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Research Article

Nutrient intakes of 1-3-year-old children attending crèches in Ibadan, Nigeria

Toluwalope E. Eyinla[1,*], Rukayat Lawal[1], Tobiloba Farinde[1], Karimot O. Hammed[1]

[1] Department of Human Nutrition and Dietetics, College of Medicine, University of Ibadan, Nigeria

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***Corresponding Author**
Eyinla T.E.
toluemma@ymail.com
ORCID: 0000-0003-1442-4392

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Highlights/Key Messages

- Home and crèche environment both shape toddlers' feeding patterns
- Toddlers consume enough energy and macronutrients but lacked key micronutrients
- Low dietary diversity among the toddlers led to low micronutrient intakes
- Nutrient intake and diet quality are influenced by socioeconomic factors
- Caregiver training and policies can improve child nutrition

Background
Poor nutrition during early childhood adversely affects growth, development, and long-term health. Nigerian toddlers experience high malnutrition rates due to sub-optimal feeding and low intake of nutrient-dense foods. Crèche environments shape toddlers' dietary intake, as many of them consume a significant portion of their daily meals there.

Objective
Thus, this study assessed nutrient intakes of toddlers attending selected crèches in Ibadan.

Methods
The methodology employed a cross-sectional design involving 345 children (12–36 months old) attending selected crèches and their mothers/caregivers, recruited through multistage probability sampling. Socio-demographic characteristics, feeding frequency, and dietary intake were collected using semi-structured questionnaire. Mothers completed the home-based section while trained interviewers administered questionnaires at the crèche. Dietary intake was assessed using an adapted 24-hour recall with foods at crèche directly weighed and mothers estimating home intake using common household measures.

Results
57.4% of the children were aged 24–36 months, and 52.6% were female. 90.1% consumed 3–5 meals and snacks daily, with 89% eating ⩽2 meals at crèche. Grains/cereals (99.7%) and fruits/vegetables (91.9%) were the most-consumed food groups, whereas dairy (59.5%) and pulses/nuts (44.5%) were the least-consumed. Median intakes of macronutrients exceeded the Estimated Average Requirement (EAR), while most micronutrient and fibre intakes were below EAR. Nutrient intake was associated with the child's gender, birth order, maternal education, and socioeconomic status ($p \leqslant 0.05$). 64.9% met Minimum Dietary Diversity, which was associated with higher intakes of vitamin B12, vitamin C, and zinc ($p \leqslant 0.05$).

Conclusion
In conclusion, the children had adequate macronutrient intakes but inadequate micronutrient intakes and many had low dietary diversity. As most meals were brought from home, it was the main influence on dietary patterns. Targeted interventions, including caregiver training and supportive policies are needed to improve early childhood nutrition and prevent long-term malnutrition.

Keywords: Nigeria. nutrient intake, children 1-3 years, adequacy

Introduction

Childhood undernutrition remains a major global public health challenge and continues to be a leading cause of child mortality in developing nations, including Nigeria (Akombi et al., 2017; Mutisya et al., 2021). Globally, an estimated 150.2 million children under five years were stunted, 42.8 million were wasted, and 35.5 million were overweight in 2024 (UNICEF/WHO/World Bank, 2025). Despite declining global childhood malnutrition, its prevalence in Africa continues to increase. In Nigeria, the 2024 National Demographic and Health Survey reported an increasing prevalence of stunting, underweight, and wasting of 40%, 27%, and 8%, respectively (FMoHSW et al., 2024).

Globally, nearly one in three children suffers from at least one form of malnutrition, including undernutrition, overweight/obesity, or micronutrient deficiencies (UNICEF/WHO/World Bank, 2025), with poor diet quality in early childhood being a key driver of non-communicable diseases late in life (Popkin et al., 2020). Most complementary foods in Nigeria are cereal-based gruels made from maize, sorghum, or millet, which are often low in essential macro- and micronutrients (Tzioumis & Adair, 2014). High rates of malnutrition among Nigerian children have also been linked to poor feeding practices such as meal skipping, unhealthy snacking, and low consumption of fruits, vegetables, milk, and dairy products (Sanusi et al., 2021). Inadequate nutrient intake in early life has profound effects on children's growth, development, and long-term health (Ochola & Masibo, 2014).

Adequate nutrition is critical to child health and development. It is well established that the first two years of life are a critical phase in children's growth, development, and even future health (Blake-Lamb et al., 2016). The years from birth through crèches and preschool involve more changes in growth, development, eating patterns, and nutrition than any other time of life. Childhood eating habits usually persist into adulthood (Leech et al., 2014); therefore, establishing healthy dietary patterns in early childhood is crucial to supporting immediate needs for growth and development and in promoting lifelong health (Birch et al., 2014). A recent study of children attending Early Child Care Centres in Benin City found that 14.5 % were stunted, 12.5 % underweight, and 12.3 % wasted, with key determinants including child age and breastfeeding (Obarisiagbon et al., 2024). Similarly, research among preschool children aged 2–4 years in Abia State showed that 20.7% of children were stunted, 26.6% wasted, and 16.4% underweight, and that eating behaviours significantly predicted anthropometric status (Okorie et al., 2024).

Children's nutrition depends not only on food availability but also on quality health services and appropriate caregiving practices (UNICEF, 2021). Caregiver choices significantly shape children's food environments, influencing their dietary preferences and risk of undernutrition or obesity (Birch et al., 2014). For many children aged 1–3 years, crèche environments play a critical role in shaping their dietary intake, as many consume a substantial proportion of their daily home-packed meals there. Despite persistent efforts, child malnutrition in Nigeria remains high, with minimal improvement over time (Sanusi et al., 2021).

The study focused on children aged I to 3 years because they represent the age group most commonly enrolled in crèches and therefore most exposed to institutional childcare feeding environments. Children under 1 year of age were excluded, as they rely more on breastfeeding and are not fully integrated into crèche feeding routines. Also, children above 3 years were excluded to avoid developmental and dietary heterogeneity, as preschool-aged children have greater feeding independence and different nutritional requirements. Focusing on toddlers ensures a relatively homogeneous group and allows clearer evaluation of dietary intake within the crèche setting.

Also, while previous studies in Ibadan have examined the dietary and nutrient intake of children aged 4–13 years, limited data exist on those aged 1–3 years, particularly regarding how crèche-based care influences their nutritional status. This study, therefore, aimed to fill this knowledge gap by assessing the nutrient intakes of children aged 1–3 years and identifying nutrient inadequacies across multiple food groups. It also explored associations between maternal socio-demographic factors and children's nutritional outcomes.

Methods

Study Design and Participants

A cross-sectional study design was used. A total of 345 children aged 1-3 years were selected using a multistage sampling technique. Of the five urban local government areas in Ibadan, three (Ibadan North, Ibadan North East, and Ibadan North West), which were considered representative, were first selected. The second stage involved the random selection of crèches. Although there were no official records of the number of registered crèches in Ibadan, we knew they could mostly be found in the industrial areas of the three urban local governments of focus, and thus we targeted those areas. In total, 30 crèches/daycare centres were selected.

The third stage involved the inclusion of all eligible children aged 1 to 3 years attending the crèches. Age eligibility was confirmed by verifying age from crèche records and caregiver reports. All eligible children present during the data collection period were included in the study, while children younger than 12 months or older than 36 months were excluded. Sick/ill children and children whose parents did not give consent were excluded from the study.

A crèche (also called a daycare centre) is a facility or nursery that provides daytime care, supervision, and early learning activities for babies, toddlers, and young children (typically 6 months to 5 years). The crèches serve busy working parents by offering safe, supervised environments for children. Thus, they are not necessarily located in relatively well-off areas of the city, but they are mostly in close proximity to where the parents work. The monthly prices at the selected centres ranged from ₦10,000 to ₦20,000 ($22.2 to $44.4) depending on the care services provided, and location. No subsidy system was reported in any of the crèches. Some crèches are standalone, and some are part of a school where primary education is also provided. Many parents drop off their children at these crèches by car.

Data Collection

Information on socio-demographic and socio-economic characteristics, feeding, and intakes was collected. All food,

beverage, and snack intakes and portions consumed were recorded using a 24-hr dietary recall questionnaire adapted to the study's objectives. It was segmented into 3 sections to capture the foods eaten in the morning before arriving at crèche, foods eaten at crèche, and foods eaten after crèche. A food measurement guide was used to help mothers and caregivers obtain detailed information on the types of food eaten and the quantities, using common household measures.

For the home component of the data collection, the children were given a prepared sheet to take home the previous day. Mothers were given guidance on how to fill the food log sheet at home (before and after crèche).

At the crèches, a semi-structured interview questionnaire was used to collect information from the crèche personnel attached to each child through face-to-face interviews. All interviewers were trained on study procedures and interviewing techniques using a standard protocol.

The foods consumed by children in the crèche were directly weighed by the caregiver, with assistance from interviewers. The crèche personnel were also instructed and monitored to review the records of the foods, beverages, and snacks each child consumed before coming to the crèche and after leaving.

The anthropometric status of the children was assessed using mid-upper arm circumference (MUAC). This was done using a UNICEF child MUAC tape made of tear- and stretch-resistant polypropylene, printed with colour codes. The child's left upper arm was measured by first bending the arm at a right angle (90°) at the elbow to locate the midpoint between the shoulder tip and the elbow tip. After marking the midpoint, the arm was allowed to hang relaxed alongside the body. The MUAC tape was then wrapped snugly around the arm at the marked midpoint, ensuring it was neither too tight nor too loose. The measurement was read to the nearest millimetre at the window or zero mark of the tape, ensuring the tape was flat and not twisted (UNICEF, 2022). The colours were then assessed to determine toddlers' nutritional status.

- Red (<11.5cm) indicates severe acute malnutrition
- Yellow (11.5cm – 12.5cm) indicates moderate acute malnutrition
- Green (>12.5cm) indicates normal nutritional status

Anthropometric data on the mothers and creche personnel were collected using digital scales calibrated to the nearest 0.1 kilograms and a stadiometer to measure height in centimetres. Maternal body mass index (BMI) was computed and categorised as follows:

- Underweight: <18.5 kg/m2
- Normal: 18.5 to 24.9 kg/m2
- Overweight: 25 to 29.9 kg/m2
- Obese: >30 kg/m2 (WHO, 2000)

Ethical Considerations

The study was conducted in accordance with the guidelines of the Declaration of Helsinki. All procedures involving human subjects were approved by the University of Ibadan/University College Hospital Ethical Committee (UI/UCH EC Registration Number: NHREC/05/01/2008a) - UI/EC/23/0338. Written informed consent was obtained from the parent/guardian. Permission was sought from the crèche management and caregiver responsible for each child participating in the study.

Data Analysis

The dietary intakes were converted to energy and nutrient values using an adapted version of ESHA's Food Processor Nutrition Analysis software version 11.7.1. (ESHA Research, Salem, OR, USA). The software was adapted to include values for the various local foods consumed by the children. Nutrient information for these local foods was obtained from the Nigerian Food Composition Table (Sanusi et al., 2021). The Estimated Average Requirement (EAR) for the nutrients and calories were obtained from the Institute of Medicine (IOM). Adequate intake was used for fibre. Since the diet of Nigerian children is predominantly plant-based, the substantially higher Recommended Nutrient Intakes of iron and zinc were used to account for low bioavailability (WHO & FAO, 2004; IZiNCG, 2004). Based on the EARs, nutrient intakes were categorised into three groups: inadequate, adequate, and excess. However, protein, iron and zinc were categorised as either inadequate or adequate as these nutrients were mostly from plant sources, which contain antinutrients that reduce their bioavailability. Also, none of the children consumed beyond the upper limits of these nutrients

The adequacy of nutrient intake among the respondents was indicated using the nutrient adequacy ratio (NAR), mean adequacy ratio (MAR) and median NAR. The NAR is the ratio of an individual's intake of a specific nutrient to the recommended intake for that nutrient. The median NAR is the middle value of NARs for a group or individual across multiple nutrients. It represents the average nutrient adequacy for a population without being affected by very high or very low values. The MAR quantifies the overall nutritional adequacy of a population based on an individual's diet using the current recommended allowance for a group of nutrients of interest (Hatløy et al., 1998). To estimate this, NAR is first capped at 1.0 to ensure that excess intake among some respondents does not compensate for low intake among others, and then the mean of the capped NAR is computed.

The minimum dietary diversity (MDD) was calculated using the revised WHO indicator for infant and young children (WHO & UNICEF, 2021). This indicator measures the proportion of 6-23-month-old children who consumed food and drinks from at least 5 of the 8 defined food groups the previous day. The 8 food groups include breast milk; grains, roots, tubers and plantains; pulses (beans, peas, lentils), nuts and seeds; dairy products (milk, infant formula, yoghurt, cheese); flesh foods (meat, fish, poultry, organ meats); eggs; vitamin A rich fruits and vegetables; and other fruits and vegetables. For children in our sample aged 12 to

23 months, this recommendation was directly adopted. Since none of the children in our sample was still breastfeeding, they had a score of 0 for breast milk consumption. For children aged 24 to 36 months, the MDD was defined as meeting 4 of the 7 remaining food groups.

Statistical Analysis

IBM Statistical Package for Social Sciences (IBM-SPSS) version 25.0 statistical software was used for data analysis. Two levels of analysis were conducted: univariate and bivariate. Univariate analyses were used to present the distribution of respondents by selected demographic characteristics, while bivariate analyses were used to assess the simultaneous associations between variables of interest and the study objectives. The descriptive statistics used included mean, standard deviation, median, quartiles, percentages, and frequencies. Pearson's chi-square was used as inferential statistics to test the association between variables. Null hypotheses were tested at the 0.05 significance level.

Results

Background Data

Socio-demographic Characteristics of Parents and Children

The socio-demographic characteristics of parents and children are summarised in Table 1. Almost all the parents (98.8%) were married and most (65.5%) belonged to the middle socio-economic class. The mean age of the children was 24.44 (7.06) months, and all of them attended crèche for ⩾5 days per week.

Table 1. Socio-demographic characteristics of parents and children

Socio-Demographic characteristics of the parents			
Characteristics of Parents	Frequency (%)	Characteristics of Parents	Frequency (%)
Mother's Age (Mean ± SD)	34.27 ± 4.39	**Ethnicity**	
⩽25 years	4 (1.2)	Yoruba	306 (91.6)
26 to 30 years	66 (19.1)	Igbo	19 (5.7)
31 to 40 years	239 (69.3)	Others	7 (2.1)
⩾ 41 years	36 (10.4)	Hausa	2 (0.6)
Mother's Highest Educational level		**Father's Highest Educational level**	
No formal education	4 (1.2)	No formal education	3 (0.9)
Primary education	24 (7.0)	Primary education	18 (5.2)
Secondary Education	86 (24.9)	Secondary Education	65 (18.8)
Tertiary education	231 (67.0)	Tertiary education	259 (75.1)
Mother's Occupation		**Father's Occupation**	
Civil servant	122 (35.4)	Civil servant	171 (49.6)
Artisan	55 (15.9)	Artisan	47 (13.6)
Business/Trading	161 (46.7)	Business/Trading	102 (29.6)
Self employed	3 (0.9)	Self employed	6 (1.7)
Unemployed	4 (1.2)	Clergyman	13 (3.8)
Socio-Economic class**		Farmer	6 (1.7)
Upper class	11 (3.2)	**Average Monthly Income (Naira)***	
Middle class	226 (65.5)	<₦50 000	139 (40.3)
Lower class	108 (31.1)	⩾₦50 000	206 (59.7)
Religion		**Household Size (Mean±SD)**	4.1±1.2
Christianity	248 (71.9)	3-4	267 (77.3)
Islam	97 (28.1)	5-6	70 (20.3)
		⩾7	8 (2.4)
Demographic characteristics of the children			
Characteristics of Children	Frequency (%)	Characteristics Children	Frequency (%)
Child's Age (Mean±SD)	24.44 ± 7.06	**Child's Gender**	
12 to 23 months	147 (42.6)	Male	163 (47.4)
24 to 36 months	198 (57.4)	Female	181 (52.6)
Child's Position		**Number of Siblings (Mean±SD)**	1.06 ± 0.91
First	139 (40.3)	None	88 (25.5)
Second and third	194 (56.2)	1 to 2	240 (69.6)
Fourth and above	12 (3.5)	⩾3	17 (4.9)

*₦50 000 was equivalent to $111 as at the time of data collection, 2023

**The socio-economic class was derived by scoring educational status and monthly income of the parents. The total score was divided by four or by two (in a single parent household). The resultant score range of 1 to 6 was then categorised into upper class (1 and 2), middle class (4 and 5) or lower class (5 and 6) (Ibadin & Akpede, 2021)

Feeding Frequency of the Children

The number of meals (including snacks) consumed per day by the children is shown in Table 2. The majority consumed 3 - 5 meals daily (90.1%), with 89.0% consuming two meals or less at the crèche and 49.9% consuming three to four meals at home. There was no significant difference in the total number of meals consumed daily, at crèche and at home between by the younger and older age group (p⩾0.05).

Table 2. Feeding frequency of the children

Feeding Frequency of Children					
		12 to 23 months n(%)	24 to 36 months n(%)	Total n(%)	p-values
Total of meals consumed daily	Mean ± SD	4.56 ± 0.76	4.49 ± 1.10	4.52 ± 0.97	0.146
	⩽ 2 meals	0 (0.0)	3 (1.5)	3 (0.9)	
	3-5 meals	137 (93.2)	174 (87.9)	311 (90.1)	
	⩾ 6 meals	10 (6.8)	21 (10.6)	31 (9.0)	
Number of meals consumed at home	Mean ± SD	2.56 ± 0.61	2.68 ± 0.92	2.63 ± 0.80	0.143
	⩽ 2 meals	73 (49.7)	91 (46.0)	164 (47.5)	
	3-4 meals	73 (49.7)	99 (50.0)	172 (49.9)	
	⩾ 5 meals	1 (0.7)	8 (4.0)	9 (2.6)	
Number of meals consumed at crèche	Mean ± SD	2.01 ± 0.52	1.81 ± 0.65	1.90 ± 0.61	0.185
	⩽ 2 meals	127 (86.4)	180 (90.9)	307 (89.0)	
	3-4 meals	20 (13.6)	18 (9.1)	38 (11.0)	
	⩾ 5 meals	0 (0.0)	0 (0.0)	0 (0.0)	

*p-values are significant at ⩽0.05
Chi-squared test was used to test for association between the number of meals consumed and the age of the children

Anthropometric Characteristics of Mother, Caregiver and Children

The anthropometric characteristics of mothers, caregivers and children are summarised in Table 3. Most mothers and caregivers were within the normal BMI range. Most of the rest in both cases were overweight, but few were obese. Among the children, the majority (84.9%) had normal MUAC, while 9.3% were severely malnourished.

Table 3. Anthropometric characteristics of mother, caregiver and children

Anthropometric Characteristics of Mother and Caregiver				
		Mother	Caregiver	
Body Mass Index	Underweight	3 (0.9)	0 (0.0)	
	Normal	240 (69.6)	206 (59.7)	
	Overweight	96 (27.8)	136 (39.4)	
	Obese	6 (1.7)	1 (0.3)	
Anthropometric Characteristics of Children				
Anthropometric indices	**Children's age**		**Total n(%)**	**p-value***
	12-23 months n(%)	**24–36 months n(%)**		
Mid Upper Arm circumference				0.114
Severe Acute Malnutrition (<11.5 cm)	18 (12.2)	14 (7.1)	32 (9.3)	
Moderate Acute Malnutrition (11.5 to 12.5 cm)	11 (7.5)	9 (4.5)	20 (5.8)	
Normal (>12.5 cm)	118 (80.3)	175 (88.4)	293 (84.9)	

Daily Dietary Intake of the Children

The children's daily dietary intake is summarised in Table 4. Most nutrient intakes were, on average, close to the EAR. Major exceptions were fibre with a median NAR of 0.31 and vitamins A, C, D, and E.

Table 4. Daily dietary intake of the children

Nutrients (N=340)	Median (IQR)	Q25	Q75	EAR[a]	<EAR n(%)	Median NAR[b]	MAR[c]
Energy (Kcals)	1290.95 (734.26)	985.76	1720.02	1200	147 (43.2)	1	0.89
Carbohydrate (g)	192.26 (125.56)	142.14	267.70	100	24 (7.1)	1	0.97
Fibre (g)	5.90 (6.44)	3.34	9.78	19[d]	324 (95.3)	0.31	0.37
Protein (g)	55.17 (32.75)	39.42	72.17	11	9 (2.6)	1	0.97
Vit A-RAE (ug)	160.55 (305.22)	88.18	393.40	210	196 (67.6)	0.76	0.68
Folate (ug)	204.77 (213.26)	113.74	327.00	120	91 (26.8)	1	0.85
Vit C (mg)	7.08 (23.46)	0.60	24.06	13	198 (58.2)	0.54	0.54
Vit D (ug)	3.80 (4.35)	2.20	6.55	10	307 (90.3)	0.38	0.45
Vit E (mg)	1.24 (1.19)	0.75	1.94	5	319 (93.8)	0.25	0.32
Calcium (mg)	446.41 (550.91)	232.92	783.83	500	190 (55.9)	0.89	0.71
Iron (mg)	12.25 (10.60)	8.15	18.75	5.4[e]	35 (10.3)	1	0.96
Zinc (mg)	5.76 (4.06)	3.81	7.87	2[e]	13 (3.8)	1	0.97

[a]Estimated average requirement (EAR) is defined as the amount of a nutrient estimated to meet the needs of half of the healthy individuals in a specific age, sex, and life-stage group.; [b]Nutrient Adequacy Ratio (NAR) is the ratio of an individual's intake of a specific nutrient to the recommended intake for that nutrient; [c] Mean Adequacy Ratio (MAR) quantifies the overall nutritional adequacy of a population based on individuals' diets using the current recommended allowance for a group of nutrients of interest (Hatløy et al., 1998); [d] The value represents the adequate intake levels for nutrients without EAR; e EARs are adjusted for bioavailability based on the consideration that the diet in Nigeria is majorly plant-based.

Dietary Diversity among Children by age group

The children's dietary diversity is summarised in Table 5. The older age group consumed more roots and tubers and less dairy products than the younger group.

Table 5. Differences in dietary diversity by age group

Food Groups	Children's age		Total n(%)	p-value*
	12-23 months n(%) (N=136)	24–36 months n(%) (N=192)	(N=328)	
Grains and Cereals	136 (100)	191 (99.5)	327 (99.7)	0.399
Roots, tubers and plantain	89 (65.4)	147 (76.6)	236 (72.0)	0.027*
Pulses, nut and seeds	62 (45.6)	84 (43.8)	146 (44.5)	0.741
Dairy Products	95 (69.9)	100 (52.1)	195 (59.5)	0.001*
Flesh Foods	84 (61.8)	115 (59.9)	199 (60.7)	0.733
Eggs	104 (76.5)	141 (73.4)	245 (74.7)	0.534
Vit A rich fruits and vegetables	85 (62.5)	114 (59.4)	199 (60.7)	0.568
Other fruits and vegetables	120 (88.2)	179 (93.2)	299 (91.2)	0.117
Dietary diversity (Mean ± SD)	5.04 ± 1.08	4.82 ± 1.14	4.91 ±1.12	
MDD Met	95 (69.9)	118 (61.5)	213 (64.9)	0.118
MDD Not met	41 (30.1)	74 (38.5)	115 (35.1)	

n= Number of children that consumed the food groups in the past 24 hours; MDD=Minimum dietary diversity; *p-values are significant at ⩽0.05; Chi-squared test was used to test for association between age of the children and consumption of foods from the various food groups

Association between Socio-demographic Characteristics, Nutrient Adequacy and Dietary Diversity among Children

The association between the socio-demographic characteristics and the number of children who consumed an adequate amount of the nutrients reported and met the Dietary Diversity is reported in Table 6. Child's birth order was found to be significantly associated with calorie intake (p=0.048), fibre (p=0.002), vitamin C (p=0.027), vitamin E (p=0.006), and calcium (p=0.017), while the child's gender was significantly associated with vitamin E intake (p=0.004). Maternal education level was significantly linked to calorie intake (p=0.006). Household socioeconomic status was also significantly associated with caloric intake (p=0.016) and intakes of vitamin A (p=0.004), vitamin D (p=0.013), and calcium (p=0.014). Similarly, meeting the minimum dietary diversity requirement was associated with higher vitamin C (p=0.036) and zinc (p=0.018) consumption.

Discussion

This study evaluated the nutrient intakes and dietary adequacy of children aged 1–3 years in Ibadan, Nigeria. In this setting, crèches did not provide meals; instead, children brought home-packed meals and were fed by caregivers during crèche hours. The findings showed suboptimal nutrient intakes, particularly of fibre, vitamins A, C, and D, and calcium, while protein and carbohydrate intakes were largely sufficient. These results agree with national nutrition surveillance reports indicating that micronutrient deficiencies remain common among young Nigerian children despite improvements in food availability (FGoN & IITA, 2024; UNICEF, 2024). The pattern of adequate energy intake alongside widespread micronutrient inadequacy illustrates a well-known phenomenon of energy-dense but micronutrient-poor diets among young children. In this study, energy intake was mainly derived from carbohydrate-rich staples such as cereals and grain-based meals. Although these foods significantly contribute to caloric intake, they are generally low in essential micronutrients with limited inclusion of animal-source foods, dairy products, fruits, and vegetables; a dietary pattern consistently reported across urban and rural Nigerian populations (Esan et al., 2022; Ogunniran et al., 2024).

The median energy intake observed in this study falls within the Estimated Energy Requirement (EAR) range and aligns with that reported in other urban-based studies in Southwest Nigeria. Energy intake was associated with household socioeconomic conditions, consistent with the report by Olatona et al. (2017) of inadequate caloric intake among toddlers in low- to middle-income families in Lagos State. The study also linked inadequate dietary intake to low dietary diversity and maternal time constraints. Similar findings in Kenya and Ghana (Mekonen et al., 2024; Asamoah et al., 2024) indicate that urbanisation does not necessarily guarantee improved dietary adequacy among young children, as economic inequalities and food costs continue to influence food choices.

Protein intakes in this study were largely within the Acceptable Macronutrient Distribution Range and higher than the EAR. This aligns with reports by Bakare et al. (2023) and Esan et al. (2022) suggesting that, although Nigerian diets are plant-based, they provide sufficient protein through legumes, cereals, and the complementary use of fish or eggs. However, the bioavailability of mainly plant-based protein sources may limit the effective utilisation of these nutrients, particularly in diets high in phytates. Similarly, carbohydrate intakes in this study were mostly within the Acceptable Macronutrient Distribution Range and above the EAR, likely reflecting the diet's heavy reliance on grains and cereals. Nevertheless, the low total fat contribution to energy intake observed among the children supports earlier findings by Sanusi et al. (2021) and Ogunniran et al. (2024), who attributed this to the limited use of oil-rich foods and low caregiver awareness of the role of dietary fats in early growth and brain development. Low dietary fat intake may further worsen micronutrient deficiencies by impairing the absorption of fat-soluble vitamins such as vitamins A and D (Gibson, 2005). This interaction may partly explain the coexistence of adequate energy intake with ongoing deficient vitamin intakes among the children studied. Encouraging the inclusion of appropriate fat sources could help achieve a balanced macronutrient profile and prevent energy deficiencies.

Table 6. Association between socio-demographic characteristics and number (%) of children who achieved Nutrient Adequacy and Dietary Diversity

	Energy (N=135)	CHO (N=37)	Fibre (N=24)	Protein (N=331)*	Vitamin A (N=35)	Folic acid (N=36)	Vitamin C (N=49)	Vitamin D (N=45)	Vitamin E (N=13)	Calcium (N=63)	Iron (N=323)	Sodium (N=80)	Zinc (N=328)	MDD (N=213)
Child's Sex (p-values*)	**0.571**	**0.838**	**0.290**	**0.403**	**0.386**	**0.983**	**0.831**	**0.729**	**0.004**	**0.807**	**0.618**	**0.978**	**0.835**	**0.104**
Male	60 (38.0)	19 (12.0)	15 (9.4)	157 (98.1)	16 (10.1)	17 (10.7)	24 (15.0)	19 (12.1)	12 (7.5)	29 (18.2)	151 (94.4)	38 (24.1)	154 (96.3)	93 (60.4)
Female	75 (41.9)	18 (10.0)	9 (5.0)	174 (96.7)	19 (10.6)	19 (10.6)	25 (14.0)	26 (14.4)	1 (0.6)	34 (19.2)	172 (95.6)	42 (23.7)	174 (96.7)	120 (69.0)
Child's Birth Position (p-values*)	**0.048**	**0.865**	**0.002**	**0.241**	**0.219**	**0.130**	**0.027**	**0.699**	**0.006**	**0.017**	**0.721**	**0.186**	**0.374**	**0.178**
First	46 (34.1)	13 (9.6)	11 (8.1)	130 (95.6)	15 (11.1)	13 (9.6)	14 (10.4)	19 (14.2)	3 (2.2)	22 (16.4)	129 (94.9)	30 (22.2)	129 (94.9)	82 (63.6)
Second and third	85 (44.7)	22 (11.6)	11 (5.8)	189 (98.4)	20 (10.5)	23 (12.0)	35 (18.3)	24 (12.6)	9 (4.7)	40 (21.1)	182 (94.8)	49 (26.1)	187 (97.4)	126 (67.4)
Fourth and above	4 (33.3)	2 (16.7)	2 (16.7)	12 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (16.7)	1 (8.3)	1 (8.3)	12 (100.0)	1 (8.3)	12 (100.0)	5 (41.7)
Mother's Age (p-values*)	**0.091**	**0.936**	**0.051**	**0.569**	**0.002**	**0.159**	**0.586**	**0.244**	**0.184**	**0.064**	**0.491**	**0.186**	**0.63**	**0.325**
<=25 years	1 (25.0)	0 (0.0)	2 (50.0)	4 (100.0)	1 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.0)	0 (0.0)	4 (100.0)	1 (25.0)	4 (100.0)	2 (50.0)
26 to 30 years	22 (33.3)	5 (7.7)	4 (6.1)	63 (95.5)	0 (0.0)	4 (6.2)	7 (10.6)	9 (13.8)	3 (4.5)	13 (20.0)	62 (93.9)	16 (24.6)	63 (95.5)	44 (69.8)
31 to 40 years	96 (41.4)	28 (12.0)	17 (7.3)	228 (97.4)	31 (13.4)	28 (12.0)	37 (15.9)	34 (14.6)	9 (3.9)	43 (18.5)	221 (94.4)	54 (23.5)	225 (96.2)	148 (65.8)
>= 41 years	16 (45.7)	4 (11.4)	1 (2.8)	36 (100.0)	3 (8.3)	4 (11.1)	5 (13.9)	2 (5.7)	0 (0.0)	7 (20.0)	36 (100.0)	9 (25.0)	36 (100.0)	19 (52.8)
Mother's Highest Education (p-values*)	**0.006**	**0.799**	**0.283**	**0.56**	**0.575**	**0.798**	**0.379**	**0.334**	**0.905**	**0.107**	**0.522**	**0.108**	**0.618**	**0.769**
No formal education	2 (50.0)	0 (0.0)	0 (0.0)	4 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.0)	4 (100.0)	1 (25.0)	4 (100.0)	3 (75.0)
Primary education	9 (39.1)	2 (8.7)	1 (4.3)	23 (100.0)	3 (13.0)	2 (8.7)	6 (26.1)	3 (13.6)	1 (4.3)	4 (18.2)	23 (100.0)	4 (17.4)	23 (100.0)	13 (56.5)
Secondary Education	44 (52.4)	12 (14.3)	3 (3.6)	83 (98.8)	7 (8.4)	9 (10.8)	13 (15.5)	7 (8.3)	4 (4.8)	21 (25.0)	78 (92.9)	18 (22.5)	82 (97.6)	52 (63.4)
Tertiary education	80 (35.4)	23 (10.1)	20 (8.8)	221 (96.5)	25 (11.0)	25 (10.9)	30 (13.2)	35 (15.4)	8 (3.5)	37 (16.4)	218 (95.2)	57 (25.0)	219 (95.6)	145 (66.2)
Household Size (p-values*)	**0.853**	**0.195**	**0.871**	**0.253**	**0.647**	**0.089**	**0.102**	**0.278**	**0.056**	**0.038**	**0.226**	**0.894**	**0.462**	**0.342**
3-4	100 (38.6)	29 (11.1)	17 (6.5)	253 (96.6)	28 (10.8)	33 (12.6)	34 (13.0)	30 (11.5)	6 (2.3)	49 (18.8)	246 (93.9)	63 (24.4)	251 (95.8)	168 (66.9)
5-6	32 (45.7)	6 (8.7)	6 (8.6)	70 (100.0)	7 (10.0)	3 (4.3)	15 (21.7)	14 (20.3)	6 (8.6)	14 (20.6)	69 (98.6)	16 (23.2)	69 (98.6)	41 (59.4)
⩾7	3 (37.5)	2 (25.0)	1 (12.5)	8 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (12.5)	1 (12.5)	0 (0.0)	8 (100.0)	1 (12.5)	8 (100.0)	4 (50.0)
Socio-Economic class (p-values*)	**0.016**	**0.221**	**0.194**	**0.088**	**0.004**	**0.387**	**0.157**	**0.013**	**0.750**	**0.014**	**0.302**	**0.113**	**0.152**	**0.398**
Upper class	3 (27.3)	0 (0.0)	2 (18.2)	11 (100.0)	1 (9.1)	0 (0.0)	1 (9.1)	5 (45.4)	1 (9.1)	0 (0.0)	11 (100.0)	2 (18.2)	11 (100.0)	6 (54.5)
Middle class	78 (35.5)	24 (10.8)	18 (8.1)	214 (96.0)	24 (10.9)	22 (9.9)	29 (13.1)	30 (13.5)	7 (3.1)	40 (18.2)	209 (93.7)	50 (22.7)	212 (95.1)	143 (67.5)
Lower class	54 (50.9)	13 (12.3)	4 (3.8)	106 (100.0)	10 (9.4)	14 (13.1)	19 (17.9)	10 (9.6)	5 (4.8)	23 (21.9)	103 (97.2)	28 (26.9)	105 (99.1)	64 (61.0)
MDD (p-values*)	**0.795**	**0.349**	**0.446**		**0.564**	**0.768**	**0.036**	**0.345**	**0.635**	**0.119**	**0.100**	**0.920**	**0.018**	
Not met	45 (39.5)	9 (7.9)	6 (5.2)	115 (100.0)	9 (8.0)	11 (9.6)	17 (15.0)	14 (12.3)	6 (5.2)	15 (13.3)	110 (95.7)	30 (26.1)	112 (97.4)	
Met	89 (42.2)	27 (12.7)	17 (8.0)	213 (100.0)	25 (11.7)	24 (11.3)	31 (14.6)	30 (14.2)	7 (3.3)	48 (22.7)	210 (98.6)	50 (24.0)	213 (100.0)	

N = Number of children who consumed an adequate amount of each nutrient reported and met the required criteria for the MDD.; *p-values are significant at ⩽0.05; The chi-squared test was used to assess associations between adequacy of nutrient intakes and the socio-demographic characteristics of parents and children.; CHO = carbohydrates; MDD = Minimum Dietary Diversity

Micronutrient intake deficiencies were most prominent for vitamins A, C, and D, as well as calcium, all of which fell significantly below the EAR. This could be due to the low intake of fruits, dairy products, and animal-source foods among the respondents. Similar deficiencies were reported in the 2024 National Food Consumption and Micronutrient Survey and in studies by Olufadewa et al. (2023) and Obasohan et al. (2024), in which limited consumption of micronutrient-rich foods was linked to inadequate micronutrient levels among young children. Families from higher socioeconomic groups are more likely to afford dairy products, fruits, eggs, and fortified foods, which directly affect calcium and vitamin intake. Conversely, lower-income households often prioritise satiety and affordability, leading to greater reliance on inexpensive, energy-dense staples with limited micronutrient content. Maternal education further influences these patterns by affecting nutrition knowledge, food choices, and engagement with crèche feeding routines, including decisions about the types and quality of foods packed from home and fed to children during crèche hours, thus perpetuating disparities in dietary quality despite sharing childcare environments.

Dietary diversity scores in this study showed that only 64.9% of children met the MDD requirement. Although this is higher than the figures reported in some northern Nigerian contexts (Obasohan et al., 2024), it still highlights a significant gap in achieving optimal dietary variety. Consistent with the current findings, Tekeba et al. (2024) in Ghana and Mekonen et al. (2024) in Ethiopia found that socio-economic status, maternal education, and household food security were associated with MDD and nutrient adequacy. The notable links between maternal education, socio-economic status, and nutrient adequacy found in this study reinforce the importance of empowering women through formal and nutritional education and boosting household income to substantially improve child feeding practices (Olufadewa et al., 2023).

The children's anthropometric indices offer further insight into the links with dietary deficiencies. Based on MUAC, 9.3% were severely malnourished and 5.8% moderately malnourished. This prevalence aligns with findings from Sanusi et al. (2021) and Esan et al. (2022), who reported similar rates of wasting and undernutrition among children in urban areas of Nigeria. The existence of micronutrient dietary shortfalls indicates the risk of “hidden hunger," a condition where children may appear to have normal anthropometric measures but are still lacking essential micronutrients (Obasohan et al., 2024). The high prevalence of overweight mothers and caregivers reflects the double burden of malnutrition within the same household and community, consistent with existing literature (Alamu et al., 2020; Adeomi, 2026).

Overall, findings from this study and comparable research in Nigeria and other sub-Saharan African countries indicate that urban residence and crèche attendance do not inherently protect children from micronutrient deficiencies. Crèche environments may play a crucial role in shaping dietary intake among children aged 1–3 years, as many eat a significant proportion of their daily meals while in care. The repeated consumption of home-packed cereal-based meals with few fruits, vegetables, dairy, or animal-source foods during crèche hours likely contributes to the pattern of sufficient energy intake but poor micronutrient dietary adequacy observed in this study.

The presence of apparently normal anthropometric indices alongside dietary deficiencies and a double burden of malnutrition highlights the need for nutrition-sensitive interventions that go beyond calorie sufficiency to enhance overall diet quality. Strengthening community-based nutrition education for mothers and caregivers, promoting affordable nutrient-dense complementary foods, and supporting policy initiatives that improve access to fortified foods are vital. Incorporating such evidence into early-childhood nutrition strategies could help close the persistent nutrient gaps seen in Nigeria’s urban settings.

Limitations of the Study

This study is limited by its cross-sectional design, which provides data on intake only at a single time point. Additionally, reliance on mother- or caregiver-reported dietary data for only a single day is a limitation. Furthermore, since data were collected from selected urban crèches in Ibadan, the results cannot be generalised to rural populations or other regions of Nigeria.

Conclusions

Despite the generally adequate intake of protein and carbohydrates, the results highlight significant gaps in energy, dietary fibre, vitamins A, C, D, and calcium. These deficiencies, combined with mild-to-severe malnutrition observed in some children, suggest an underlying qualitative dietary inadequacy rather than widespread overt food insecurity. The findings therefore emphasise the need to enhance child feeding practices and encourage a greater inclusion of nutrient-rich, diverse foods in Nigerian toddlers' diets. Additionally, the results underscore that nutrient adequacy in early childhood should not be assumed solely on the basis of anthropometric normalcy. While most children maintained normal MUAC values, their low intakes of energy and essential micronutrients indicate potential hidden deficiencies that could impair growth, cognitive development, and immune function.

Consequently, nutrition interventions in early childhood should go beyond calorie sufficiency, focusing also on nutrient balance and diversity. Further investigation into the dynamics of responsive feeding is also recommended. Based on these findings, policies and community programmes should prioritise diet diversification within early childcare feeding initiatives to combat hidden hunger. Nutrition education for parents and caregivers, especially regarding the importance of vitamins and minerals in child health, remains vital. Strengthening these practices within crèches can help reduce the silent burden of nutrient inadequacy and

support the realisation of optimal child nutritional outcomes across Nigeria and similar Sub-Saharan African contexts.

Author Contributions

TEE: Conceptualisation, Methodology, Supervision, Writing first draft, Review and editing.; ROL: Methodology, Writing first draft, Review and editing.; TF: Methodology, Writing first draft, Review and editing.; KOH: Methodology, Writing first draft, Review and editing. All authors have read and approved the final version of the paper and its submission and have given consent for publication.

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All relevant data are available within the manuscript

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Conflict of Interest

The authors declare that they have no potential conflicts of interest.

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Appendix

A sample of the adapted 24-hour Recall Questionnaire.

24-hour Recall Questionnaire
I will like you to tell me everything your child had to eat and drink after he/she woke up yesterday morning. Including everything he/she ate and drank at the crèche, even snacks or tea.

Date: ..... Day of week: .....

(B1) Foods Eaten in the Morning before Crèche

Item No	Food/drink Addition	Description of food or drink (TYPE, VOLUME, SIZE/PRICE)	Place Taken	Time	Quantity (how much he/she actually ate or drank)	Weight Equivalent (g)

(B2) Foods Eaten at Crèche

Item No	Food/drink Addition	Description of food or drink (TYPE, VOLUME, SIZE/PRICE)	Place Taken	Time	Quantity (how much he/she actually ate or drank)	Weight Equivalent (g)

(B3) Foods Eaten After Crèche

Item No	Food/drink Addition	Description of food or drink (TYPE, VOLUME, SIZE/PRICE)	Place Taken	Time	Quantity (how much he/she actually ate or drank)	Weight Equivalent (g)