

Nutritional Status, Dietary Patterns and Selected Biochemical Indicators among Children and Adolescents with Disabilities in Enugu Metropolis, Nigeria

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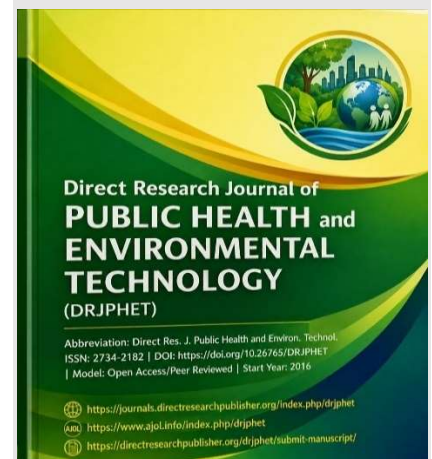
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ABSTRACT

Children and adolescents with disabilities may be particularly vulnerable to nutritional problems because of functional limitations, feeding difficulties, dependence on caregivers, and socioeconomic constraints. However, disability-specific evidence on nutritional status, dietary diversity, and biochemical indicators remains limited in Nigeria. This study assessed the nutritional status, dietary patterns, and selected biochemical indicators among children and adolescents with disabilities in Enugu Metropolis, Nigeria. A cross-sectional observational study was conducted among 529 children and adolescents aged 5–19 years with disabilities recruited through total enumeration from selected disability homes, centres, and schools in Enugu Metropolis. Data were collected using a structured questionnaire, food-frequency questionnaire, 24-hour dietary recall, anthropometric measurements, and biochemical assessments. Dietary diversity was assessed. Biochemical assessments were conducted on a 10% of the sample size, comprising 6 children and 47 adolescents, for fasting blood glucose (FBS), serum zinc, haemoglobin. Data were analysed using descriptive statistics and Pearson correlation at a significance level of $p < 0.05$. Of the 529 participants, 151 (28.5%) were children aged 5–9 years and 378 (71.5%) were adolescents aged 10–19 years; 48.2% were male and 51.8% were female. The respondents commonly consumed snacks and pastries, particularly biscuits (22.7%), buns/chin-chin (22.5%) and bread (21.6%); snacks were consumed mainly 1–3 times weekly (37.2%) or occasionally (33.3%). Meal skipping was attributed mainly to lack of appetite (10.4%), hunger (12.1%) and food unavailability (7.9%). Anthropometric measurements were available for 394 participants, comprising 43 children and 351 adolescents. Among children, 18.6% were wasted, 27.9% were stunted, 11.6% were underweight, and 58.1% were overweight based on BMI-for-age. Among adolescents, 49.6% were stunted, 8.5% were underweight, and 34.8% were overweight based on BMI-for-age. More than half of the participants had medium dietary diversity. Participants assessed biochemically, 7.5% had hypoglycaemia and 1.9% had prediabetes. Zinc deficiency was observed in 94.3% and 17.0% had anaemia. Difficulty in daily life activities was positively correlated with serum zinc concentration ($r = 0.511$, $p < 0.001$), while Visual impairment was also positively correlated with haemoglobin concentration ($r = 0.271$, $p = 0.049$). There was high prevalence of malnutrition among the study group. Nutritionist and Nutrition Educators should educate the public on the importance of adequate nutrition especially in the early stages of mental development in children so as to boost their development.

Keywords: Nutritional status; Dietary diversity; Anthropometry; Zinc deficiency; Anaemia; Nigeria



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INTRODUCTION

Disability is an important public health and human rights concern that can affect an individual's health, development, participation, and quality of life. Globally, an estimated 1.3 billion people, or one in six people, experience significant disability. Persons with disabilities experience substantial health inequities, including poorer health outcomes and barriers to accessing appropriate and affordable healthcare (WHO, 2022). In Nigeria, disability remains an important public health and social concern.

Children and adolescents with disabilities may be particularly vulnerable to malnutrition because of factors that directly affect their ability to obtain, consume, digest, and utilize food and nutrients. Feeding and swallowing difficulties, impaired motor function, dependence on caregivers, altered nutritional requirements, and restricted access to appropriate foods and healthcare may contribute to inadequate dietary intake and poor nutritional status (Rohil *et al.*, 2025). These challenges may reduce food intake and dietary diversity and increase the risk of both macronutrient and micronutrient deficiencies.

A high incidence prevalence of malnutrition is often reported in children with disability, and this may result in poorer health and development, leading to a perpetuating cycle of Sub-optimal nutrition, disability and worsening health status (Engl *et al.*, 2022). The field of malnutrition and disability are closely interrelated with a number of points of convergence. Countries with high levels of malnutrition and nutrient deficiency also often report higher rates of disability and developmental delay (WHO & UNICEF, 2023; Wondmagegn *et al.*, 2024). Recent evidence from 30 low- and middle-income countries showed that children with disabilities had significantly higher risks of stunting, wasting, and underweight than children without disabilities (Rotenberg *et al.*, 2024). In Enugu Metropolis, a study among adults with disabilities reported inadequate intakes of calories, protein, and fat, alongside high prevalences of anaemia and zinc deficiency, highlighting the nutritional challenges experienced by people with disabilities in the area (Ani *et al.*, 2021). These challenges may be particularly important among children and adolescents with disabilities, who are vulnerable to poor health and nutritional outcomes and may require appropriate nutritional, healthcare, and rehabilitation support. However, their health and dietary needs remain relatively underexplored in public health research and practice. Evidence indicates that persons with disabilities face significant barriers to accessing essential healthcare and rehabilitation services, which may further increase their vulnerability to poor health and nutritional problems (Aenishanslin *et al.*, 2022).

Despite evidence of nutritional challenges among persons with disabilities, research on the nutritional status of children and adolescents with disabilities in Nigeria remains limited. Most available studies have focused on children and adolescents in the general population,

providing limited information on those living with disabilities. Consequently, there is insufficient evidence on the specific nutritional challenges experienced by children and adolescents with disabilities, particularly regarding their dietary patterns and biochemical indicators. This gap is especially relevant in Enugu Metropolis, where evidence among adults with disabilities has already indicated important nutritional concerns (Ani *et al.*, 2021). Therefore, this study aimed to assess the nutritional status, dietary patterns, and selected biochemical indicators among children and adolescents with disabilities in Enugu Metropolis, Nigeria.

MATERIALS AND METHODS

Study Area

Enugu is the capital of Enugu State in Nigeria. It is located in south-eastern Nigeria. This study was carried out in disability schools and centres in Enugu Metropolis of Eastern part of the Nigeria. St. Joseph's comprehensive school located at the southern part of Enugu, The coal camp school for the deaf and dumb located in the north, Enugu, Federal Therapeutic School Emene, Enugu, Mother loisa Charity Home Coal camp Enugu, Daughters of Divine Love Charity Home Amorji Nike Enugu were used for the research.

Study Design

This study adopted a cross-sectional observational study conducted in selected disability schools/homes in Enugu Metropolis.

Study Population

The study population consist of children (5 – 9 years) and adolescents (10 – 19 years) in centres and schools of disability in Enugu metropolis

Sample Size Determination

A total of 529 children and adolescents with disabilities, comprising 151 children and 378 adolescents, were identified in the selected disability centres and schools in Enugu Metropolis. The study employed total enumeration; therefore, all 529 eligible children and adolescents were included in the main study. For the biochemical assessment, a 10% subsample of the total study population was selected, giving a target sample of 53 participants ($529 \times 10\% = 52.9$). The final biochemical subsample comprised 53 participants, including 6 children and 47 adolescents. Therefore, the final biochemical subsample represented 4.0% of the total children (6/151) and 12.4% of the total adolescents (47/378), while

accounting for 10.0% of the overall study population (53/529).

Sampling Technique

Total enumeration sampling technique was used to select the disability schools and centres based on the presence of eligible children and adolescents with disabilities and the institutions' willingness to grant permission for the study. Five institutions that met these criteria were therefore selected. Following the selection of the institutions, all eligible children and adolescents available in the selected institutions were recruited into the study.

Ethical Approval and Informed Consent

Ethical approval for the study was obtained from the Health Research Ethics Committee of the University of Nigeria Teaching Hospital (UNTH), Ituku-Ozalla, Enugu State. A letter of introduction issued by the Head, Department of Nutrition and Dietetics, University of Nigeria, Nsukka, was presented to the management of the selected homes and schools to obtain permission to conduct the study. Permission to access and recruit participants was obtained from the respective management of the homes and schools. Written informed consent was obtained from the parents or legal guardians of the children and adolescents before their participation in the study. The purpose and procedures of the study, as well as the voluntary nature of participation, were clearly explained to the parents/guardians through an information and consent letter sent to them through their wards.

Data Collection

Data was collected using questionnaire, anthropometric measurements, and food consumption pattern and biochemical analysis

Questionnaire

A well structured and pre-test questionnaire was validate and used for the study. It sought for background information of the children and adolescents. background information of the respondent (age, sex, religion, Tribe, Vocation/skill, Educational level, Working Status of Parents or caregivers, Birth position of respondent, residence, areas of difficulty), food frequency questionnaire, and 24 hour dietary recall was also be recorded in the questionnaire. The questionnaire was developed by the authors following a review of relevant literature and was adapted to suit the objectives of the study. The questionnaire was reviewed for clarity and content validity prior to data collection. The questionnaire was pretested among 40 children with disability. The reliability index of the questionnaire was 0.80. Data collectors received structured training on the objectives of the study, standardized administration of the questionnaire, appropriate interaction with participants and

caregivers, and relevant ethical considerations. 24-hour dietary recall was used to estimate food and nutrient intake. Dietary information was obtained directly from children and adolescents who were able to recall and report their intake independently. For participants who were unable to provide reliable information because of their age or disability, dietary information was obtained from their caregivers. Caregivers were asked to report all foods and beverages consumed by the participant during the preceding 24 hours, including meals, snacks, and drinks. Household measures were used to estimate portion sizes. The reported foods were converted to estimated quantities, and daily energy and nutrient intakes were calculated using the West African Food Composition Table (Stadlmayr *et al.*, 2012), supplemented with Platt (1977) where necessary. Dietary diversity was assessed using a 24-hour dietary recall adapted from the FAO guidelines (Kennedy *et al.*, 2011). Foods consumed were classified into nine food groups: cereals/roots and tubers, legumes and nuts, vegetables, fruits, meat and poultry, eggs, fish, milk and dairy products, and oils and fats. Participants received one point for each food group consumed and zero for each food group not consumed, yielding a dietary diversity score (DDS) ranging from 0 to 9. DDS was categorized as low (0–3), moderate (4–5), and high (6–9), with higher scores indicating greater dietary diversity.

Anthropometric Measurements

Weight was measured using a bathroom weighing scale (Hana H-9012) graduated in kg. They were weighed with minimal clothing and no foot wear on. Participants stood upright at the centre of the scale with their weight evenly distributed on both feet. The reading was taken at nearest 0.1kg and recorded.

Height was measured with a portable stadiometer height rod (Seca 213). Height was measured without shoes, with participants standing erect on the stadiometer, feet together, heels appropriately positioned, and back of the head touching the height metre. The headpiece was lowered to the crown of the head, and the measurement was recorded to the nearest 0.1 cm.

The result obtained used to ascertain the level of underweight and stunting of the respondents in comparison with WHO (2007) Growth Reference for children and adolescents aged 5–19 years. For BMI-for-age, respondents were classified according to the corresponding WHO 2007 age- and sex-specific BMI-for-age z-scores, with the appropriate cut-off points used to identify thinness, normal weight and overweight.

Biochemical Analysis

Haemoglobin was determined using a portable haemoglobinometer (HemoCue). Haemoglobin results were expressed in g/dL and interpreted using the age and sex specific WHO 2024 haemoglobin cut-offs. Anaemia

was defined as haemoglobin <11.5 g/dL for children aged 5–11 years, <12.0 g/dL for those aged 12–14 years, and <12.0 g/dL for females aged 15 years and above and <13.0 g/dL for males aged 15 years and above (WHO, 2024).

Zinc: For participants below 10 years of age, serum zinc deficiency was defined as a serum zinc concentration below 65 µg/dL. For participants aged 10 years and above, including adolescents, deficiency was defined as a serum zinc concentration below 70 µg/dL for females and 74 µg/dL for males, based on the age- and sex-specific cut-off values proposed by Hotz *et al.* (2003).

Fasting blood glucose was determined using an Accu-Chek glucometer according to the manufacturer's kit manual. Fasting blood glucose ≥7.0 mmol/L (126 mg/dL) was considered elevated, consistent with the ISPAD diagnostic threshold for diabetes in children and adolescents (Shah *et al.*, 2022).

Data Analysis

Data were analyzed using SPSS version 21. Frequencies

and percentages were used for categorical variables, while means and standard deviations were used for continuous variables. Chi-square test was used to assess associations between categorical variables, which were coded numerically for analysis. Pearson's correlation coefficient was used to examine the strength and direction of linear relationships between continuous variables, such as age, anthropometric measurements, dietary intakes, and biochemical indicators. Pearson's correlation was appropriate because these variables were measured numerically and were suitable for assessing linear relationships. Statistical significance was set at $p < 0.05$.

RESULTS

Table 1 presents the background information of the respondents. Most (48.0%) of the respondents were from the Government School for the Deaf and Dumb Ogbete, 21.0% were from St. Joseph Vocational School, while 15.5% were from Daughters of Divine Love Charity Home. Majority (56.3%) of the questionnaires were filled by the care givers, 19.1% were filled by the teachers and 22.9% were filled by the persons with disability.

Table 1: Background Information of the Respondents.

Background information	Frequency	Percentage
School/Homes		
Government School for the Deaf and Dumb Ogbete	254	48.0
St. Joseph's Vocational Institute	111	21.0
Federal Therapeutic School	23	4.3
Mother Louisa Charity Home	59	11.2
Daughters of Divine Love Charity Home	82	15.5
Total	529	100.0
Respondents		
Children/Adolescents	121	22.9
Care giver	298	56.3
Teacher	101	19.1
Others	9	1.7
Total	529	100.0
Age groups		
5-9 years	66	12.5
10-14 years	106	20.0
15-19 years	357	67.5
Total	529	100.0
Sex		
Male	255	48.2
Female	274	51.8
Total	529	100.0
Religion		
Christianity	503	95.1
Islam	25	4.7
African Traditional Religion	1	0.2
Total	529	100.0
Tribe		
Igbo	479	90.5
Hausa	23	4.3
Yoruba	23	4.3
Igala	4	0.8
Total	529	100.0

Table 1: Contd.

Vocational skills	Frequency	Percentage
Sewing	2	0.4
Bead making	4	0.8
Mat making	1	0.2
Vulcanizer	4	0.8
No vocation/ still in school	518	97.9
Total	529	100.0
Educational level		
Nursery	13	2.5
Primary	137	25.9
JSS	148	28.0
SSS	216	40.8
Not in school	15	2.8
Total	529	100.0
Parental working status		
Never worked	93	17.6
Self-employed	192	36.3
Worked before	33	6.3
Still employed	197	37.2
Others	14	2.6
Total	529	100.0
Birth position		
1 st position	68	12.9
2 nd position	104	19.7
3 rd position	47	8.9
Other positions	72	13.6
Do not know	238	45.0
Total	529	100.0
Residence		
Boarder	327	61.8
Day student	202	38.2
Total	529	100.0

Table 2: Area of Difficulty, Period it Started, Causes of Difficulty, Cause and Name of Health Condition.

Area of difficulty	Frequency	Percent
Moving round	271	51.2
Difficulty in carrying out daily life activity	263	49.7
Unable to move	261	49.3
Hearing impairment	222	42.0
Difficulty in communication	219	41.4
Intellectual disability/developmental delay	198	37.4
Learning difficulty	198	37.4
Mental illness/emotional disorder	182	34.4
Visual impairment/seeing	133	25.1
Difficulty started at		
At birth	202	38.2
<1year	46	8.7
1-3yrs	73	13.8
4-6yrs	61	11.5
7-9yrs	26	4.9
10 -12yrs	23	4.3
13 - 15yrs	37	7.0
16 -19yrs	61	11.5
Total	529	100.0

More than half (67.5%) of the respondents were aged 15-19 years, 20.3% were aged 10-14 years while 12.5% were aged 5-9 years. More than half (51.8%) were females and 48.2% were males. Majority (95.1%) were Christians, 4.7% were Muslim while 0.2% were African Traditional Religion. Most (90.2%) of them were from the Igbo tribe, 4.3% and 4.3% were from Hausa and Yoruba respectively while 0.8% were from the Igala. For vocational skills, 0.4% did sewing, 0.4% and 0.4% did bead making and

vulcanizer while 0.2% did mat making. For educational level, 40.8% were in Senior Secondary School class, 28.0% were in Junior Secondary School class while 2.8% were not in school. Most (37.2%) of their parents were still employed. Majority (61.8%) of the respondents stays in the boarder while 38.2% were day students. Table 2 showed the area of difficulty, period it started, causes of difficulty, cause and name of health condition. More than half (51.2%) had difficulty in moving round, 49.3% were unable

Table 2 Contd.

Cause of health condition	Frequency	Percent
Before or during birth	196	37.1
Disease / sickness	169	31.9
Injection	40	7.6
Motor accident	34	6.4
Perceived spiritual/traditional cause	23	4.3
Domestic accident	22	4.2
Political violence	1	0.2
Don't know	44	8.3
Total	529	100.0
Name of disease/sickness	Frequency	Percent
Hereditary disorder	22	4.2
Club feet	20	3.8
Polio	16	3.0
HBP	14	2.6
Arthritis	11	2.1
Cerebral palsy	10	1.9
Spinal cord	8	1.5
Meningitis	7	1.3
Stroke	4	0.8
Mental illness	4	0.8
Leprosy	1	0.2
Measles	1	0.2
Don't know	51	9.7
Total	169	31.9

Table 3: Frequency of Consumption of Some Food Item.

Food item	Daily	4–6 times per week	1–3 times per week	Occasionally	Never
Fruits					
Mango	25.7	8.9	13.4	45.6	6.4
Tangerine	3.4	13.8	13.2	44.4	25.2
Orange	21.9	14.6	24.8	31.9	6.8
Kiwi	1.9	18.3	7.8	13.0	59.0
Banana	20.8	14.6	33.8	23.4	7.4
African mango (ujuru)	4.5	16.3	16.1	33.5	29.6
Guava	10.8	10.4	22.7	42.2	13.9
Grapefruit	7.6	12.5	14.7	39.9	25.3
Lime	6.4	13.4	11.2	34.6	34.4
Pears	10.2	15.1	17.0	45.0	12.7
African apple	8.5	10.2	16.4	45.7	19.2
Apple	20.6	19.1	13.2	44.4	2.7
Pawpaw	8.9	11.0	34.0	37.8	8.3
Watermelon	14.4	15.9	23.3	42.0	4.4
Cucumber	10.0	16.4	26.8	43.1	3.7
Pineapple	13.0	13.8	23.3	48.6	1.3
Vegetables					
Okro	25.5	14.7	31.6	27.8	0.4
Ugu	7.0	24.6	41.4	26.8	0.2
Tomatoes	6.8	18.3	27.0	42.9	5.0
Oha	10.6	9.5	21.2	48.7	10.0
Bitterleaf	10.6	15.1	22.9	45.9	5.5
Garden egg	6.8	18.7	22.7	44.0	7.8
Carrot	16.3	9.3	23.8	44.6	6.0
Cabbage	4.7	19.8	20.6	50.4	4.5
Sweet potato	10.2	10.6	24.6	49.5	5.1
Green	13.4	13.8	22.7	46.5	3.6
Spinach	6.2	7.6	16.4	51.0	18.8
Lettuce	4.7	9.1	12.9	48.3	25.0

to move, 49.7% had difficulty in performing daily life activity while those with hearing impairment were 42.0%. A total of 38.2% of the disability started at birth, 13.8% had difficulty at 1-3years, 11.5% had difficulty at 4-6years and 7.0% had difficulty at 13-15 years while 11.5% had difficulty at 16-19 years. The causes of the disability were complications before/during birth (37.1%), disease/sickness (31.9%) motor accident (6.4%) and injection (7.6%). A total of 4.2%

identified the disease/ sickness as hereditary disorder, 3.8% as club feet, 3.0% as polio, 2.6% as high blood pressure and 2.1% as arthritis.

Table 3 presents the frequency of consumption of some food items. Banana (20.8%), apple (20.6%), mango (25.7%), okro (25.5%), groundnut (33.3%), orange (21.9%) and rice (26.8%) were consumed daily. Ugu (24.6%), apple (19.1%), cabbage (19.8%), beans (30.4%),

Table 3 Contd.

Legumes					
Groundnut	33.3	11.2	19.7	33.5	2.3
Beans	12.9	30.4	25.9	28.5	2.3
Cowpea	11.7	14.4	20.0	36.1	17.8
Soybean	8.1	18.0	20.4	39.7	13.8
Bambara pudding	13.6	15.5	38.2	23.8	8.9
Fiofio	10.0	18.9	20.8	41.4	8.9
Oil bean	8.5	12.1	24.2	42.5	12.7
Cereals					
Mustard seeds	3.6	6.6	13.2	45.2	31.4
Rice	26.8	26.3	21.2	23.6	2.1
Maize	16.3	22.7	24.2	30.1	6.8
Oat meal	11.3	12.9	11.9	35.9	28.0
Corn meal	10.4	8.5	17.6	43.1	20.4
Millet	10.0	18.1	18.3	35.3	18.1
Wheat	10.2	13.0	22.7	45.2	8.9
Custard	17.0	15.5	16.8	46.9	3.8
Milk and milk products					
Milk	31.2	12.5	21.0	33.6	1.7
Cheese	4.9	18.1	18.3	39.9	18.7
Yoghurt	17.6	13.0	20.0	42.2	7.2
Condensed milk	5.3	16.6	20.0	50.3	7.8
Ice cream	11.2	21.7	15.7	48.0	3.4
Asha	3.4	4.0	5.7	19.7	67.3
Fat and oil					
Palm oil	19.5	21.4	21.7	33.6	3.8
Cod liver oil	10.6	10.2	14.7	41.2	23.3
Coconut oil	14.7	16.3	17.6	40.5	11.0
Groundnut oil	17.4	18.0	13.8	41.2	9.6
Soybean oil	12.5	11.2	12.9	50.3	13.2
Butter/margarine	10.6	11.3	13.8	53.3	11.0
Olive oil	4.2	9.8	5.9	50.7	29.5
Mayonnaise	2.6	10.0	16.4	52.7	18.1
Avocado	8.1	9.8	14.0	58.8	9.3

Table 3 Contd.

Fish and meat	Daily	4–6 times per week	1–3 times per week	Occasionally	Never
Fish	28.0	11.3	18.7	39.5	2.5
Chicken	13.4	16.8	24.2	44.4	1.1
Cow meat	20.2	16.1	25.7	37.2	0.8
Pork	10.0	16.8	18.0	39.5	15.7
Egg	19.5	17.0	19.3	39.1	5.1
Goat meat	11.7	10.6	27.4	47.1	3.2
Snail	6.6	11.3	17.4	52.7	11.9
Liver/kidney	8.1	7.2	10.0	51.6	23.1
Starchy roots and tubers					
Yam	28.2	14.4	22.9	34.6	0.0
Cocoyam	11.3	22.9	17.6	45.0	3.2
Cassava	17.0	16.8	21.6	44.2	0.4
Garri	14.6	20.4	24.0	39.1	1.9
Plantain	9.1	14.0	21.9	48.4	6.6
Tree leaf yam	6.6	11.5	7.6	38.6	35.7
Sweetened drinks					
Chivita	19.3	11.2	8.5	54.6	6.4
5 Alive	9.8	19.5	11.9	52.0	6.8
Chi-exotic	9.6	12.7	17.2	55.2	5.3
Happy Hour	17.0	9.5	15.7	53.3	4.5
Fanta	13.2	14.6	19.3	49.1	3.8
Sprite	12.9	12.7	21.9	48.4	4.2
Coke	12.5	13.2	21.6	51.0	1.7
7-Up	9.6	13.0	18.1	54.4	4.7
Pepsi	11.3	16.6	18.7	47.4	5.9
Hollandia	7.4	12.5	17.6	51.6	11.0

fiofio (18.9%), rice (26.3%) and maize (22.7%) were consumed 4-6 times per week. Orange (24.8%), banana (33.8%), guava (22.7%), pawpaw (34.0%), ugu (41.4%), tomatoes (27.0%) carrot (23.8%) and maize (24.8%) were

consumed more 1-3 times per week. Kiwi (59.0%), mustard seed (31.4%), lettuce (25.0%) were never consumed. Palm oil (19.5%), milk (31.2%), fish (28.0%), yam (28.2%) were consumed daily. Ice cream (21.7%),

Table 4: Food Consumption Pattern of the Respondents.

Food consumption pattern	Frequency	Percentage
Reason for skipping meal		
No time to eat	35	6.6
Not hungry	64	12.1
No appetite	55	10.4
No food	42	7.9
Too weak or tied to cook or eat	19	3.6
Religion	6	1.1
Weight loss	11	2.1
Total	232	43.9
Type of snacks		
Biscuit	120	22.7
Buns/chin-chin	119	22.5
Chewing gum	104	19.7
Bread	114	21.6
Ice cream	40	7.6
Peanut	31	5.9
Others e.g Gala	1	0.2
Total	529	100.0
Frequency of snack consumption		
Daily	26	5.0
4-6 times a week	116	21.9
1-3 times a week	197	37.2
Occasionally	176	33.3
Never	14	2.6
Total	529	100.0
Frequency of pastry consumption		
Daily	27	5.1
4-6 times a week	72	13.6
1-3 times a week	197	37.2
Occasionally	194	36.7
Never	39	7.4
Total	529	100.0
Frequency of soft drink consumption		
Never	27	5.1
Rarely	56	10.6
Most times	176	33.3
Always	33	6.2
Sometimes	237	44.8
Total	529	100.0
No of time		
4-6 days per week	39	7.3
1-3 days per week	63	11.9
Less than once a month	49	9.3
Total	150	28.4
Number of drinks/day		
1 drink	71	13.4
2 drinks	63	11.9
3 drinks	12	2.3
4 drinks	4	0.8
Total	150	28.4

cocoyam (22.9%) and garri (20.4%) were consumed 4-6 times per week. Cow meat (25.7%), goat meat (27.4%), egg (19.3%), plantain (21.9%) and yam (22.9%) were among the food item consumed 1-3 times per week. Asha (67.3%), oat meal (28.0%), olive oil (29.5%) and tree leaf yam (35.7%) were never consumed. Chivita (19.3%), Happy hour (17.0%) and Fanta (13.2%) were consumed daily. 5alive (19.5%) was consumed 4-6 times per week, Sprite (21.9%), coke (21.6%) and Fanta (19.3%) were consumed 1-3 times per week. Hollandia was never consumed by 11.0%.

Table 4 revealed the food consumption pattern of the respondents. Reasons for skipping meals were not hungry

(12.1%), no food (7.9%) and no appetite (10.4%). Biscuit (22.7%), buns and chin chin (22.5%), bread (21.6%) and chewing gum (19.7%) were consumed as snacks. A total of 37.2% consumed snacks 1-3 times a week, 33.3% occasionally, 21.9% 4-6 times a week and 5.0% daily. Pastry was consumed 4-6 times per week (13.6%) 1-3 times per week (37.2%) and occasionally (36.7%). Soft drinks was consumed rarely (10.6%), most times (33.3%) and sometimes (44.8%). Table 5 revealed the dietary diversity of the respondents. More than half (51.2%) of the respondents belong to average DDS group, 47.6% belong to low DDS group while 1.1% belong to high diet diversity group. Table 6 presents the anthropometric indices and

Table 5: The DDS of the Respondents.

Dietary Diversity Score	Frequency (n)	Percentage (%)
Low (≤ 4 food groups)	252	47.6
Average (5 food groups)	271	51.2
High diet diversity (≥ 6 food groups)	6	1.1
Total	529	100.0

Low = ≤ 4 food groups, average = 5 food groups, high diet diversity ≥ 6 food groups

Table 6: Anthropometric and Biochemical Status of the Respondents.

Anthropometric/biochemical indices	5-9 years N (%)	10-19 years N (%)
Wasting		
N/A	1(2.3)	347(98.9)
Wasted (< -2 SD)	8(18.6)	0(0.0)
Normal (-2 SD to $+2$ SD)	26(60.5)	3(0.9)
Overweight ($> +2$ SD)	8(18.6)	1(0.3)
Total	43(100.0)	100.0
Stunting		
N/A	0 (0.0)	72 (20.5)
Stunted (< -2 SD)	12 (27.9)	174 (49.6)
Normal (-2 SD to $+2$ SD)	17 (39.5)	76 (21.7)
Tall ($> +2$ SD)	14 (32.6)	29 (8.3)
Total	43 (100.0)	351 (100.0)
BMI-for-age		
N/A	0 (0.0)	70 (19.9)
Underweight (< -2 SD)	5 (11.6)	30 (8.5)
Normal (-2 SD to $+2$ SD)	13 (30.2)	129 (36.8)
Overweight ($> +1$ SD)	25 (58.1)	122 (34.8)
Total	43 (100.0)	351 (100.0)
Fasting Blood Glucose		
Hypoglycemia (< 70 mg/dl)	0(0.0)	4(7.5)
Normal (70-100mg/dl)	6(11.3)	42(79.2)
Prediabetes (100 - 126mg/dl)	0(0.0)	1(1.9)
Total	6(11.3)	47(88.7)
Zinc (μg/dL)		
Deficiency	5(9.4)	45(84.9)
Normal	1(1.9)	2(3.8)
Total	6(11.3)	47(88.7)
Hemoglobin (g/dL)		
Non-anemic	4(7.5)	40(75.5)
Mild anemia	2(3.8)	6(11.3)
Moderate anemia	0(0.0)	1(1.9)
Total	6(11.3)	47(88.7)

biochemical variable of the respondents. Anthropometric measurements were obtained from 394 of the 529 respondents (74.5%). The remaining 135 respondents (25.5%) were excluded from anthropometric analysis because valid anthropometric measurements were unavailable or could not be reliably obtained. Anthropometric indices were therefore calculated and classified using the available valid measurements, and the appropriate denominator was reported for each indicator. A total of 60.5% were normal, 18.6% of children aged 5–9 years were wasted and 18.6% were overweight, and 0.3% were overweight. A total of 49.6% of adolescents were stunted, 8.3% were tall and 21.7% were normal, while 32.6% of children were tall, 27.9% were stunted and 39.5% were normal. A total of 58.1% of children were overweight, 11.6% were underweight and 30.2% were normal, while 34.8% of adolescents were overweight, 8.5% were underweight and 36.8% were normal. A total of 7.5% of

adolescents had hypoglycemia, 1.9% were prediabetes and 79.2% were normal while all (11.3%) the children were normal. Majority (84.9%) of adolescent were deficient in Zinc and 3.8% were normal while 9.4% of children deficient in Zinc and 1.9% were normal. Majority (75.5%) of the adolescent were non anemic, 11.3% had mild anemia and 1.9% had moderate anemia while 7.5% of children were non anemic, 3.8% had mild anemia.

Table 7 shows the relationship between type of difficulty and biochemical status. Visual impairment showed a significant positive correlation with haemoglobin ($r = 0.271$, $p = 0.049$), while Mental illness showed a significant negative correlation with haemoglobin ($r = -0.288$, $p = 0.037$). No significant correlations were observed between the types of difficulty and fasting blood sugar or zinc ($p > 0.05$). Table 8 shows the relationship between age, types of disability and biochemical status of the respondents. Difficulty in carrying out daily life activities was significantly

Table 7: Relationship between Type of Difficulty and Biochemical Status.

Type of Difficulty	FBS, r (p)	Zn, r (p)	Hb, r (p)
Visual impairment (VI)	0.021 (0.882)	-0.209 (0.134)	0.271 (0.049)
Hearing impairment (HI)	0.031 (0.825)	0.125 (0.372)	0.074 (0.596)
Communication impairment (CI)	0.231 (0.095)	-0.135 (0.334)	-0.268 (0.052)
Difficulty in moving around (MA)	0.029 (0.834)	-0.038 (0.785)	-0.231 (0.096)
Mental illness (MI)	0.241 (0.082)	0.022 (0.874)	-0.288 (0.037)

Note: FBS = fasting blood sugar; Zn = serum zinc; Hb = haemoglobin; r = correlation coefficient; p = probability value.

Table 8: Relationship between age, type of disability and biochemical status.

Variable	FBS, r (p)	Zn, r (p)	Hb, r (p)
Age	-0.067 (0.634)	-0.170 (0.223)	-0.118 (0.399)
Difficulty in daily life activities	0.072 (0.611)	0.511 (<0.001)	-0.112 (0.426)
Intellectual disability	-0.024 (0.864)	0.031 (0.823)	-0.092 (0.514)
Learning difficulty	0.112 (0.425)	0.022 (0.874)	-0.198 (0.154)
Mental illness	0.149 (0.287)	-0.017 (0.905)	-0.280 (0.042)

Note: FBS = fasting blood sugar; Zn = serum zinc; Hb = haemoglobin; r = correlation coefficient; p = probability value.

Table 9: Percentage Contribution of Meals to RNI of the Respondents.

	Age	Sex	Energy (kcal)	Protein (g)	Fat (g)	CHO (g)
Mean intake	6-9 years	M	705.77	22.50	16.20	128.67
RNI			2190	38	59	130
% contribution			32.22	59.21	27.46	98.98
Mean intake	6-9 years	F	632	38.34	28.54	124
RNI			2190	42	59	130
% contribution			28.86	90.28	39.64	95.38
Mean intake	10-12 years	M	586.56	28.93	30.53	144.41
RNI			2600	47	72	171
% contribution			22.64	61.55	42.40	84.45
Mean intake	10-12 years	F	467.64	47.00	43.26	129.09
RNI			2350	58	69	167
% contribution			19.90	81.03	62.70	77.30
Mean intake	13-18 years	M	614.59	31.00	20.39	123.69
RNI			2900	45	85	160
% contribution			21.19	68.89	23.99	77.30
Mean intake	13-18 years	F	512.02	36.29	21.65	131
RNI			2490	49	73	137
% contribution			20.56	74.06	29.66	95.62

and positively correlated with zinc level ($r = 0.511$, $p < 0.001$), while mental illness was significantly and negatively correlated with haemoglobin level ($r = -0.280$, $p = 0.042$). No significant relationships were observed between age and the biochemical indicators or between the other types of disability and fasting blood sugar, zinc and haemoglobin levels ($p > 0.05$). Table 9 presents mean intake and the percentage contributions of meals to RNI of the respondents. The percentage of recommended energy and nutrient intakes met by the consumed meals for male respondents aged 6-9 years was energy (32.22%), protein (59.21%), fat (27.46%) and carbohydrate (98.98%). The percentage of recommended energy and nutrient intakes met by the consumed meals for female respondents aged 6-9 years was energy (28.86%), protein (90.28%), fat (39.64%) and carbohydrate (95.38%). The percentage of recommended energy and nutrient intakes met by the consumed meals for male respondents aged 10-12 years was energy (22.64%), protein (61.55%), fat (42.40%) and carbohydrate (84.45%). The percentage of recommended energy and nutrient intakes met by the consumed meals

for female respondents aged 10-12 years was energy (19.90%), protein (81.03%), fat (62.70%) and carbohydrate (77.30%). The percentage of recommended energy and nutrient intakes met by the consumed meals for male respondents aged 12-18 years was energy (21.19%), protein (68.89%), fat (23.99%) and carbohydrate (77.30%). The percentage of recommended energy and nutrient intakes met by the consumed meals for female respondents aged 12-18 years was energy (20.56%), protein (74.06%), fat (29.66%) and carbohydrate (95.62%).

DISCUSSION

The study showed a relatively balanced sex distribution among the respondents, with girls constituting a slightly higher proportion (51.8%) than boys (48.2%). This finding differs from the report by Bharthi *et al.* (2017), who recorded 15.01% boys and 18.35% girls among their respondents. Despite differences in the proportions

reported, both studies observed a slightly higher representation of girls than boys among participants with disabilities. The observed difference in sex distribution may reflect variations in the study populations, settings, sampling approaches, and types or severity of disabilities represented. The age groups selected for the study were mostly the adolescents aged 15-19 years and this could be because most of them do not start school at an early stage. This was followed by children 10 – 14 years and the least being children 5-9 years. Reason again could be that their parents/ guardians do not allow them stay far from home and most of the parents/ guardians do not even enrol them in school because of the disability so they don't start school at an early stage. For the vocational skills, the 0.4% engaged in sewing, bead making and vulcanizing but 0.2 % had a skill in mat making possibly because of the type of disability that do not restrict the use of hands and feet. This is similar to a research done by (Ananian & Dellafrerra, 2024) where many disabled people's organizations, mostly in the developing countries, have also initiated self-help employment projects. These businesses have proven immensely successful in terms of job skills training for disabled people, demonstrating that disabled people can work as efficiently as nondisabled people, providing a living for disabled people, and in making a profit, which is often used to fund the self-help organization. Majority of the respondents were in senior secondary school and in boarders while minority were from the junior secondary school class and also day students. Very few of the respondents are not in school at all. This is possibly because most of their families stay in very far places or most of their parents might have tight schedule, so they enrol them as boarders to care for them and at the same time work.

The present study revealed a high prevalence of stunting (57.8%) among children and adolescents with disabilities in Enugu metropolis. This prevalence was higher than the 41.6% reported among school-aged children aged 6–15 years in a rural South-eastern Nigerian community by Ayogu *et al.* (2018), indicating a greater burden of chronic undernutrition among the participants in the present study. The high prevalence of stunting observed may reflect prolonged nutritional inadequacy and other factors that can impair linear growth, including household food insecurity, recurrent illness, and inadequate access to appropriate healthcare and nutrition services. Using BMI-for-age Z-scores according to age and sex, an overall prevalence of thinness (10.8%) was recorded in the study, which was slightly higher than the 10.3% reported by Adeomi *et al.* (2022) among school-aged children and adolescents in a community-based study conducted in Osun and Gombe States, Nigeria. Using Weight-for-height Z score, a high prevalence of wasting (17%) was observed among respondents in this study indicating a serious nutritional problem. The result of the study was higher than 3.3% reported by Igbokwe *et al.* (2017) among school children in Enugu. Overall disparities in findings might be due to differences in study location, nature of

respondents used and differential feeding habits. The high prevalence of stunting, wasting and underweight could be attributed to the children and adolescents not meeting up with their daily nutrient intake due to the availability of the affordable foods in the environment, cost of the food and also might relate to the disease condition.

More than half of the respondents had difficulty moving around, while nearly half reported being unable to move independently, experiencing difficulty performing activities of daily living, and having hearing impairment. Most of the disabilities were reported to have been present from birth. The commonly reported causes were complications occurring before or during birth and motor accidents. These findings are consistent with current evidence indicating that childhood disabilities may result from congenital conditions, developmental disorders, birth-related complications, trauma and other acquired conditions. Cerebral palsy (CP), in particular, is an important cause of motor disability in childhood and is characterized by permanent disorders affecting movement and posture due to non-progressive disturbances in the developing brain (Panda *et al.*, 2024). The findings regarding mobility limitations are particularly relevant because cerebral palsy can result in varying degrees of motor impairment and activity limitation, depending on the type and severity of the condition. Children with cerebral palsy may also experience associated hearing, visual, communication, feeding and intellectual difficulties (Hallman-Cooper & Rocha Cabrero, 2024).

Majority of the food item consumed weekly by the respondents were pawpaw, groundnut, mango, banana, rice, okro, orange, yam, milk, palm oil and apple. Ugu (pumpkin leaf), cabbage, beans, fio-fio, maize, ice cream, cocoyam, garri were presented with moderate weekly consumption while cow meat, goat meat, egg, plantain and yam were poorly consumed. This could mean that most of the vegetables consumed frequently were available in season and, or they could possibly afford it or simply because the vegetables were generally accepted. But the fruits that were not consumed could probably be because they were not available in the environment, they were not in season or that they were not generally accepted. Among the sweetened drinks, chivita, happy hour and fanta were most commonly consumed weekly while 5alive was moderately consumed with sprite, coke and Hollandia yourgurt presented with poor weekly consumption. Reason for this pattern of consumption could be that sweetened drinks especially soft drinks are available and affordable, thus, the lower the percentage, the lower the availability and the higher the cost. This is similar to the report by Abubakar *et al.*, (2017) where over the past few decades, the diet quality of adolescents has declined with increased energy intake from fast food, soft drinks, and salty snacks, and decreased fruit and vegetable intake. The food consumption pattern of the respondents also showed that majority of the respondents ate three meals in a day which is necessary for good health. This is similar to findings from a study carried out by Eze *et al.*, (2017)

among school children in Enugu state. The present study also showed that less than half of the respondents skipped meals. Although breakfast was often skipped, the study also found that lunch and dinner were also often skipped by some of the children. Reasons for skipping meals being attributed to not being hungry at that moment or loss of appetite. Consequently, missing meals could induce hunger which is a major cause of under-nutrition in children (Ayogu *et al.*, 2015).

The study also showed that more than half of the respondents had medium dietary diversity score while some had low dietary diversity. However, the result is in contrast with that reported by Ukegbu and Ogu (2017) among Under-5 Children in some rural areas of Imo State, Nigeria where majority (73.5%) had high diversity score. The disparity in findings could be attributed to the study location and DDS tool/classification adopted. The low and medium DDS score of respondents in this study, however, indicates that the disabled children have limited access to varieties of foods and this could be associated with their condition and, or lack of proper care from their parents/caregivers. A recent study among children with disabilities also reported that dietary diversity was associated with feeding difficulties and household socioeconomic factors (Haile & Sewnet, 2024).

The study showed very high prevalences of anaemia (98%) and zinc deficiency (94%) among the respondents. These findings indicate a substantial burden of micronutrient deficiencies in the study population. This is consistent with a recent systematic review of 51 studies on Nigerian adolescents aged 10–19 years, which identified inadequate intake of essential micronutrients, including iron, zinc and calcium. Among the studies reviewed, iron-related problems included anaemia in 64% of participants and iron deficiency in 43.3% of adolescent females, while 91% had iron intake below the estimated average requirement. Similarly, zinc deficiency was reported in 43.3% of adolescents, with 58% having zinc intake below the estimated average requirement. Inadequate calcium intake was reported in 76.7% and 99% of participants in two of the reviewed studies (Abubakar *et al.*, 2024). The high zinc deficiency among the respondents was also similar with 99% reported by Abah *et al.* (2015) among school children in a rural setting in North-central Nigeria but in contrast with 24% reported by Abubakar *et al.* (2017) in Northern Nigeria (Kano). The high prevalence of zinc deficiency observed in the present study is consistent with evidence of zinc deficiency among Nigerian children. For instance, a study among school children in Enugu-South LGA reported a zinc deficiency prevalence of 43.6%, highlighting the persistence of inadequate zinc status among school-aged children in southeastern Nigeria. Generally, the high deficiency of serum iron, and zinc in this population could be multi-factorial. It could be due to their disabilities, low dietary diversification or consequence of the food consumption pattern (high plant food consumption as against low consumption of animal products). The higher prevalence of deficiencies among

respondents aged 10–19 years may also be associated with the increased nutrient requirements during adolescence. The study also showed that the meals consumed by the children were adequate in carbohydrate for all the age groups having met up to 70% of their daily carbohydrate requirements. The meals were also adequate in protein for 6-9 years children (both male and female), 10-12 years female children as well as 13-18 years female adolescents, having contributed 70% of the recommended protein intake per day. However, the meals did not meet up to 70% of the daily recommended fat intake for the children, meaning that meals commonly consumed by the children were inadequate in fat.

Conclusion

This study demonstrates that malnutrition is a major public health concern among children and adolescents with disabilities in Enugu metropolis. A high burden of stunting, wasting and underweight was observed, alongside very high prevalences of anaemia, zinc and calcium deficiencies. The respondents also had predominantly low-to-medium dietary diversity, characterized by frequent consumption of plant-based foods and limited consumption of animal-source foods. These findings highlight the need for disability-inclusive nutrition interventions, including regular nutritional assessment, improved dietary diversity, access to micronutrient-rich foods, and appropriate nutrition education and support for parents and caregivers.

Recommendations

1. Government and relevant agencies should implement programmes that improve the socioeconomic conditions of families of children and adolescents with disabilities, including employment opportunities, social protection, and financial support, to improve household food security and access to nutritious foods.
2. Nutritionists, dietitians, and nutrition educators should provide regular nutrition education and counselling to parents, caregivers, teachers, and children with disabilities on the importance of adequate and balanced nutrition for growth, development, and overall health.
3. Schools, residential homes, and other care institutions for children with disabilities should have access to the services of qualified nutritionists or dietitians to assess nutritional status, provide individualized dietary counselling, develop appropriate meal plans, and monitor the nutritional progress of the children and adolescents.
4. Schools and residential homes should promote the regular consumption of fruits and vegetables by incorporating a variety of affordable, locally available fruits and vegetables into school meals and household diets to improve dietary diversity and micronutrient intake.
5. Routine nutritional screening should be integrated into the care of children and adolescents with disabilities,

including regular assessment of weight, height, BMI-for-age, haemoglobin, and relevant micronutrient status, to facilitate early identification and management of malnutrition and nutrient deficiencies.

6. Parents and caregivers should receive support on appropriate feeding practices for children with disabilities, particularly those experiencing feeding, swallowing, motor, or communication difficulties. Referral to appropriate healthcare professionals should be encouraged when feeding problems are identified.

Limitation

The study had some limitations. First, its cross-sectional design limits the ability to establish causal relationships between disability, dietary intake, micronutrient deficiencies, and nutritional status. Second, dietary information obtained from participants or caregivers may have been affected by recall and reporting bias. Dietary data collected using a food-frequency questionnaire and 24-hour recall were subject to recall and reporting bias, which may have affected the accuracy of dietary intake and diversity estimates. Proxy reporting by parents or caregivers for some participants may also have introduced reporting errors. Third, some biochemical indicators may have been influenced by infection or other health conditions at the time of sample collection. Fourth, the study was conducted among children and adolescents with disabilities in selected homes and schools in Enugu metropolis, which may limit the generalizability of the findings to other populations. Finally, differences in the types and severity of disabilities among participants may have influenced their nutritional status and feeding patterns. Differences in types and severity of disabilities, functional limitations, medication use, and other individual characteristics may have influenced dietary intake, anthropometric measurements and biochemical indicators. These factors were not equally measurable or controllable across all participants and may have introduced residual confounding. Despite these limitations, the study provides important evidence on the nutritional and health status of children and adolescents with disabilities in Enugu Metropolis and offers findings that can inform future research and public health interventions.

Knowledge Contribution

This study contributes disability-specific evidence on the nutritional status, dietary patterns and selected biochemical indicators of children and adolescents with disabilities in Enugu Metropolis, addressing the limited Nigerian literature in this area. The findings demonstrate a double burden of malnutrition, with both undernutrition and overweight present, alongside dietary practices such as meal skipping and frequent consumption of snacks and pastries. The study also provides biochemical evidence of

anaemia and micronutrient deficiencies that may not be detected through anthropometric assessment alone. Overall, the findings provide baseline evidence to support disability-sensitive nutrition screening, education, dietary interventions and nutrition support services in schools, homes and care centres.

Conflicts of interest: The authors declare that there are no conflicts of interest associated with this publication

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