

## BMI-For-Age Cut-Off as an Indicator of Adiposity among In-School Children (Age 4-11 Years) in Obio/Akpor LGA, Rivers State, Nigeria

Research Article

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### Abstract

**Background:** Childhood overweight and obesity has been an issue of great concern to developing and developed nation where as degenerative underweight has ravaged the underdeveloped and war turn countries.

**Aim:** This present study investigated the nutritional status of in-school children in Obio/Akpor Local Government Area of Rivers State using the WHO Body Mass Index-for-Age percentiles cut-offs.

**Design and Methods:** This study was designed as a cross-sectional analytical research. A total of 310 in-school children comprising of 149 boys and 161 girls were multi-staged randomly selected from primary schools within Obio/Akpor LGA of Rivers state, Nigeria. Anthropometric determination of weight and height of the selected children were carried out by standard methods. Stages of development (early childhood [4-7 years] and late childhood [8-11 years]) and sex-specific prevalence of adiposity were determined using WHO BMI-for-age percentile cut-offs. SPSS version 23 (IBM® Armonk, New York) was used to analyse the data.

**Results:** The Prevalence of overweight was found to be 29%; with 44% in children age 4-7years and 15% for children age 8-11years. Chi-square ( $\chi^2$ ) analysis showed that more girls (33.7%) than boys (29.1%) were significantly overweight ( $F=2.138, P=0.032$ ); however nutritional status was not associated with sex ( $\chi^2=3.12, P>0.05$ ) but with developmental stage when stratified with sex ( $\chi^2=52.306, P<0.01$ ).

**Conclusion:** The prevalence of overweight was high; but higher in females than males, observed at early childhood. Greater adiposity at early childhood with gradual reduction through late childhood may be associated with high calorie-based dieting, reduced exercise and sedentary life among younger children.

**Keywords:** BMI-for-Age Percentile; In-School Children; Adiposity; Obio/Akpor Local Government Area.

### Introduction

Childhood overweight and obesity has been an issue of concern for both developing and developed countries [1] while underdeveloped and war turn countries still suffers ravaging underweight and nutritional impoverishment. Overweight and obesity are linked to more deaths worldwide than underweight. Most of the world's population live in countries with high motility associated with overweight and obesity as observed in underweight [2]. WHO report for 2014 identified a doubled prevalence of worldwide obesity between 1980 and 2014. In 2013, 42 million children under the age of 5 were overweight or obese. Overweight

and Obesity which was once considered a high-income country problem, are now on the rise in most urban settlements of low- and middle-income countries. There is a higher percentage of about 30% increase in childhood overweight and obesity of lower- and middle-income countries when compared to that of high-income countries [2].

Childhood obesity have long considered as the most serious public health challenges of the 21<sup>st</sup> century, with evidence of increased morbidity and mortality across the globe [3]. Obesity can harm nearly every system in a child's body. The heart and lungs, muscles and bones, kidneys and digestive tract and the hormones that

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**Received:** October 27, 2017

**Accepted:** November 28, 2017

**Published:** November 30, 2017

**Citation:** Aigbogun EO Jr, Ibeachu PC, Ikechukwu E. BMI-For-Age Cut-Off as an Indicator of Adiposity among In-School Children (Age 4-11 Years) in Obio/Akpor LGA, Rivers State, Nigeria. *Int J Pediat Health Care Adv.* 2017;4(7):63-69.

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control blood sugar and puberty are target in obesity which can have negative social and emotional consequences [4]. Sadly, overweight or obese youth have substantially higher odds of remaining so through adulthood [5], thus increasing their risk of disease and disability later in life.

Hunger, underweight, and stunting of children have over the years been a nutritional concerns across Africa, and even at present, 20 to 25% of pre-schoolers in sub-Saharan Africa have been said to be underweight [6]. Child overweight and obesity are on the rise too, as the percentage of pre-schoolers in Africa who are overweight or obese have more than doubled over the past two decades, from 4% in 1990 to 8.5% in 2010 [7]; however, statistics shows that the increase are more obvious in Northern Africa than the rest of the continent. WHO [2], Ogden et al., [8] and NCHS [9] reported that Childhood obesity has more than doubled in children and tripled in adolescents in the past 30 years; with the fundamental cause associated with energy imbalance between calories consumed and expended [2, 10, 11]. Globally, there is increased consumption of fatty food, coupled with increased physical inactivity due to the increasingly sedentary nature of children both in and out of school, changing modes of transportation, and increased urbanization [10, 11]. According to Lobstein et al., [1] and Mogre et al., [12] childhood overweight and obesity is currently not only associated with the economic status of the country, as both developed, developing and underdeveloped countries have high prevalence. The issues of obesity cuts across both social and economic norms of a country as changes in dietary and physical activity patterns are often the result of environmental and societal changes associated with poorly formulated policies in sectors associated with human endeavours [2].

Studies have shown that overweight/obese children and adolescent when compared to their normal counterparts are at a higher risk of growing up to remain obese, even at adulthood [13, 14]. Also Freedman et al., [13] indicated that children who became obese as early as age 2 were more likely to be obese as adults, with a strong established between childhood obesity and cardiovascular diseases [2, 15], cancer and osteoarthritis [16]. Several non-pathologic factors (lifestyle) such as physical inactivity, television viewing/video games [12, 17], pre-and post-school activities, diet (especially midnight snacking) [12], bedtime [18-20] as well as an obesogenic environment [12, 17] has been shown to be the cause of increasing prevalence of obesity among children. Strategies for reducing obesity have been explored and these include but not limited to; Limiting unhealthy foods (refined grains and sweets, potatoes, red meat, processed meat) and beverages (sugary drinks), Increase availability of healthier food and beverage choices in public service venues [20], Increasing physical activity, Limiting television time, screen time, and other "sit time", Improving sleep [18-21], healthy habits during pregnancy, reducing stress [20], among others.

Therefore this study was carried out to determine the nutritional status (using the WHO BMI-for-Age percentile cut-offs) of in-school children of ages 4-11 years in Obio/Akpor Local Government Area of Rivers State.

## Significance for Public Health

This work is significance to public health because the economic and social burden of childhood overweight and obesity on the

parent and the nation is grave. The nutritional status of children can be effectively evaluated using the BMI-for-age percentile, as it takes into consideration growth pattern with respect to age. The evaluation of children in any Nigerian state cannot be holistic, because of the complex settlement systems; thus the need to study the Local Government Areas (LGAs) separately is very significant. Obio/Akpor is the second richest LGA in Nigeria and has developed rapidly causing a spontaneous change in life style which has created an opportunity for obesity/overweight to thrive. Therefore, in designing an interventional and management plan, it is necessary to have a good understanding of the dynamics, backed up by statistical evidence, to ensure effective strategy to tackle the causes and not the symptoms.

## Research Design and Methods

This research is designed in the form of quantitative, normative and analytical cross-sectional survey to collect data from a set of in-school children from age 4-11 years within Obio/Akpor LGA of Rivers State, through a multistage random sampling technique involving 310 randomly selected children. Ethical approval was obtained from the Ethics Committee of the University of Port (reference number UPH/R&D/REC/04), while informed consent were received from the primary school headmasters and proprietors prior to commencement of the research. The research was carried out in line with the current Revised CIOMS (Council for International Organization of Medical Sciences) International Ethical Guidelines. This study was carried out from June 19, 2016 to October 2016.

## Demographic Data

Demographic data such as age, sex, mode of transport to school and parents' occupation were obtained from the comprehensive schools' record and the participating pupils.

## Anthropometric Measurements

About three hundred and ten (310) in-school children who presented themselves for measurement were given health education and detailed information on the aim as well as the objectives of this study. Two anthropometric variables (height and weight) were measured using standard procedure. The height was measured to the nearest 0.1cm using a stadiometer and the weight was measured to the nearest 0.5kg using digital weighing scale, while the ages of the children were obtained from a comprehensive school register.

The data collected from the fieldwork were sorted out in two categories; early childhood=4-7years and late childhood=8-11years, assigning separate codes for each category. The data collected were manually compiled, summarized and entered into master sheets. Coding and entries were checked with both the master sheet, and the computer. Data processing was done first manually on the data master sheets using results from questionnaire and then it was entered into the 2013 EXCELSHEET and cross-checked for errors.

## Statistical Analysis

Age- and sex-specific classification of overweight and obesity were determined by BMI-for-age percentile cut-off points;

as recommended by the World Health Organisation [22]. Classification based on the WHO cut-off points using percentiles were as follows; values >95<sup>th</sup> percentile (overweight), 85<sup>th</sup>-95<sup>th</sup> percentile (at risk of overweight), 5<sup>th</sup>-85<sup>th</sup> percentile (normal), and <5<sup>th</sup> percentile (underweight). These values are age specific and differ from one age to another. BMI was calculated as weight (kg) divided by height (m) squared. Subjects were categorized into 2 groups based on the WHO recognized children's developmental stages; 4-7 years (early childhood) and 8-11 years (late childhood); coincidentally, the grouping aligned with the Nigerian in-school age range.

SPSS Version 23 (IBM® Armonk, New York, USA) ANOVA and Unpaired t-test was used in assessing sex differences in the measured anthropometric parameters. Fisher's Chi-square trend analysis and Z-test of proportionally were used to determine the association between BMI-for-age status with age, sex, and the stages of childhood development. Confidence level was set at 95% and  $p < 0.05$  was considered to be statistically significant.

**Results**

The data used in this study were expressed in graphs and tables. Presented in Figure 1 are the sex distributions of the participants. Table 1 summarizes the demographic characteristics of the studied participants and the comparative analysis was done in Table 2-5. The study included 141 boys (45.5%) and 169 girls (54.5%) distributed in the age groups; 4 years (48, 15%), 5 years (45, 15%), 6 years (28, 9%), 7 years (28, 9%), 8 years (35, 11%), 9 years (30, 10%), 10 years (44, 14%), 11 years (52, 17%) (Figure 1). The mean ( $\pm$ S.D) weight of male in-school children was  $24.11 \pm 5.07$  kg while female was  $25.41 \pm 5.22$  kg. Their height did not vary significantly as boys were slightly taller ( $1.15 \pm 0.11$ mm) than girls ( $1.14 \pm 0.10$ mm). The mean ( $\pm$ S.D) body mass index (BMI) of boys was calculated to be  $19.42 \pm 2.73$  kg/m<sup>2</sup> while girls had a BMI of  $19.42 \pm 3.39$  kg/m<sup>2</sup>. The weight and body mass index of the children showed significant variation which no variance was observed in the height [Table 1].

Generally from Table 2, 48.1% (149/310) of the studied participants were aged 4-7 years of age; more girls (89; 28.7%) than boys (60; 19.4%) were observed within that age range while 51.9% (161/310) were aged 8-11; more boys (81; 26.1%) than girls (80; 25.8%) were observed within that age range. Christians were observed to be 281 (90.7%), Islamist 24 (7.7%) while others 5 (1.6%) included those who declined disclosing their religious affiliation. 208 (67%) of the children indicated their parents as skilled workers while 102 (33%) stated unskilled labour as their parents occupational status. 97 (31%) of the children walked to school while 28 (9%) ride a bicycle and 185 (60%) makes use of pick-up vehicles/motorbikes.

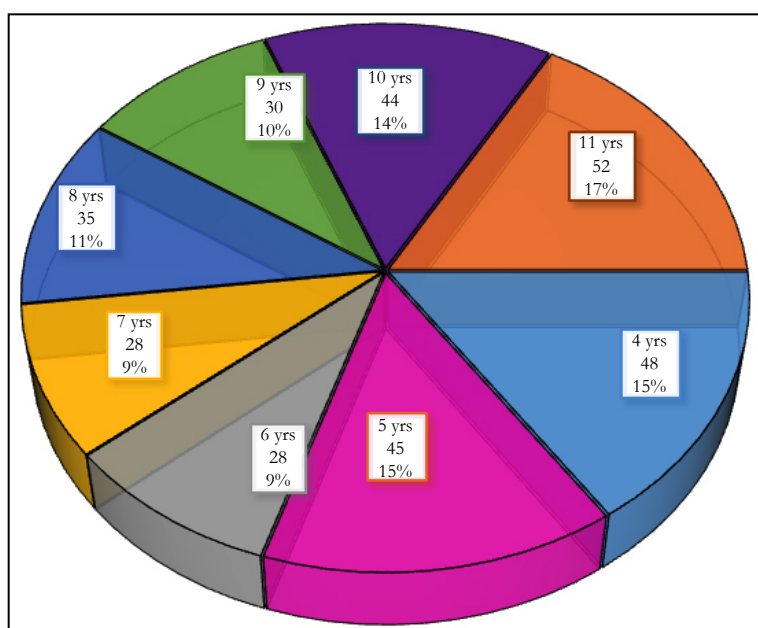
The nutritional status of the children were determined and compared using the BMI-for-Age cut offs percentile, ANOVA and t-test with two broad classifications;

- [1] Sex of the child
- [2] Stages of development (early childhood and late childhood)

**Sex and Nutritional Status**

The comparison of the distribution of the BMI-for-age status of the sexes presented in Table 3 showed that 4.2% of the total children were underweight, 26.5% were at risk of overweight, 28.7% were overweight, and 40.6% were normal. The test of association showed no relationship between sex and nutritional status ( $\chi^2=6.98; P=0.072$ ). Insignificant but higher number of boys (6.4%) compared to 2.4% of girls were found to be underweight ( $F=1.757; P=0.064$ ). On the other hand, almost equal proportions of normal children were observed (41.8% of boys and 39.6% of girls) ( $F=0.393; P=0.697$ ). By proportion more boys (29%) were found to be at risk of being overweight than girls (24%), but the difference was not significant ( $F=0.958; P=0.337$ ) and significantly greater percentage of girls (33.7%) were overweight when compared to boys (23%) ( $F=0.958; P=0.337$ ).

**Figure 1. Total Age Distribution of the Children.**



**Table 1. General Characteristics of the study population.**

Variables	Total (n=310)	Boys (n=141)	Girls (n=169)
<b>Age group</b>			
4yr-7yr (Early childhood)	149 (48.1%)	60 (19.4%)	79 (28.7%)
8yr-11yr (Late childhood)	161 (51.9%)	81 (26.1%)	80 (25.8%)
<b>Religious Background</b>			
Christianity	281 (90.7%)	126 (40.6%)	155 (50.0%)
Islam	24 (7.7%)	11 (3.5%)	13 (4.2%)
Others	5 (1.6%)	4 (1.3%)	1 (0.3%)
<b>Parent's Occupational Status</b>			
Skilled labour	208 (67%)	97 (31%)	111 (36%)
Unskilled labour	102 (33%)	44 (14%)	159 (19%)
<b>Means of Transport to School</b>			
Walking	97 (31%)	57 (18%)	40 (13%)
Bicycle riding	28 (9%)	20 (6%)	8 (3%)
Vehicle/Motorcycle pick up	185 (60%)	64 (21%)	121 (39%)

**Table 2. Descriptive Statistics, ANOVA and T-test of Difference in Sample Means.**

Parameters	Sex	Mean ± S.D	M.D ± S.E.D (M-F)
Weight (kg)	Male	24.11 ± 5.07	-1.304 ± 0.58* <sup>†</sup>
	Female	25.41 ± 5.23	
Height (m)	Male	1.25 ± 0.11	0.01 ± 0.01
	Female	1.24 ± 0.10	
Body Mass Index (kg/m <sup>2</sup> )	Male	18.12 ± 2.73	-1.302 ± 0.35***
	Female	19.42 ± 3.39	

Note: Kg=Kilogram, m=meters, S.E=Standard error, S.D=Standard deviation, M.D=Mean difference, S.E=Standard error of mean difference.

† Varies significantly at p<0.05; Significant mean difference at \*P<0.05; \*\*P<0.01.

**Table 3. Sex and BMI-for-age (Nutritional) Status.**

	Nutritional status				Chi-square analysis		
	<5 <sup>th</sup> percentile (underweight)	5 <sup>th</sup> -85 <sup>th</sup> percentile (normal)	85 <sup>th</sup> -95 <sup>th</sup> percentile (at risk of overweight)	>95 <sup>th</sup> percentile (overweight)	χ <sup>2</sup>	P-value	Inf.
Male (%)	9 (6.4)	59 (41.8)	41 (29.1)	32 (29.1)	6.98	0.072	NS
Female (%)	4 (2.4)	67 (39.6)	41 (24.3)	57 (33.7)			
Total (%)	13 (4.2)	126 (40.6)	82 (26.5)	89 (28.7)			
[z] test of proportion (P-value)	1.757 (0.064)	0.393 (0.697)	0.958 (0.337)	-2.138 (0.032)			

Note: χ<sup>2</sup> = Chi-square calculated, P-value=Probability value, Inf.=Inference (NS=Not Significant).

**Stages of Development and Nutritional Status**

Table 4 displays the outcome for the comparison of nutritional status of children at early (4-11yrs) and late (8-11yrs) childhood. Among the studied children in their early childhood, 5% (7/149) were underweight, 31% (46/149) at risk of becoming overweight, 44% (65/149) overweight, 31% (21/149) had normal BMI-for-age status. At late childhood, 6% (4/161) were underweight,

22% (36/161) at risk of becoming overweight, 15% (24/161) overweight, 59% (95/161) had normal BMI-for-age status. Except for the underweight group of children (F=0.619; P=0.535), the normal group had significantly higher percentage at the late stage (F=6.109, P<0.001) while the group of children at risk of obesity (F=2.251, P=0.024) and overweight (F=6.181, P<0.001) were significantly higher in the group of children within age 4-7 years (their early stage).



**Sex and the Nutritional Status of Children at Early (4-7 years) and Late (8-11 years) Childhood**

The comparison of male and female children with nutritional status at their early and late childhood was presented in Table 5. The chi-square analysis showed that the outcome of the nutritional status of the children at early childhood was significantly associated with sex ( $\chi^2=14.493, P=0.002$ ); as 7.1% of male children within age 4-7 years were observed to be underweight as against 2.5% for the female children. Significantly, more male (31.4%) than female (11.4%) children were observed to be normal ( $F=3.007, P=0.003$ ) and more female (31.4%) than male (31.4%) children were observed to be overweight ( $F=2.495, P=0.013$ ). When the nutritional status of children at late childhood was related to sex, there was no significant association ( $\chi^2=3.171, P=0.366$ ), although more boys (25.9%) were observed to be at risk of being overweight while girls children were overweight (18.8% as against 11.1% for females). However, the Z-test of proportionality did

not reveal any significant difference in the distribution ( $P>0.05$ ).

**Discussion**

Childhood overweight and obesity has been an issue of great concern for both developing and developed countries.[1-3]Body mass index (BMI) is NOT a diagnostic tool but a screening tool used to identify and classify individuals who are below or above normal weight. The use of BMI-for-age percentile cut-offs limits the discrepancy in age and sex for children. BMI-for-age is regards as one of the standard measure of the nutritional status of children between ages 2 to 19 years, because at such age, there is a greater probability that their BMI could rapidly change [23]. The expert committees' of W.H.O recommendations are to classify BMI-for-age at or above the 95<sup>th</sup> percentile as overweight and between the 85<sup>th</sup> and 95<sup>th</sup> percentile as "at risk of overweight" [24]. Overweight rather than obesity is a preferred term for describing children and adolescents with a BMI-for-age equal to or greater than the 95<sup>th</sup> percentile.

**Table 4. Stages of Development and BMI-for-Age (Nutritional) Status.**

	Nutritional status				Chi-square analysis		
	<5 <sup>th</sup> percentile (underweight)	5 <sup>th</sup> -85 <sup>th</sup> percentile (normal)	85 <sup>th</sup> -95 <sup>th</sup> percentile (at risk of overweight)	>95 <sup>th</sup> percentile (overweight)	$\chi^2$	P-value	Inf.
Early childhood (4-7yrs) (%)	7 (4.7)	31 (20.8)	46 (30.9)	65 (43.6)	52.306	<0.001	S
Late childhood (8-11yrs) (%)	6 (3.7)	95 (59.0)	36 (22.4)	24 (14.9)			
Total (%)	13 (4.2)	126 (40.6)	82 (26.5)	89 (28.7)			
[z] test of proportion (P-value)	0.619 (0.535)	-6.109 (<0.001)	2.251 (0.024)	6.181 (<0.001)			

Note:  $\chi^2$ =Chi-square calculated, P-value=Probability value, Inf.=Inference (S=Not Significant).

**Table 5. Sex and the Nutritional Status of Children at Early (age 4-7 years) and late Childhood (age 8-11 years).**

	Nutritional status				Chi-square analysis		
	<5 <sup>th</sup> percentile (underweight) Early childhood (4-7 years)	5 <sup>th</sup> -85 <sup>th</sup> percentile (normal)	85 <sup>th</sup> -95 <sup>th</sup> percentile (at risk of overweight)	>95 <sup>th</sup> percentile (overweight)	$\chi^2$	P-value	Inf.
	<b>Early childhood (4-7 years)</b>						
Male (%)	5 (7.1)	22 (31.4)	20 (28.6)	23 (32.9)	14.493	0.002	S
Female (%)	2 (2.5)	9 (11.4)	26 (32.9)	42 (53.2)			
Total (%)	7 (4.7)	31 (20.8)	46 (30.9)	65 (43.6)			
[z] test of proportion (P-value)	1.327 (0.184)	3.007 (0.003)	-0.572 (0.569)	-2.495 (0.013)			
	<b>Late childhood (8-11 years)</b>						
Male (%)	4 (4.9)	47 (58.0)	21 (25.9)	9 (11.1)	3.171	0.366	NS
Female (%)	2 (2.5)	48 (60.0)	15 (18.8)	15 (18.8)			
Total (%)	6 (3.7)	95 (59.0)	36 (22.4)	25 (14.9)			
[z] test of proportion (P-value)	0.817 (0.412)	-0.255 (0.803)	1.093 (0.276)	-1.361 (0.174)			

Note:  $\chi^2$ =Chi-square calculated, P-value=Probability value, Inf.=Inference (S=Significant, NS=Not Significant).

In this study, the prevalence of overweight for the Abio/Akpor in-school children was 28.7%; with 43.6% contributed by age's 4-7 years and 15% by children between ages 8-11 years. The result was higher than those of Janssen [25] which he reported childhood overweight/obesity prevalence of 25.4% in Malta and 21.2% in Wales. A study in Brazil by de Assis et al., [26] reported childhood overweight/obesity prevalence of 22% among 7-10 year olds. In Saudi Arabia, El Mouzan et al., [27] reported childhood and adolescent overweight, obesity and severe obesity prevalence of 23.1%, 9.3% and 2% respectively. Mogre et al., [12] revealed an overweight/obesity prevalence of 17.4% for the Tamale population of North Ghana. An overweight/obesity prevalence of 17% has been reported among children aged 10-16 years in Greece and Italy [25]. The prevalence rate in this study was higher than those of Greece and Italy, Tamale population of North Ghana, Malta and Wales but lower than the prevalence rate in Saudi Arabia.

Reduction in BMI with increasing age was observed in this study. However, no sex association was established in the outcome of this research which is in contrast to the findings of Janssen [25]; that sex influences BMI. More male children were underweight than female children, as observed in a study by Fazili et al., [28] among 5-14 year old higher underweight prevalence in boys. A study by Mogre et al., [12] among school-aged children in Tamale, Ghana and several other studies in other Sub-saharan African countries have reported also malnutrition associated underweight. [29-32].

In this study, children at early childhood was significantly influenced by sex, however at late childhood no sex influence was noticed although females were more likely to be overweight than males during childhood development. Overweight was significantly associated with the stage of childhood development; as it significantly reduced with age. The lower prevalence of overweight at age 8-11 years is an indication that adipose deposit can be overgrown which could be as a result of significant increase in height to weight gain, accompanied by increased stress experienced at late childhood with need for bodily activities. In contrast to the findings of Schultz [33] reported that overweight significantly increased with age while obesity did not in a cross-sectional study of Aboriginal kids aged 5-15 years. Toriola et al., [34] also reported that overweight and obesity among rural black South African children aged 10-16 years increased with age, peaking at age 12 years but declined thereafter. This present study only covered children within age 4-11 years without separating overweight and obese which may have contributed to the differences in the relationship between age and level of childhood overweight.

Although Schultz [33] and Toriola et al., [34] classified obesity and overweight separately in contrast with the W.H.O recommendation of 1996 reviewed in 2002 with some charts realigned in 2010. The joint classification of overweight and obesity used in this study may have contributed to the high prevalence of overweight among in-school children in Obio/Akpor Local Government Area.

## Conclusion

It could be concluded that the prevalence of overweight was high;

but higher in females than males, observed at early childhood. Greater adiposity experienced in early childhood with gradual reduction through late childhood may be associated with high calorie-based dieting, reduced exercise and sedentary life among younger children.

The finding of this study reinforces the World Health Organization report of 1996; that BMI status is significantly affected by the age and developmental stages but not sex.

## Acknowledgements

We sincerely appreciate all private and public school within Obio/Akpor LGA for giving us an unrestricted access to their pupils which formed the subject of this study. We acknowledge the efforts of the principals and head teachers for their cooperation throughout the research period.

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