(RESEARCH ARTICLE)

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Anthropometric indices and academic performance of primary school pupils in Enugu south local government area of Enugu state, Nigeria

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Abstract

Anthropometric indices are commonly used to assess nutritional status, health, and development of children as well as the whole population. Nutritional status depends on dietary intake of food, nutrients, diseases and overall health status, and health care practices, which indirectly affects the educational performances. This study focused on anthropometric indices and academic performance of primary school pupils in rural and urban area of Enugu South Local Government Area, Enugu State, Nigeria. The objectives of the study were to determine the anthropometric indices (height-for –age, weight –for –age and body mass index (BMI- for-age) among primary school pupils, assess the academic performance of primary School pupils and to determine the association of anthropometric indices (nutritional status) of primary school pupils in Enugu South Local Government Area of Enugu State with their academic performance. Descriptive cross sectional research design was utilized for the study; a sample of 434 respondents (from 5 public primary schools in rural and urban areas) was selected through multistage sample technique. 420 copies of questionnaire were completely returned giving a response rate of 96.7%. Data were collected using researcher's structured questionnaire on anthropometric indices and academic performance of primary school children. Data collected were analyzed using frequencies, percentages, mean, standard deviation and chi square with the use of SPSS Version 23.0 at P< 0.01. The results showed that a lesser proportion of primary school pupils were moderately stunted (2.1%) regarding height –for-age, moderately underweight (19.8%) regarding weight –for-age and moderately thin (3.8%) regarding BMI –for –age. Higher proportion of pupils in Schools in rural area were moderately thin, stunted and underweight than those in Urban areas (13.8%, 9.2% and 21.8%) respectively. 28.1% of the respondents had low score of < 50%, 41.7 % had average score of 50 % -74 % and 30.2 % had high score of >75 % in their academic performance. A greater proportion of the pupils were rated as average. Higher proportion of pupils in rural area had low academic performance (29.9 %).There was significant association between anthropometric indices and academic performance (P < 0.01). Health promotion and nutritional information should be disseminated as a matter of urgency to parents and caregivers of the children because they play a great role in meeting the nutritional needs of the children as well as determining their nutritional status.

Keywords: Anthropometric indices; Academic Performance; Anthropometry; Primary school pupils

1. Introduction

Primary School age is a dynamic period of physical growth, mental development and social adaptation of a child (Srivastava, Mahmood, Srivastava, Shrotiya and Kumar, 2012). School age is the active growing phase of childhood. It is a period of rapid growth from 6years to puberty age that is about 12years. Council on Hemispheric Affairs (2013) states that poor nutritional status in primary school age children is a major cause of low school enrolment, school absenteeism, reduced attention span, decreased learning ability, poor academic performance, repeating grades in school and early school dropout.

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Anthropometry is the measurement of the human body (Kristen and Lesley, 2018). It is one of several approaches—which also include biochemical, clinical, and dietary assessment—used to assess nutritional status. Anthropometry can help identify the types of malnutrition present in an individual or population and measure progress toward improvement. Common anthropometric measurements used in development programs include height/length, weight, and mid-upper arm circumference (MUAC). Some of these measurements (e.g., adult height) can be used alone to assess nutritional status. Others, such as children's height, do not provide enough information on their own and must be used in conjunction with age or another anthropometric measurement to provide meaningful information about nutritional status (Kristen and Lesley, 2018). When two or more anthropometric measurements are combined with each other or with age, it is called an anthropometric index (Kristen and Lesley, 2018). This combination of information can be used to identify some nutritional conditions. Common anthropometric indices include weight-for-height, weight-for-age, height-for-age, BMI (combination of weight and height), and BMI-for-age.

The nutritional and health benefits of school feeding programmes in terms of improvements in weight, height, school attendance, mathematics performance and improved concentration among school children have been reported. (Yendaw and Dayour,2015) .Consequently, school-feeding programmes have been established and implemented by governments across the globe to address hunger and its negative effect on the nutritional status and learning capacity of school-age children(Ogunode and Abubakar 2021). In Nigeria, the National Home Grown School Feeding Programme (NHGSFP) was launched in 2016 by the resent (Buhari) administration and it aimed to curb hunger and malnutrition by feeding 5.5 million school pupils one meal a day for all public primary schools annually (Punch, 2020).

Malnourished children suffer from slow rate of brain development in form of low brain weight, thin cerebral cortex and decrease number of neurons (Shashidhar, et al, 2017). Therefore, there is no doubt malnutrition has the greatest effect on academic performance of primary school children (Zeru, Mulugeta and Gebret, 2017). Malnutrition can be quantified using anthropometric indices as weight- for -age, height- for- age and Body mass index (BMI-for-age) which are expressed as Z-Score in comparison with standard references (Zeru, Mulugeta and Gebret , 2017).

Anthropometric indices are used to assess nutritional status, Nutritional status depends on dietary intake of food, nutrients, diseases and overall health status, and health care practices, which indirectly affects the educational performances. It is against this background that the researchers in this study examined the association between the anthropometric indices and academic performance of primary school pupils in Enugu South Local Government Area of Enugu State, Nigeria.

Objectives of the study

- To determine the anthropometric indices (height-for –age, weight –for –age and body mass index (BMI- for-age) among primary school pupils.
- To determine the academic performance of primary School pupils in Enugu South Local government area of Enugu State.
- To determine the association of anthropometric indices (nutritional status) of primary school pupils in Enugu South Local Government Area of Enugu State with their academic performance.

1.1. Theoretical Framework

This study hinges on Measurement Theory. Measurement theory dates back to the 4th century BC. Measurement theory is the study of how numbers are assigned to objects and phenomena, and its concerns include the kinds of things that can be measured, how different measures relate to each other, and the problem of error in the measurement process (Augustyn, 2020). The problem of error is one of the central concerns of measurement theory. The usefulness and truthfulness of assessments whether performed in the clinic on one patient or in the laboratory on many subjects depends on valid measurements (Krebs, 1987). Measurement theory is the thought process and interrelated body of knowledge that form the basis of valid measurements. One of the purpose of this study is to assess anthropometric measurements of primary school pupils in rural and urban areas of Enugu South Local Government area of Enugu state and these measurements are based on physical body measurements such as weight and height, hence the need to apply measurement theory.

2. Material and methods

2.1. Design and Sampling

The research design that was adopted in this study was cross-sectional descriptive survey design. Multistage sampling method was used to select the sample size for the study. The Schools were clustered into rural and urban areas. The simple random sampling technique of balloting without replacement was used to draw a sample of 5 Schools (1 from rural area and 4 from urban area) out of 35 primary schools (10 schools from rural areas and 25 Schools from the Urban areas) that made up Enugu South Local Government Area of Enugu State. Proportionate sampling was used to draw number of pupils according to their size in population and purposive sampling technique was used to draw a sample of 87 children age 6 to 12 years old male and female from each of the five schools giving a sample of 434 respondents that were used for the study.

2.2. Instrument for Data collection

The instrument that was used for data collection is researcher's developed semi-structured questionnaire that is based on anthropometric indices and Academic performance of primary school pupils. The questionnaire is divided into three sections. Section A consisted of items that elicited information on socio-demographic characteristics such as age, sex, number in the family, parents' occupation, level of education and income. This was filled by the parents/guardians. A consent form was attached to this section and it was used to get consent from pupils /'wards,' parents/guardians as they were still minor. Weighing scale and stadiometer were used to check weight and height of the pupils respectively for anthropometric measurements. Section B comprises column for anthropometric measurements which includes weight, height, body mass index (BMI). Section C comprises column used to record the grades scored by the pupils in four key subjects (English, Mathematics, social studies and Basic sciences) offered during each of three terms examination for 2020/2021 academic session. The average of the grades in the four subjects in each term were obtained. Then, the overall average score of the three terms were determined for each child as a measure of their academic performance. Academic performance was categorized as high (>75%), average (50-74%) and low (<50%) (Nduagubam et *al.,* 2017). The instrument was subjected to face and content validity by experts in physical measurement from department of measurement and evaluation as well as in maternal and child health from Department of Nursing Science.

2.3. Reliability of the Instrument

The instrument was tested for reliability using test- retest method. Twenty two (22) Copies of the instrument were administered to respondents in rural area and another twenty two (22) Copies were administered to respondents in urban area of another Local Government area that was not used in the study representing 10% of the sample. Cronbach's Alpha was used to test the internal consistency of the instrument and an alpha value of 0.917 was obtained.

2.4. Method of Data collection

Ethical approval was obtained for the study and informed consent was obtained from the parents'/ Guardians of the pupils since they were minor. Those pupils whose parents/guardian did not sign the consent forms and answer Section A of the questionnaire, those not up to six years and not up to a session in the School were not included in the study.

Two research assistants (Nurses) were recruited and instructed on the purpose of the study, use of the instrument, characteristics of the subjects and process of data collection which included administration of instrument, taking measurements and recording grades scored by the pupils on four core subjects. Prior to data collection, initial visit was made to the selected Schools by the researcher with the introductory letter and permission letter from Enugu State Universal Basic Education Board (ENSUBEB). This was to introduce researcher and assistants and establish rapport. The visit was also to provide forum for creating sample frame from registers and choosing days of data collection for each School. The subsequent visits to the Schools was for data collection. The pupils were indicated to participate from register were given section A part of questionnaire that comprises socio demographic characteristics and consent form. These were answered by parents/guardian. On the following day the participating pupils' measurements were taken. This immediately was followed by recording their scores on four core subjects (English, Mathematics, Social Studies and Sciences) from School register. Weight and height were measured by use of standardized weighing scale and a wooden stadiometer respectively. The weight and height measurement were carried out according to standard procedures described by WHO (WHO Growth Standard, 2006). All measurements were taken with pupils on only their school Uniform because the weight is relatively the same and without shoes. Each pupil was weighed using calibrated standardized weighing scale with the accuracy of scale to the nearest 0.1kg. The weight was recorded twice and the average value was used in the analysis. The scale was set to zero point before each use and checked for accuracy with standard weights after every 20 measurements and wherever the scale was moved from place to place. Height was

measured with a wooden stadiometer placed on a flat surface measured to the nearest 0.1cm.Two measurements were taken and the average value obtained. BMI was calculated using the formula

$$BMI = \frac{weight\ (kg)}{Height\ (m)^2}(Dinsdale,\ Ridler\ and\ Ells,\ 2011)$$

Then weight for-age, Height –for-age and BMI-for-age was derived from the new WHO reference (WHO 2007 reference).Four hundred and thirty four (434) copies of the questionnaire were administered to the respondents in the five primary schools in Enugu South Local Government area within three (3) months duration and four hundred and twenty (420) were returned. Giving a response rate of 96.7%

2.5. Method of Data Analysis

Frequencies, percentages, Mean, standard deviation and Chi square were used in data analysis. Data obtained were analyzed using the Statistical Package for Social Sciences (SPSS) (Version 23.0) software. The hypothesis was tested at 0.01 level of significance.

3. Results

Table 1 Socio-demographic characteristics of respondents (n = 420)

Characteristics	Frequency	Percent (%)
Age Group (years)		
6 – 8	106	25.2
9 – 11	299	71.2
12 and above Total	15 420	3.6 100%
Mean ± SD (years)	*9 ± 1.7*	
Gender		
Male	205	48.8
Female	215	51.2
Total	420	100%
Number of children in household		
1 – 2	111	26.4
3 - 4	164	39.1
5 and above	145	34.5
Total	420	100%
Position in family		
1st child	103	24.5
2nd child	114	27.1
3rd child	107	25.5
4th child and above but not last child	39	9.3
Last child	57	13.5
Total	420	100%
Number of persons in household		
2	0	0

3 – 4	69	16.4
5 – 6	206	49.0
More than 6	145	34.5
Total	420	100%
Family size		
Small	275	65.5
Large	145	34.5
Total	420	100%
Area of residence		
Rural	87	20.7
Urban	333	79.3
Total	420	100%

Table 1 revealed the socio-demographic characteristics of the respondents. The findings indicate that their mean age was 9 (SD ± 1.7) years. More than half (51.2%) were females and a little above one-third (34.5%) were in families with more than 5 children. Less than a third (27.5%) were the 2nd child in the family. A little less than half (49.0%) were in households of about 5 – 6 people and majority were in families of a small size (65.5%). Majority of the respondents lived in urban areas (79.3%).

Table 2 Anthropometric Measurements of Respondents (n = 420)

Characteristics	Frequency	Percent (%)
Height (cm)		
111 – 120	22	1.4
121 – 130	110	72.1
131 – 140	224	6.4
141 – 150	53	13.3
151 and above	11	6.7
Total	420	100%
Mean ± SD (cm)	*134 ± 8.0*	
Weight (kg)		
16 – 21	117	27.9
22 – 27	217	51.7
28 – 33	75	17.9
34 - 39	0	0
40 and above	11	2.6
Total	420	100%
Mean ± SD (kg)	*25 ± 4.5*	
Body Mass Index (BMI)		
10.0 – 15.0	45	10.7
15.1 – 20.1	277	66.0

20.2 – 25.2	87	20.7
Above 25.2	11	2.6
Total	420	100%
Mean ± SD (cm)	18 ± 0.2	
Mid Upper Arm Circumference (MUAC)		
10 – 15	37	8.8
16 – 21	372	88.6
22 – 27	0	0
28 and above	11	2.6
Total	420	100%
Mean ± SD (cm)	*18 ± 2.8*	

Table 2 revealed the anthropometric measurements of the respondents. The mean height of the respondents was 134 (SD ± 8.0) cm and their mean weight was 25 (SD ± 4.5) kg. The mean BMI of the pupils was 18 (SD ± 0.2) cm and the mean MUAC of the respondents was 18 (SD ± 2.8) cm.

Table 3 Anthropometric indices of Respondents (n = 420)

Characteristics	Frequency	Percent (%)
Height-for-Age		
Normal	411	97.9
Moderate stunting	9	2.1
Acute stunting	0	0
Total	420	100%
Weight-for-Age		
Normal	337	80.2
Moderate underweight	83	19.8
Acute underweight	0	0
Total	420	100%
BMI-for-Age		
Overweight	147	35.0
Normal	257	61.2
Moderate thinness	16	3.8
Total	420	100%

Table 3 revealed the anthropometric indices (nutritional status) of the respondents. The proportion of the respondents who were moderately stunted and moderately underweight was 2.1% and 19.8% respectively. The prevalence of respondents who were moderately thin were 3.8%.

Table 4 Academic Performance of Respondents (n = 420)

Characteristics	Frequency	Percent (%)
Average score (%)		
0 – 24	10	2.4
25 – 49	108	25.7
50 – 74	175	41.7
75 and above	127	30.2
Total	420	100%
Rating of academic performance*		
Low	118	28.1
Average	175	41.7
High	127	30.2
Total	420	100%

Rating – low (< 50%), average (50 – 74%), high (> 75%)

Table 4 showed the academic performance of the respondents. Less than half (41.7%) had an average score of 50% - 74%. A greater proportion of the pupils were rated as average (41.7%).

Table 5 Association between Nutritional Status and Academic Performance of the Pupils (N = 420)

		Academic performance			x^2	P-value
		High N (%)	**Average** N (%)	**Low** N (%)		
Height-for-Age	Normal	118 (28.7)	175 (42.6)	118 (28.7)	21.2	<0.0001
	Moderate stunting	0 (0)	9 (100.0)	0 (0)		
Weight-for-age	Normal	111 (32.9)	145 (43.0)	81 (24.0)	14.8	0.001
	Moderate underweight	16 (19.3)	30 (36.1)	37 (44.6)		
BMI-for-age	Overweight	32 (21.8)	84 (57.1)	31 (21.1)	56.9	<0.0001
	Normal	79 (30.7)	91 (35.4)	87 (33.9)		
	Moderate thinness	0 (0)	16 (100.0)	0 (0)		

Table 4. 10 showed the association between nutritional status of the primary school schools and their academic performance. There was significant association between the height-for-age, weight-for-age and BMI-for-age of the pupils and their academic performance ($\chi 2$ = 21.2, 14.8 and 56.9 respectively at p < 0.01).

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4. Discussion

4.1. Anthropometric indices (height-for –age, weight –for –age and body mass index (BMI- for-age) among primary school pupils.

Findings from the study showed that a proportion of the primary school pupils in rural and urban areas in Enugu south LGA were moderately stunted (2.1%), moderately underweight (19.8%) and moderately thin (3.8%) (Table 3). The findings in this present study is similar but slightly higher than the findings in the study of Yadav, Kotwal and Valida (2016) in Pune, India that showed prevalence of stunting was 4.4%, wasting 6.3 % and underweight 5%. Perhaps, the reason for the variation in both studies could be linked to the fact that this present study was conducted in urban and

rural area of Enugu south LGA while the study of Yadav, Kotwal and Valida (2016) was conducted in an urban area. However, the findings in this study is better than the report in the study of Umeokonkwo, Ibekwe, Umeokonkwo, Okike, Obumneme and Ibe (2020) in Ebonyi state who documented a prevalence of 8%, 7.2% and 9.9% for underweight, thinness and stunting respectively. Perhaps, it could be asserted from the finding that there was a low prevalence of malnutrition among primary school pupils in rural and urban areas of Enugu south LGA. Possibly, there is considerable improvement of the quality of nutrition among the participants in this study propably due to Federal Government Feeding programme initiative.

4.2. Academic performance

There was observed to be variation in the academic performance of the primary school pupils in rural and urban areas of Enugu south LGA (Table 4). Specifically, a greater proportion of the respondents were found to have average performance in their academics while a third of them recorded high academic performance (41.7% and 30.2% respectively). Those, who had low academic performance were in the minority (28.1%). This is similar to the study carried out by Muluken, Alemayehu, Abate and Simegnew (2020) and Adedeji et al (2017).Perhaps, it could be suggested that a proportion of primary school pupils in this study were above board in their academics. While this finding goes a long way to commend the efforts of the state government in boosting academic performance in the state, it also reveals that there are still gaps to cover in the provision and quality educational services for primary school children in the study area. The influence of age and area of residence was also observed on the academic performance of the respondents in this present study. Highest academic performance was found among pupils who were between the ages of 6 – 8 years and who resided in urban areas (t = 5.16 and 4.37 respectively at P < 0.01).

4.3. Association between anthropometric indices (nutritional status) and Academic Performance

Findings showed significant association between anthropometric indices (nutritional status) and academic performance ($\chi2$ = 21.2, 14.8 and 56.9 respectively at p < 0.01). (Table 5). Greater percentage of the pupils who were found to be moderately stunted and moderately thin were found to have average performance in their academics than those who had normal height-for-age and BMI-for-age (100% for each as against 42.6% and 35.4% respectively). In a similar vein, a greater proportion of those who were found to be moderately underweight were found to have low academic performance than those who had normal weight (44.6% and 24.0% respectively). These findings are similar to the findings in the studies of Biachew, Mekuanint,Sileshi and Fasil (2018), Kristen and Lesley (2018); Eme, Oluwadolapo and Adeyimika (2014) as well as that of Igbokwe et al, (2017) who documented that the nutritional status of a child does not only impair the individual's health but is also associated with poor cognitive and motor development and lower school achievement.

Abbreviations Definition of terms

- Anthropometric indices in this study: Include height -for-age, weight - for-age and BMI-for-age derived using WHO 2007 reference standard.
- Academic performance: Is the quality of academic achievements of the child graded by the teacher as high (>75%), average (50-74%) and low (<50%) in 2020/2021 academic session.
- Anthropometry: Is the measurement of human body used to assess nutritional status which include height/length, weight, and mid-upper arm circumference (MUAC).
- Primary School pupils: Is a period of rapid growth from 6years to puberty age that is about 12 years.

5. Conclusion

The study revealed that a proportion of the primary school pupils in rural and urban areas in Enugu south LGA were moderately stunted, moderately underweight and moderately thin. The Anthropometric indices (nutritional status) of the primary school pupils in this study was observed to have significant influence on their academic performance as the findings showed significant association between their anthropometric indices and academic performance.

Recommendation

Health promotion and nutritional information should be disseminated as a matter of urgency to parents and caregivers of the children because they play a great role in meeting the nutritional needs of the children as well as determining their nutritional status.

Compliance with ethical standards

Disclosure of conflict of interest

The Authors declare that they have no conflict of interest.

Statement of ethical approval

Ethical clearance was gotten from Ethical Committee of the University of Nigeria Teaching Hospital, Enugu, Nigeria. When ethical clearance for the study is granted, it was submitted to the Enugu State Universal Basic Education Board (ENSUBEB) for permission to carry out the study in the selected public primary schools.

Statement of informed consent

Informed consent was obtained from parents'/ Guardians of the pupils included in the study.

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