ANTHROPOMETRIC INDICES AND COGNITIVE PERFORMANCE OF SCHOOL-AGE CHILDREN IN SAGAMU, OGUN STATE, NIGERIA.

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ABSTRACT
This study examined the anthropometric status and cognitive performance of school-age children in Sagamu, Ogun State, Nigeria. A descriptive cross-sectional survey with multistage sampling approaches was carried out on 250 school children, to gather data on their socio-demographic characteristics. The World Health Organization's Anthro Plus software was used to calculate body mass index for age, height for age, and nutritional status using the anthropometric assessment approach. Additionally, the respondent's academic performance was evaluated through the use of a cognitive questionnaire, which included questions about drawing the human figure, thinking patterns, numerical recall, and sentence structure. Results showed that the respondents' mean weight, height, age, and gender did not differ significantly. The nutritional state of the respondent showed that, while 65.2% had a normal BMI-for-age, (28.4%), (5.6%), and (0.8%) were mildly, moderately, and severely thin respectively. Of the respondents, a majority had a normal nutritional status, 36, 11.2, and 1.2% were mildly, moderately, and severely stunted. In addition, nearly all the respondents performed well academically in terms of number recall; around 90% are very excellent at pattern reasoning. In conclusion, anthropometric indices were found to be significantly correlated with students' cognitive ability.

Keywords: Anthropometric indices, Academic performance, School-age children, Nutritional status, Health

1.0 INTRODUCTION

Worldwide, it is estimated that over 200 million school-age children are overweight and stunted, making malnutrition in this population a major public health concern (UN-IGME, 2019). It is believed that malnutrition is a pathological condition caused by an inconsistent diet. Based on the quantity of energy and other nutrients ingested, it can be roughly classified as either under or over-nutrition. Inadequate consumption of foods high in energy and other essential nutrients for growth, survival, and reproduction leads to undernutrition (Ngo, Ortiz-Andrellucchi & Serra-Majem, 2016).
Amare, Benson, Fadare, and Oyeyemi (2018) reported that the prevalence of stunting in Nigeria differs by geopolitical zone, with the North-West reporting a 55% prevalence and the South-East reporting a 16% prevalence. School-age children (SAC) who eat diets high in starchy staples and low in fresh produce**,** meat, and dairy products are more vulnerable to undernutrition and its effects. This is due to the possibility of vitamin deficits brought on by such diets (Moursi, Arimond & Dewey, 2008).
According to Grantham-McGregor, Walker, and Chang (2007), about 200 million children under the age of five do not reach their full potential in terms of cognitive development because of a combination of malnourishment, diseases, poverty, and poor care. Cognitive performance is the mental process through which an individual applies perception, reasoning, memory, learning, and attentional skills to process information (Udani, 1992).
Poorer academic performance is associated with both hunger and undernutrition, which both impact cognitive function (Zerga, Tadesse, Ayele & Ayele, 2022). Children who endure malnutrition during the most developmental years of their brains score substantially worse on reading, vocabulary, mathematics, and general knowledge assessments (Brown & Pollitt, 1996). Research has shown that undernourishment throughout the school-age period has a significant impact on children's cognitive and motor skills **(**De Onis & Branca, 2016; Adedeji, John, Okolo, Ebonyi, Abdu & Bashir, 2017).
Protein-energy malnutrition (PEM) has several impacts on SAC, one of which is decreased physical and mental development. This has to do with students enrolling in school late or not at all **(**Gibson, Manger, Krittaphol, Pongcharen, Gowachirapa, Bailey & Winichagoon, 2007**;** Lodhi, Rahman, Lodhi, Wazir, Taimor, &Jadoon, 2010**).** It's also important to keep in mind that children who seem to be eating well and getting enough calories for their daily activities may nevertheless be suffering from "hidden hunger" brought on by vitamin inadequacies. Stunting, a decreased IQ, and even death are risks associated with deficiency in certain micronutrients, such as iodine, zinc, iron, and vitamin A (WHO, 1999).
Furthermore, because many children in less developed countries do not complete their primary education, and those who completed did not perform as well as children in developed countries, many researchers are interested in the relationship between nutrition, health, and educational achievement of the school-age population in these countries Several studies in developing countries found out that height- for -age, which is an indicator for stunting, is related to educational achievement (Adepoju & Cooker, 2019**).**
Thus, the current study aims to determine the anthropometric indices and cognitive performance of school-age children in Sagamu, Ogun state, Nigeria.

2.0 MATERIALS AND METHODS

Research design and sampling techniques
The study's design was descriptive and cross-sectional. The research population was selected using a multi-stage sampling technique that included a purposive selection of Sagamu, a random selection of five out of the fifteen political wards, and a systematic selection of pupils (respondents) from primary four through primary six at regular intervals.

Sample Size Determination
Gibson's 2007 formula was used to calculate the sample size;

$$N = {Z^2 P(1-P)}/{d^2}$$

Where N= sample size
Z= the standard normal variable for a 95% confidence level is: 1.96
P= prevalence of stunting in Ogun state is 17.4% (Idowu et al., 2011).

Q= 1-P (1-0.174) = 0.826

D = the desired level of precision at 5% (0.05)

$$N = \frac{1.96^2 X 0.174 X 0.826}{0.05^2} = \frac{3.8416 X 0.144}{0.0025} = 220$$

10% was added to account for non-response

0.10 x 220 =22

220 + 22 = 242, it was rounded off to 250.

The total number of respondents that were assessed during the research was 250.

Data collection

Data collection was done with the aid of a semi-structured questionnaire with the following sections; socio-demographic characteristics where information on respondent's age, sex, family structure, religion, and other personal data of the respondents was obtained, academic performance, and Anthropometric measurement.

Anthropometric measurements

The participant was told to stand with their backs to the height metre and their heads resting on it to measure the pupil's height barefoot using a height metre. It was requested of the respondent to look straight. The meter's headpiece was pressed flat or lowered to the level of the hair before the measurement was taken and recorded, with a precision of 0.1cm. A digital bathroom scale, calibrated regularly to ensure accuracy, was used to measure weight. Readings were taken twice to ensure precision. The weight was measured in kilograms (kg). Thereafter, height-for-age, weight-for-age, and BMI-for-age indices were derived from anthropometric parameters.

Academic performance.

The respondents' grades from prior promotion exams were used to evaluate the student's academic achievement. A questionnaire covering numerical recall, pattern recognition, and human anatomy drawing was also given out. The student's overall performance was divided into three categories: poor, good, and very good.

Statistical/Data analysis

The data collected was subjected to both descriptive and inferential statistics. Descriptive statistics such as percentage, frequency, chart, mean and standard deviation were used. The chi-square test was used to test for the statistically significant association between the anthropometric indices and cognitive performance of the pupils using Statistical Package for Social Science (SPSS) version 20.0. Z-score for Height-for-age (HAZ) Weight-for-age, (WAZ), and Body mass index-for-age (BMIZ) were used to define stunting, underweight, and thinness, respectively using a cut-off value of <-2 standard deviations from the median value of the references, using WHO-Anthroplus software.

3.0 RESULTS AND DISCUSSION

Results

Table 1 shows the socio-demographic characteristics of the respondents. The majority of the respondents (51.6%) were between the ages of 8-10 years, most (56.4%) were male, while 56.8% were in primary 4-6. The result also shows that more than half (56%) of the respondents were Christian, 31.2% of the respondents occupied third position in the family while 16% of the respondents belonged to other birth ranges other than first and second.

Table 1: Socio-demographic characteristics (SDC) of respondents

Variables	Frequency	Percentage (%)
Age range		
6-7 years	17.0	6.8
8-10 years	129.0	51.6
11-12	104	41.6
TOTAL	**250.0**	**100**
Sex		
Male	140.0	56.0
Female	109.0	43.6
NR	1.0	4.0
TOTAL	**250.0**	**100**
Class		
Primary 1-3	107.0	42.8
Primary 4-6	142.0	56.8
NR	1.0	4.0
TOTAL	**250.0**	**100**
Religion		
Christianity	140.0	56.0
Islam	106.0	42.4
Others	4	1.6
TOTAL	**250.0**	**100**
Position of the child		
First born	55.0	22.0
Second born	77.0	30.8
Third born	78.0	31.2
Others	40.0	16.0
TOTAL	**250.0**	**100**

The mean weight, height, and age of the respondents were 31.25±5.89, 133.25±6.73 and 116.12±15.91 respectively for males while females had a mean weight, height, and age of 30.61±5.29, 132.42±7.59 and 114.80±16.31 respectively. There was no significant difference (P>0.05) between the mean weight, height, age, and gender of the respondents as evident in table 2 below.

Table 2: Mean and standard deviation of anthropometric measurements

Gender	Average Weight Mean ±SD	Average Height Mean ±SD	Average Age Mean ±SD
Male	31.25±5.89	133.25±6.73	116.12±15.91
Female	30.61±5.29	132.42±7.59	114.80±16.31
F	0.78	0.80	0.41
P-value	0.38	0.37	0.52

Significant at (P<0.05)

Table 3 below show the cognitive performance of the respondents. In number recall, almost all the respondents (99.6%) were very good, regarding pattern reasoning, the majority (90%) were very good, 92.4% were very good in sentence arrangement while for drawing the human body, (56.4%) were good and 38.6% of the respondents were very good respectively.

Table3: Cognitive performance of the respondents

Variable (score)	Frequency	Percentage (%)
Number Recall		
Very good **(8-10)**	249	99.6
Good **(5-7)**	0	0
Poor **(< 5)**	1	0.4
Total	250	100.0
Pattern Reason		
Very good **(8-10)**	225	90.0
Good **(5-7)**	11	4.4
Poor **(< 5)**	14	5.6
Total	250	100.0
Sentence arrangement		
Very good **(8-10)**	231	92.4
Good **(5-7)**	6	2.4
Poor **(< 5)**	13	5.2
Total	250	100.0
Drawing human body		
Very good **(8-10)**	94	37.6
Good **(5-7)**	141	56.4
Poor **(< 5)**	15	6.0
Total	250	100.0

With regard to cognitive performance, more than half of the respondents (76.8%) were good, 14.4% were very good and 8.8% were poor respectively as shown in Figure 3.

The table 4 below shows the association between nutritional status and academic performance of respondents. No significant association (P>0.05) was observed between nutritional status and the academic performance of respondents.

Table 4: Association between Nutritional Status and Academic Performance

	Height for age					
	Normal	**Mildly Stunted**	**Moderately Stunted**	**Severely Stunted**	χ^2	**P-Value**
Academic performance						
Excellent/very good	39 (15.6)	24(9.6)	5(2.0)	0(0.0)		
Good	69(27.6)	46(18.4)	20(8.0)	2(0.8)	6.24	0.40
Fair/average	21(8.4)	20(8.0)	3(1.2)	1(0.4)		
			BMI for Age			
	Normal	**Mildly Thin**	**Moderately Thin**	**Severely Thin**	χ^2	**P-Value**
Academic performance	**X^2**	**Df**	**P-value**			
Excellent/very good	49(19.6)	17(6.8)	1(0.4)	1(0.4)		

Good	88(35.2)	38(15.2)	10(4)	1(0.4)	5.62	0.47
Fair/average	26(10.4)	16(6.4)	3(1.2)	0(0.0)		

In table 5 below, a significant association (P<0.05) was observed between nutritional status (height for age and socio-demographic characteristics such as age. Also, a significant relationship was observed between BMI for age status, class and position in the family.

Table5: Association between nutritional status and socio-demographic characteristics

	Height for Age			BMI for age		
Socio-demographic	**χ^2**	**df**	**P- value**	**χ^2**	**df**	**P-value**
Age	14.37	6	0.03*	7.03	6	0.32
Sex	5.72	3	0.13	4.78	3	0.12
Class	12.91	9	0.13	22.26	9	0.01*
Religion	5.93	6	0.43	5.63	6	0.47
Position in the family	23.23	6	0.08	18.14	15	0.4*

Statistically significant (p<0.05) *

Nutritional status of the respondents

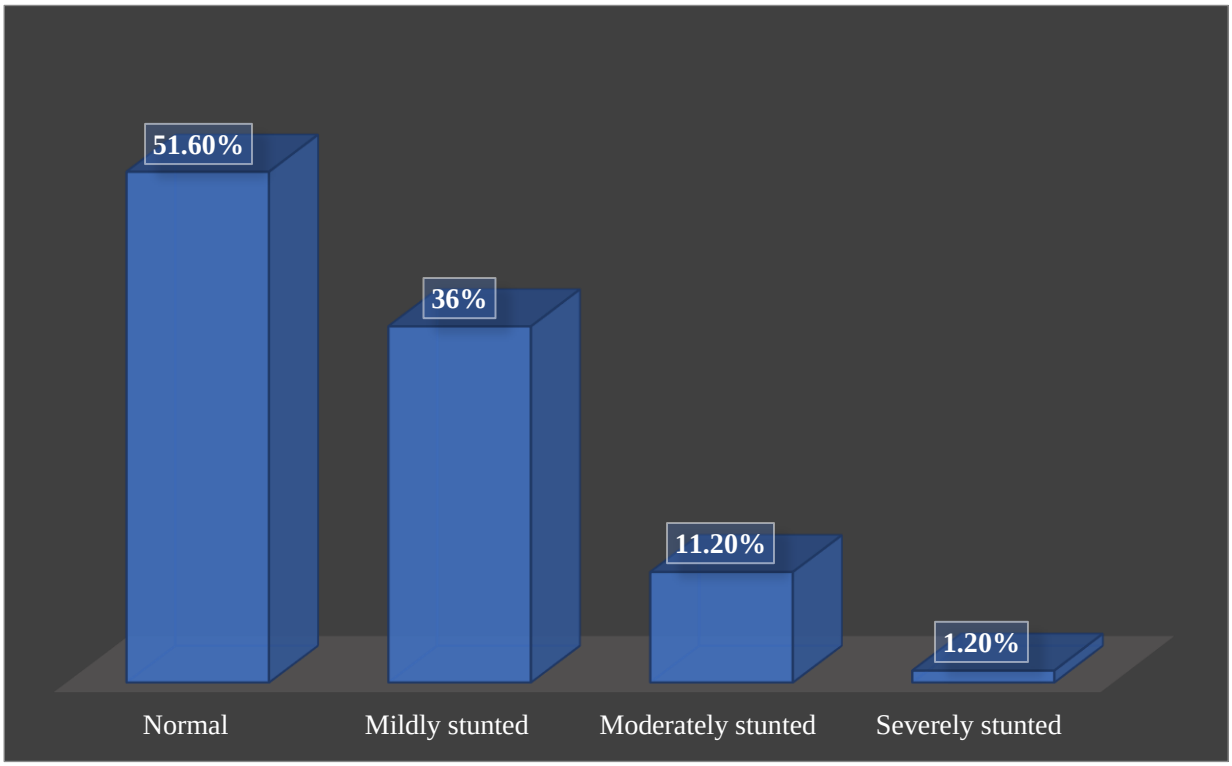

Figure 1: Height for Age status of the respondents

Figure 1 shows the height for age status of the respondents. It revealed that half (51.6%) of the respondents had normal height for their age, while 36% were mildly stunted, 11.2% were moderately stunted and 1.2% were severely stunted.

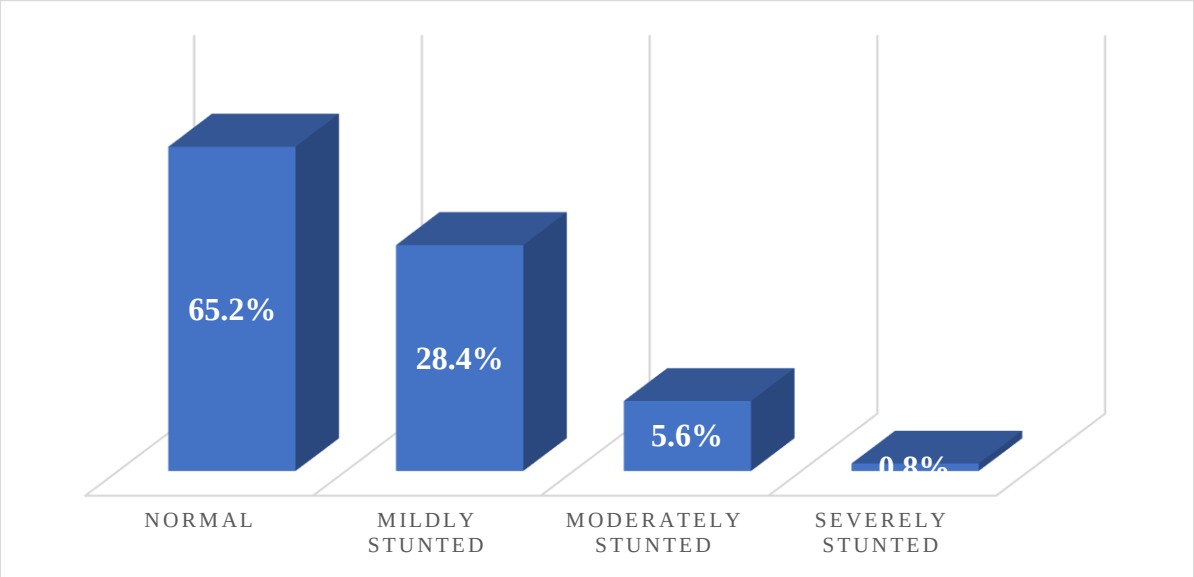

Figure 2: BMI for age of respondents

Figure 2 shows the BMI (Body Mass Index) for the age status of respondents. It revealed that the majority (65.2%) of the respondents had normal body mass index for age, while 28.4% were mildly thin, 5.6% were moderately thin and 0.8% were severely thin.

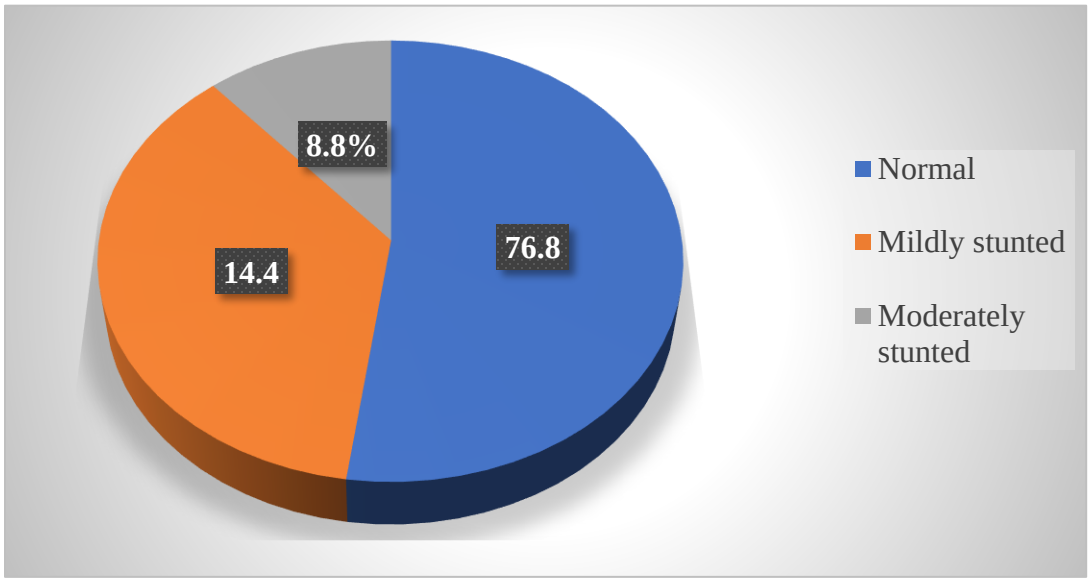

Figure 3: Shows the overall cognitive performance of the respondents

DISCUSSION

The school-age group has higher nutritional needs than the preschool years since it is a dynamic time of active growth and mental development in childhood. To maintain the need, malnutrition among this age group continues to be a serious public health issue in developing nations (Fontanilla. Catza. Nano, & Adaya, 2023). Over the years, several studies have been carried out in different parts of Nigeria to investigate the connection between childhood malnutrition and cognitive performance; however, none of them have been carried out in Sagamu, Ogun state, Nigeria. Therefore, there is no information available about childhood malnutrition in this area.

According to the SDC results, the majority of respondents (56.0%) were male and between the ages of 8 and 9; most were in primary 4 to 6 (56.8%) and 56.2 percent identified as Christians. These findings are consistent with the study of Olwedo, Mworozi, Bachou, & Orach, (2008). In a study conducted by Adepoju and Cooker

(2019), 99.3% of the respondents were between the ages of 6 and 10 years old, and more than half (61.7%) of the respondents identified as Christians. The bulk of respondents in this survey were the family's second (30.8%) and third (31.2%) born children, which aligns with a study by Acham, Kikafunda, Malde, Oldewage-Theron, and Egal (2012).

Male mean weight, height, and age (31.25±5.89, 133.25±6.73, and 116.12±15.91) were found to be substantially closer to female mean values (30.61±5.29, 132.42±7.59, and 114.80±16.31) respectively according to the respondents' mean anthropometry. The respondents' mean weight, height, age, and gender did not differ significantly (P>0.05). Similar results were obtained in the study undertaken in Southern Nigeria by (Omuemu & Ogboghodo, 2020). Stunting is a sign of past or long-term undernutrition, wasting is a sign of present undernutrition, and being underweight is a convenient synthesis of both past and present undernutrition. Stunting, wasting, and underweight prevalence were shown to be indicators of undernutrition in the current investigation. The respondents' height concerning their age was measured. The data showed that 51.6% of the participants had normal height for their age, 36% had mild stunting, 11.2% had moderate stunting, and 1.2% had severe stunting. This suggests that nearly half of the respondents assessed in this study were stunted. Nevertheless, this data still reveals a significant number of nutritional status departures from the norm. This is at odds with a study by Acham et al. (2012) in Ghana, where a higher number of respondents (56.7%) were stunted. Furthermore, a 2019 study by Adepoju and Cooker among a similar population in Ilaro revealed that the respondents had a high prevalence of stunting, with an overall reported percentage of moderate stunting of 50.7% and severe stunting of 3.7%. Variations in location, socioeconomic background, and nutritional consumption may be the cause of the discrepancy. In addition, the respondent's body mass index was determined; it was found that the majority of the respondents (65.2%) had a body mass index that was normal for their age, with the remaining respondents (28.4, 5.6, and 8%) being mildly, moderately, and severely thin, respectively. The study's conclusions represent the nutritional condition of the participants in the research area; eating habits, inadequate nutrition during pregnancy, and a lack of access to food are the main causes of undernourished infants.

When comparing mean cognitive test scores to anthropometric indices, children who are stunted (HAZ < -2SD) and underweight (WAZ < - 2SD) had lower scores than normal. The cognitive test scores were assessed using number recall, pattern reasoning, sentence arrangement, and drawing the human body.

Stunted children showed significantly lower scores in pattern reasoning and number recall when compared to normal children. Underweight children showed significantly lower mean scores in sentence arrangement and school performance, indicating short-term memory.

This adds to the body of evidence demonstrating how poor nutrition negatively influences schoolchildren's cognitive development and academic ability. This result is in line with studies conducted in other developing countries (Taras, 2005). A comparable study from Malaysia that looked at the effects of gender and nutritional status on academic achievement and cognitive function among primary school pupils revealed a negative correlation between stunting and cognitive function (Hanks, Just, Smith, & Wansink, 2012). Undernutrition and schoolchildren's psychological exam scores were found to be negatively correlated in an Indian cross-sectional study (Kleinman, Hall, Green, Korzec-Ramirez, Patton, Pagano, & Murphy 2002).

CONCLUSION

This study concludes that Stunting was more common among school-age children in Sagamu, Ogun state, Nigeria than other anthropometric indices (underweight and thinness), and the stunted pupils showed significantly lower scores in cognitive evaluation when compared to school-aged children with normal nutritional status**.**

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