grandmother, a common finding across cultures. Several studies have found that the better the CF knowledge of the grandmother, the better the CF knowledge of the mother, resulting in better CF practices.[46,47] Interventions to combat stunting may benefit by including grandmothers in the intervention.[45,48-51]

Wasting was found to be significantly associated with the duration of breastfeeding (still breastfeeding at one year) in this study. Other studies conducted in various countries, did not find an association between wasting and any of the IYCF indicators, including BF.[32,50,51] Underweight in this study was significantly associated with the age at which the first solid food was introduced. This is consistent with a study by Marriot et al,[52] which found proper timing of the introduction of solids to reduce the likelihood of children being underweight. Another study found that children who did not receive a MDD, had higher odds of becoming underweight.[53]

Overweight and obesity was significantly associated with where the primary caregiver received feeding advice from. The primary source of feeding information was health facilities, indicating a need for these facilities to be equipped to provide feeding advice to mothers. Overweight was also found to be associated with whether the child was currently being breastfed or not. This is consistent with a study conducted in Bhutan, where they found overweight and obesity to be less in children who are currently breastfed.[54] This is concerning for SA, as breastfeeding rates decrease with increasing age, and with an already high overweight and obesity prevalence of children in SA, low BF rates only exacerbate the situation.

4.1 Strengths and limitations

This study is one of the few in South Africa to look at how complementary and other feeding practices may affect the growth status of children aged 6-23 months. It highlights some of the most common feeding practices of caregivers in Soweto and emphasises the rising problem of childhood overweight and obesity. The cross-sectional study design and small study sample limit the generalisability of these findings. Information related to feeding practices were subject to recall bias as it relied solely on caregiver report, with no means of verification. The IYCF indicators relied on participant recall, and they may have answered according to what they believed was the expected answer, known as social desirability bias.

5. CONCLUSION

There is a need for future research on this topic with larger, longitudinal studies, with multiple sites (including urban and rural) and collection of in-depth data of dietary intakes over several

days. Additional data regarding CF knowledge and food security would be valuable data to collect.

This study highlighted the lack of diversity in the diets of the children in the study sample, aged 6-23 months children and mirrored the rest of South Africa with their low breastfeeding rates and early cessation of breastfeeding. The high prevalence of overweight children in this study is particularly concerning, and highlights the need for targeted public health interventions. The intake of unhealthy foods needs to be closely monitored and assessed in future studies for associations with growth outcomes.

Although the IYCF indicators were not significantly associated with growth outcomes in this study, they remain valuable as a broad evaluation of a child's diet and to establish trends within a community.

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