



## DIETARY DIVERSITY AND ANTHROPOMETRIC CHARACTERISTICS OF IN-SCHOOL ADOLESCENTS IN THE UNIVERSITY OF IBADAN COMMUNITY

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### ABSTRACT

Adolescence presents a window of opportunity to prepare nutritionally for a healthy adult life, hence exploring the synergy between dietary diversity and anthropometric parameters is important to help inform appropriate health promoting dietary interventions in this age group. The study was designed to assess the dietary diversity and its relation to nutritional status of in-school adolescents in University of Ibadan community, Nigeria.

This descriptive cross-sectional study involved 440 in-school adolescents selected using simple random sampling from a private (223) and a public secondary school (217) located within the university. Data on socio-demographic characteristics and dietary pattern were collected using a semi-structured, self-administered questionnaire. Dietary intake was assessed using multiple-pass 24-hour recall. Dietary diversity score (DDS) was computed based on 14 food groups and categorized as low (<4), moderate (4-6) and high (>6). Weight and height were measured and analysed using WHO Anthro-plus software. Data were analysed using descriptive statistics and chi-square at  $p=0.05$ .

Female respondents constituted 55.7%, about 57% of all respondents were aged 14-17 years. Meal skipping was common (62.3%), higher in the private (70.4%) than the public schools (53.9%), while overweight and obesity were more prevalent in the private school (28.7%). On the other hand, mean DDS was higher in the public ( $5.55\pm 0.9$ ) than the private school ( $4.72\pm 1.0$ ) while overall, 6.6% had low DDS; more in private (11.2%) than public schools. Dietary diversity was significantly associated with BMI for age as low DDS found to be higher among the obese (17.6%) and overweight (12.3%) adolescents.

The adolescents in the public school appeared to have better diversity in their dietary intake. Dietary diversity score was associated with anthropometric characteristics of the adolescents irrespective of being in the public or private school. Further investigation is hereby recommended to understand the pathway of this association.

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### INTRODUCTION

Abundant evidence has shown the importance of adequate nutrition in all phases of human life, particularly at certain critical periods of development such as infancy, childhood and adolescence. Moreover, studies have reported high burden of malnutrition among Nigerian adolescents (Olumakaiye and Ajayi, 2007; Ejike *et al.*, 2013). Adolescents refer to individuals whose ages ranged from 10–19 years and constitute about 20.0% and 22.3% of the global and Nigeria population respectively (Patton *et al.*, 2012; NPC/ICF, 2013). Adolescents are nutritionally vulnerable due to enormous physiological, cognitive, and psychosocial changes that occur at this phase of life (Olumakaiye and Ajayi, 2007; Sanusi *et al.*, 2014).

Malnutrition during adolescence occurs due to poor dietary intake (Ogechi *et al.*, 2007), food insecurity

(Belachew *et al.*, 2011), poor lifestyle (Kim *et al.*, 2010) and carry-over of nutritional disadvantage from childhood and failure to correct early nutritional deficits in life (Montgomery, 2003). Adolescent malnutrition has several consequences including poor birth outcomes among females (Montgomery, 2003) and high vulnerability to adult-onset chronic diseases (Olumakaiye and Ajayi, 2007).

Dietary diversity is an indicator of the 'richness' or nutrient adequacy of a person's diet. Arimond and Ruel (2004) reported that lack of dietary diversity is a severe problem among poor populations in developing nations following high consumption of starchy staple diets with few or no animal products and seasonal fruits and vegetables intake. Dietary diversification is a concept introduced to promote consumption of healthy diets and prevent micronutrient malnutrition across all age groups. It literally promotes the choice of a mixture of foods across the range of food types to promote

biodiversity and sustainability, nutritional adequacy, overall diet quality and reduce the risks of diet-related non-communicable diseases. Measuring dietary diversity involves a simple count of food items or food groups consumed over given a period of time (Ruel, 2003). High dietary diversity among adolescents has been found to be positively correlated with nutrient adequacy ratio (Torheim *et al.*, 2004; Mirmiran *et al.*, 2004) and adequate micronutrient intake (Kennedy *et al.*, 2007). Poor dietary diversity has been found to be associated with iron deficiency anaemia among female adolescents (Olumakaiye, 2013), obesity (Jayawardena *et al.*, 2013), metabolic syndrome (Azadbakht *et al.*, 2005), and increased risk of mortality (Kant *et al.*, 1993).

Beyond being a period of intense development and growth, adolescence presents a window of opportunity to prepare nutritionally for a healthy adult life. It is therefore important to focus on adolescents in order to advance health promoting life-long dietary practices among this age group. Although some studies have reported dietary diversity among Nigerian adolescents (Olumakaiye, 2013; Sanusi *et al.*, 2014), further understanding of the relationship between dietary diversity and anthropometric characteristics among in-school adolescents is essential to inform intervention activities. The study was therefore designed to assess the dietary diversity and its relation to nutritional status of in-school adolescents in University of Ibadan community, Nigeria. This Nigerian tertiary institution of learning is the oldest in Nigeria and consists of a large community in which there are primary and secondary schools nestled within the academic and research setting. However, there is a dearth of documented information on the nutrition of adolescents attending these schools.

## METHODOLOGY

**Study design:** This study was descriptive cross-sectional in design.

**Sampling and respondents:** The study was conducted among a representative sample of adolescents (aged 10-19 years) attending Abadina College, Ibadan (public) the University of Ibadan International School (private); both schools were purposively selected for the study being located within the University of Ibadan community. A public school is that which is funded and managed solely by government, and is usually not-for-profit. On the other hand, a private school is owned,

funded and managed by an individual, a group of individuals, or even an institution, and may be profit-oriented. Using a simple random sampling approach, five classes of students who had spent at least a session in each school were selected. From the selected classes, 46 students were selected per class using a simple random procedure. A total of 440 in-school adolescents completed the study comprising of 223 from the private school and 217 from the public school.

**Data collection:** A semi-structured, self-administered questionnaire was used to obtain information on socio-demographic characteristics and dietary pattern of the participants. All questionnaires were administered by trained research assistants under close supervision of the authors. To obtain information on dietary intake for the previous day, a single 24-hour recall using the multiple-pass method was conducted. Subsequently, dietary diversity scores were derived using the FAO dietary diversity questionnaire consisting of 14 food groups (FAO, 2007). Dietary diversity scores were calculated based on nine food groups and categorized into three: low (<4), moderate (4-6) and high dietary diversity (>6) (Bukania *et al.*, 2014).

Anthropometric characteristics were assessed using standard procedures. Body weight was measured on a smooth level surface using an electronic weighing scale (SECA) with a precision of 0.1 Kg. Subjects were made to stand and look straight without shoes, belt and any items in their pocket. Height was measured without shoes using a stadiometer and recorded to the nearest 0.1 cm. The World Health Organization (WHO) Anthroplus software was used to calculate the z-scores for BMI-for-age and to indicate thinness (<5th percentile), normal weight (<85th percentile), at risk of overweight ( $\geq 85^{\text{th}}$  but <95th percentile) and overweight ( $\geq 95^{\text{th}}$  percentile).

**Data Analysis:** All data collected were analyzed using Statistical Package for Social Science (SPSS) software for Windows (version 20.0). Data were reported as frequencies, means and standard deviations, for the descriptive statistics while Chi-square test at 5% level of significance were used to determine the relationship between dietary diversity scores and other variables.

**Ethics:** The study was approved by the University of Ibadan/University College Hospital, Ibadan Medical Research Ethics Committee (UI/EC/14/0388).

Permission to conduct the study was obtained from the principals of the selected schools and informed consent was obtained from the study participants.

**Table 1: Socio-demographic characteristics of the in-school adolescents**

Variables	School types			P-value
	Total n(%) N=440	Private n(%) N=223	Public n(%) N=217	
<b>Sex</b>				0.46
Male	195 (44.3)	95 (42.6)	100 (46.1)	
Female	245 (55.7)	128 (57.4)	117 (53.9)	
<b>Age (years)</b>				0.00*
10-13	176 (40.0)	113(50.7)	63(29.0)	
14-17	250 (56.8)	110(49.3)	140(64.5)	
≥18	14 (3.2)	0(0.0)	14(6.5)	
<b>Ethnicity</b>				0.00*
Yoruba	372 (84.5)	201 (90.1)	171 (78.8)	
Hausa	3 (0.7)	1 (0.4)	2 (0.9)	
Igbo	39 (8.9)	9 (4.0)	30 (13.8)	
Others	26 (5.9)	12 (5.4)	14 (6.5)	
<b>Religion</b>				0.00
Christianity	305 (69.3)	179 (80.3)	126 (58.1)	
Islam	135 (30.7)	44 (19.7)	91 (41.9)	
<b>Household size</b>				0.00
Small (≤5)	215 (48.9)	134 (60.1)	81 (37.3)	
Large (>5)	225 (51.1)	89 (39.9)	136 (62.7)	
<b>Fathers' education status</b>				0.00
No formal education	9 (2.0)	0 (0.0)	9 (4.2)	
Primary	14 (3.2)	4 (1.8)	10 (4.6)	
Secondary	122 (27.7)	19 (8.5)	103 (47.5)	
Tertiary	295 (67.0)	200 (89.7)	95 (43.8)	
<b>Fathers' occupation</b>				0.00
Farmer	6 (1.4)	0 (0.0)	6 (2.8)	
Petty trader	31 (7.0)	0 (0.0)	31 (14.3)	
Artisan	17 (3.9)	2 (0.9)	15 (6.9)	
Retiree	20 (4.5)	8 (3.6)	12 (5.5)	
Civil servant	167 (38.0)	115 (51.6)	52 (24.0)	
Business man	199 (45.2)	98 (43.9)	101 (46.5)	
<b>Mothers' education status</b>				0.00
No formal education	15 (3.4)	0 (0.0)	15 (6.9)	
Primary	30 (6.8)	4 (1.8)	26 (12.0)	
Secondary	105 (23.9)	12 (5.4)	93 (42.9)	
Tertiary	290 (65.9)	207 (92.8)	83 (38.2)	
<b>Mothers' occupation</b>				0.00
Farmer	8 (1.8)	0 (0.0)	8 (3.7)	
Petty trader	66 (15.0)	3 (1.3)	63 (29.0)	
Artisan	11 (2.5)	2 (0.9)	9 (4.1)	
Retiree	8 (1.8)	7 (3.1)	1 (0.5)	
Civil servant	150 (34.1)	116 (52.0)	34 (15.7)	
Business man	197 (44.8)	95 (42.6)	102(47.0)	

*P* - probability value of Pearson's Chi-square test

## RESULTS

### Socio-demographic characteristics of the in-school adolescents

The socio-demographic characteristics of the in-school adolescents are presented in Table 1. Four hundred and forty in-school adolescents participated in the study including 195 males (44.3%) and 245 females (55.7%). More females participated in the study from both private (57.9%) and public schools (53.9%). Table 1 compares the socio-demographic characteristics of the in-school adolescents. There was significant difference in the age distribution, ethnicity, religion, household size, parents' educational level and occupation between the in-school adolescents in the public and the private schools.

### Household characteristics of the in-school adolescents

The household characteristics are as presented in Table 2. Majority (65.9%) of the in-school adolescents lived in parent's-owned houses, this was higher in private (70.0%) than in public schools (61.8%). The housing type of the in-school adolescents also varied significantly. About 34% lived in bungalows, higher in private (47.5%) than public schools (19.4%). Almost one-third (32.3%) lived in flats, higher in public (45.2%) than private schools (19.7%) and 20.7% lived in duplex, higher in the private (32.7%) than public school (8.3%). In-school adolescents with access to water closet toilet system were significant more in private (99.1%) than public school (89.4%).

**Table 2: Household characteristics of the in-school adolescents**

Variables	School types			p-value
	Total n(%) N=440	Private n(%) N=223	Public n(%) N=217	
<b>Parent-owned house</b>				
Yes	290 (65.9)	156 (70.0)	134 (61.8)	0.07
No	150 (34.1)	67 (30.0)	83 (38.2)	
<b>Housing type</b>				0.00
Face to face	59 (13.4)	0 (0.0)	59 (27.2)	
Flat	142 (32.3)	44 (19.7)	98 (45.2)	
Bungalow	148 (33.6)	106 (47.5)	42 (19.4)	
Duplex	91 (20.7)	73 (32.7)	18 (8.3)	
<b>No. of Vehicle owned by parents</b>				0.00
None	77 (17.5)	2 (0.9)	75 (34.6)	
≤2	261 (59.3)	134 (60.1)	127 (58.5)	
>2	102 (23.2)	87 (39.0)	15 (6.9)	
<b>Toilet facility</b>				0.00
Water closet	415 (94.3)	221 (99.1)	194 (89.4)	
Pit latrine	20 (4.5)	1 (0.4)	19 (8.8)	
Field, bush, riverside	5 (1.1)	1 (0.4)	4 (1.8)	
<b>Major cooking fuel</b>				0.00
Gas	259 (58.9)	194 (87.0)	65 (30.0)	
Electricity	43 (9.8)	18 (8.1)	25 (11.5)	
Firewood	5 (1.1)	1 (0.4)	4 (1.8)	
Kerosene	132 (30.0)	10 (4.5)	122 (56.2)	
Others	1 (0.2)	0	1 (0.5)	
<b>Major source of drinking water</b>				0.00
Community water system	23 (5.2)	10 (4.5)	13 (6.0)	
Borehole	271 (61.6)	145 (65.0)	126 (58.1)	
Dug well	48 (10.9)	16 (7.2)	32 (14.7)	
Rainwater	25 (5.7)	1 (0.4)	24 (11.1)	
Spring/river/stream	4 (0.9)	0 (0.0)	4 (1.8)	
Tanker truck/peddler	9 (2.0)	4 (1.8)	5 (2.3)	
Others	60 (13.6)	47 (21.1)	13 (6.0)	

**Table 3: Dietary habits of the in-school adolescents**

Variables	School types			P-value
	Total n (%) N=440	Private n (%) N=223	Public n (%) N=217	
<b>Number of meals per day</b>				0.00
One meal	4 (0.9)	4 (1.8)	0 (0.0)	
Two meals	55 (12.5)	33 (14.8)	22 (10.1)	
Three meals	269 (61.1)	105(47.1)	164 (75.6)	
More than three meals	112 (25.5)	81(36.3)	31 (14.3)	
<b>Meal skipping</b>				
Yes	274 (62.3)	157(70.4)	117(53.9)	
No	166 (37.7)	66(29.6)	100(46.1)	0.00*
<b>Reasons for meals skipping</b>				
Dislike the meal	70 (25.5)	47 (29.9)	23 (19.7)	0.09*
Self dieting	32 (11.7)	13 (8.3)	19 (16.2)	
Inadequate time to prepare meals	131 (47.8)	75 (47.8)	56 (47.9)	
Others	41 (15.0)	22 (14.0)	19 (16.2)	
<b>Often take snacks</b>				
Yes	397 (90.2)	193 (86.5)	204 (94.0)	0.01
No	43 (9.8)	30 (13.5)	13 (6.0)	
<b>Often take breakfast</b>				
Yes	382 (86.8)	175 (78.5)	207 (95.4)	0.00
No	58 (13.2)	48 (21.5)	10 (4.6)	

*P - probability value of Pearson's Chi-square test*

#### Dietary habits of the in-school adolescents

The dietary habits of the in-school adolescents are as shown in Table 3. In total, 61.1% of the adolescents ate three meals per day; 75.6% in the public school compared to 47.1% in the private school. In total, 62.3% skipped meals and this was significantly higher among adolescents in the private school (70.4%) than the public school (53.9%). Reasons for meals skipping were similar in both settings. Inadequate time to prepare meals was the most common reason in both public (47.9%) and private (47.8%) schools. Dislike of the meal was another common cause of meal skipping among adolescents in private (29.9%) and public (19.7%) schools. Snacking was common (90.2%) and was significantly higher in the public school (94.0%) than the private school (86.5%). Overall, 86.8% of the adolescents consumed breakfast often; regular breakfast consumption was significantly higher in the public school (95.4%) compared to the private school (78.5%).

#### Anthropometric characteristics of in-school adolescents

The anthropometric characteristics of study respondents are as shown in Table 4. Adolescents with normal body mass index were 78.6%, higher in the public school (87.1%) compared to the private school (70.4%). Prevalence of overweight was 13.0% and was six times higher in the private (22.0%) than public school (3.7%). Similar pattern was observed for obesity. Underweight was 4.5% and its prevalence was nine times higher in the public (8.3%) than the private school (0.9%). Underweight was higher among males (7.2%) than females (2.4%). Likewise, overweight was 13.8% among males and 12.2% among females Underweight was twice higher among adolescents from large households (6.2%) compared to those from small households (2.8%). Parents' educational status was significantly associated with MI-for-age of the adolescents

**Table 4: Anthropometric characteristics of the in-school adolescents and associated factors**

	BMI for Age				P value
	Underweight	Normal	Overweight	Obese	
<b>School type</b>					
Total	20(4.5)	346(78.6)	57(13.0)	17(3.9)	
Private n(%) N=223	2(0.9)	157(70.4)	49(22.0)	15(6.7)	0.00
Public n(%) N=217	18(8.3)	189(87.1)	8(3.7)	2(0.9)	
<b>Sex</b>					
Male n(%) N=195	14(7.2)	143(73.3)	27(13.8)	11(5.6)	0.01
Female n(%) N=245	6(2.4)	203(82.9)	30(12.2)	6(2.4)	
<b>Age</b>					
10-13 (n(%) N=176)	7(4.0)	119(67.6)	38(21.6)	12(6.8)	0.00
14-17 (n(%) N=250)	11(4.4)	215(86.0)	19(7.6)	5(2.0)	
≥18 (n(%) N=14)	2(14.3)	12(85.7)	-	-	
<b>Ethnicity</b>					
Yoruba	17 (4.6)	294 (79.0)	47 (12.6)	14 (3.8)	0.93
Hausa	0 (0.0)	3 (100.0)	0 (0.0)	0 (0.0)	
Igbo	3 (7.7)	28 (71.8)	6 (15.4)	2 (5.1)	
Others	0 (0.0)	21 (80.8)	4 (15.4)	1 (3.8)	
<b>Religion</b>					0.00
Christianity	10 (3.3)	233 (76.4)	47 (15.4)	15 (4.9)	
Islam	10 (7.4)	113 (83.7)	10 (7.4)	2 (1.5)	
<b>Household size</b>					0.28
Small (≤5)	6 (2.8)	176 (81.9)	26 (12.1)	7 (3.3)	
Large (>5)	14 (6.2)	170 (75.6)	31 (13.8)	10 (4.4)	
<b>Fathers education status</b>					0.00
No formal education	1 (11.1)	7 (77.8)	0 (0.0)	1 (11.1)	
Primary	1 (7.1)	11 (78.6)	2 (14.3)	0 (0.0)	
Secondary	13 (10.7)	102 (83.6)	7 (5.7)	0 (0.0)	
Tertiary	5 (1.7)	226 (76.6)	48 (16.3)	16 (5.4)	
<b>Mothers education status</b>					0.00
No formal education	0 (0.0)	15 (100.0)	0 (0.0)	0 (0.0)	
Primary	3 (10.0)	23 (76.7)	4 (13.3)	0 (0.0)	
Secondary	12 (11.4)	83 (79.0)	9 (8.6)	1 (1.0)	
Tertiary	5 (1.7)	225 (77.6)	44 (15.2)	16 (5.5)	
<b>Fathers' occupation</b>					0.64
Farmer	0 (0.0)	6 (100.0)	0 (0.0)	0 (0.0)	
Petty trader	2 (6.5)	26 (83.9)	2 (6.5)	1 (3.2)	
Artisan	1 (5.9)	15 (88.2)	1 (5.9)	0 (0.0)	
Retiree	2 (10.0)	16 (80.0)	1 (5.0)	1 (5.0)	
Civil servant	4 (2.4)	132 (79.0)	26 (15.6)	5 (3.0)	
Business man	11 (5.5)	151 (75.9)	27 (13.6)	10 (5.0)	
<b>Mothers' occupation</b>					0.15
Farmer	2 (25.0)	5 (62.5)	1 (12.5)	0 (0.0)	
Petty trader	3 (4.5)	58 (87.9)	5 (7.6)	0 (0.0)	
Artisan	0 (0.0)	10 (90.9)	1 (9.1)	0 (0.0)	
Retiree	0 (0.0)	7 (87.5)	1 (12.5)	0 (0.0)	
Civil servant	3 (2.0)	115 (76.7)	23 (15.3)	9 (6.0)	
Businessman	12 (6.1)	151 (76.6)	26 (13.2)	8 (4.1)	

*P* - probability value of Pearson's Chi-square test

**Table 5: Association between Dietary Diversity Score, BMI-for age and other factors**

	Dietary Diversity Score			P value
	Low	Moderate	High	
<b>School Type</b>				0.00
Private N= 223	25 (11.2)	192 (86.1)	6 (2.7)	
Public N=217	4 (1.8)	183 (84.3)	30 (13.8)	
Total N=440	29 (6.6)	375 (85.2)	36 (8.2)	
<b>Body Mass Index for age</b>				0.03
Underweight	0 (0.0)	19 (95.0)	1 (5.0)	
Normal	19(5.5)	296 (85.5)	31 (9.0)	
Overweight	7 (12.3)	47 (82.5)	3 (5.3)	
Obese	3 (17.6)	13 (76.5)	1 (5.9)	
<b>Sex</b>				0.95
Male n(%) N=195	12(6.2)	167(85.6)	16(8.2)	
Female n(%) N=245	17(6.9)	208(84.9)	20(8.2)	
<b>Age</b>				0.00
10-13 (n(%) N=176)	21(11.9)	144(81.8)	11(6.3)	
14-17 (n(%) N=250)	8(3.2)	221(88.4)	21(8.4)	
≥18 (n(%) N=14)	0(0.0)	10(71.4)	4 (28.6)	
<b>Ethnicity</b>				0.55
Yoruba	25 (6.7)	314 (84.4)	33 (8.8)	
Hausa	0 (0.0)	3 (100.0)	0 (0.0)	
Igbo	1 (2.6)	35 (89.7)	3 (7.7)	
Others	3 (11.5)	23 (88.5)	0 (0.0)	
<b>Religion</b>				0.32
Christianity	21 (6.9)	263 (86.2)	21 (6.9)	
Islam	8 (5.9)	112 (83.0)	15 (11.1)	
<b>Household size</b>				0.45
Small (≤5)	15 (7.0)	186 (86.5)	14 (6.5)	
Large (>5)	14 (6.2)	189 (84.0)	22 (9.8)	
<b>Fathers education status</b>				0.06
No formal education	0 (0.0)	9 (100.0)	0(0.0)	
Primary	1 (7.1)	13 (92.9)	0 (0.0)	
Secondary	3 (2.5)	103 (84.4)	16 (13.1)	
Tertiary	25 (8.5)	250 (84.7)	20 (6.8)	
<b>Mothers education status</b>				0.07
No formal education	2 (13.3)	13 (86.7)	0 (0.0)	
Primary	1 (3.3)	24 (80.0)	5 (16.7)	
Secondary	2 (1.9)	92 (87.6)	11 (10.5)	
Tertiary	24 (8.3)	246 (84.8)	20 (6.9)	
<b>Number of meals per day</b>				0.01
One meal	0 (0.0)	4 (100.0)	0 (0.0)	
Two meals	10 (18.2)	42 (76.4)	3 (5.5)	
Three meals	10 (3.7)	235 (87.4)	24 (8.9)	
More than three meals	9 (8.0)	94 (83.9)	9 (8.0)	
<b>Meal skipping habit</b>				0.00*
Yes	25 (9.5)	222(84.7)	15(5.7)	
No	4 (2.2)	153(86.0)	21(11.8)	
<b>Often take snacks</b>				0.73
Yes	25 (6.3)	339 (85.4)	33 (8.3)	
No	4 (9.3)	36 (83.7)	3 (7.0)	
<b>Often take breakfast</b>				0.01
Yes	20 (6.3)	328 (85.4)	34 (8.3)	
No	9 (9.3)	47 (83.7)	2 (7.0)	

*P* - probability value of Pearson's Chi-square test

The diversity of the respondents' diet, as reflected by the dietary diversity score are presented in Table 5. Mean DDS was significantly higher among those in the public school ( $5.55 \pm 0.9$ ) compared to those in the private school ( $4.72 \pm 1.0$ ). Overall, 6.6% had low DDS; higher in private (11.2%) than the public school. Most in-school adolescents (85.2%) fell into the category of moderate DDS, but the proportion of those with high DDS was five times higher in the public (13.8%) than the private school (2.7%). A significant relationship was found between DDS and BMI for age. Most (95%) of the underweight adolescents had moderate DDS and a similar observation was made among adolescents in other BMI-for-age category. The result further shows that low DDS was particularly higher among obese (17.6%) and overweight (12.3%) adolescents. Conversely, high dietary diversity, was highest among adolescents with normal BMI-for-age (9.0%). There was no significant sex difference in the DDS of the adolescents, though disparity in DDS by age was significant as it increased from early to late adolescence, with low DDS being highest among early adolescents. Other variables and association with DDS are as shown in Table 5.

## DISCUSSION

Dietary diversification is a long term, sustainable strategy to reduce micronutrient malnutrition. Earlier studies have shown highly diverse diets as reflected by high dietary diversity as a pointer to adequate micronutrient intake (FAO, 2007; Oldewage-Theron and Kruger, 2011; Rathnayake *et al.*, 2012; Steyn *et al.*, 2014). Dietary diversity is particularly important among the adolescents following rapid growth which heighten nutritional requirements and risks of undernutrition at this phase of life (Alam *et al.*, 2010). Moreover, adolescence offers the last opportunity to recover from childhood growth failure and support growth spurt and skeletal development to break the cycle of intergenerational undernutrition (Golden, 1994).

In the present study, contrary to expectation, the mean DDS was higher among in-school adolescents in the public than the private school). The results showed that averagely, the number of food groups covered by the daily dietary intake among public school adolescents was about six compared to five among their private school counterparts. Moderate DDS was predominant among the adolescents in both private and public schools. The preponderance of medium dietary diversity

in this study is consistent with earlier Nigerian studies suggesting that usual dietary intake covers an average of five to six food groups (Sanusi, 2011; Sanusi *et al.*, 2014). Similar findings have been reported among adolescents in Iran (Mirmiran *et al.*, 2004; Vakili *et al.*, 2013) and Mali (Hatloy *et al.*, 1998). Sanusi *et al.* (2014) reported high reliance on daily dietary intake characterized by starchy staples, little or non-inclusion of fruits and milk products. Such diets have little potential to make substantial contribution to micronutrient adequacy. Studies in Nigeria have shown that adolescents with unhealthy dietary patterns, as indicated by poor fruits and vegetables consumption, are at risk of malnutrition (Olumakaiye and Ajayi, 2007; Ogunkunle and Oludele, 2013).

In the same vein, high DDS was significantly higher in the public than the private school. The higher DDS among in-school adolescents in public schools may be attributed to lower meal skipping, higher snacking and higher breakfast consumption habits than observed among in-school adolescents in private school. Meal skipping is known to inhibit good nutrition and a major reason for skipping of meals in this population was lack of time, this is similar to findings among Nigerian undergraduates (Afolabi *et al.*, 2013). Looking at the occupation profile of the parents of adolescents in this study, lack of time is a valid issue of concern. Traditionally, most of the students in the primary and secondary schools located in the University of Ibadan are children of members of staff of the University who need to arrive early in the morning at work. Unexpectedly, this study found no significant relationship between DDS and parents' education, an indication of socio-economic status. It has been shown that parents' education contributes to healthy food choices, better nutritional knowledge and dietary habits, all of which enhance diet quality among adolescents (Beghin *et al.*, 2014). Labadarios *et al.* (2011) reported strong relationship between dietary diversity and living standard or socio-economic characteristics. This association has been explained in terms of financial constraints within the parents' education and occupation levels context. In this study, however, the differential in educational level of parents did not reflect in occupation distribution of the parents. Moreover, the environment plays an important role in food choice and the two study schools are within the same University campus, the environment may have homogenized the study

participants and thereby attenuating the influence of parents' educational status on dietary diversity.

It was also observed that the percentage of adolescents with high dietary diversity increased with age. This could be attributed to increased freedom for diet selection with increasing age. Also, DDS had a strong association with body mass index for age among in-school adolescents. This was observed in both public and private schools with widely different socio-demographic, household and dietary characteristics. Contrary results have been reported on the association between BMI and DDS, some studies have reported no relationship among Nigerian adolescents (Sanusi, 2011), Malian adults (Torheim *et al.*, 2004), and Belgian adults (Vandevijvere *et al.*, 2010). The association between these two concepts as found by the present study is however consistent with findings among women in Burkina Faso (Savy *et al.*, 2005), Brazilian adults (Bezerra and Sichieri, 2011) and Nigerian adolescents (Sanusi *et al.*, 2014). Dietary diversity was also significantly associated with school type, age, number of meals consumed per day, meal skipping habit and breakfast consumption habit of the adolescents. Likewise, the body mass index for age was significantly associated with school type, gender, age, religion and parents education status. Thus, DDS association with body mass index for age could be either as a main effect or in an interaction. Although anthropometric indices represent a long term cumulative process and DDS reflects a recent process, both concepts are linked to household socio-economic factors and may partly explain the observed association in the present study. Arimond and Ruel (2004) had proposed dietary diversity as a proxy for household socio-economic status. This is explained by the fact that families with greater incomes and resources tend to have more diverse diets, better access to health care and better environmental conditions.

## CONCLUSION

The present study shows that dietary diversity score is associated with anthropometric characteristics of in-school adolescents in private and public schools in University of Ibadan community. Further prospective investigation is hereby recommended to understand the pathway of this association.

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## REFERENCES

- Afolabi, W. A. O., Towobola, S. K., Oguntona, C. R. B., & Olayiwola, I. O. (2013). Pattern of Fast Food Consumption and Contribution to Nutrient intakes of Nigerian University Students. *International Journal of Education and Research*, 1(5), 1-10.
- Alam, N., Roy, S. K., Ahmed, T., & Ahmed, A. S. (2010). Nutritional status, dietary intake, and relevant knowledge of adolescent girls in rural Bangladesh. *Journal of Health, Population and Nutrition*, 86-94.
- Arimond, M. and Ruel, M. T. (2004). Dietary Diversity Is Associated with Child Nutritional Status: Evidence from 11 Demographic and Health Surveys. *J. Nutr.* 134: 2579-2585, 2004.
- Azadbakht, L., Mirmiran, P., and Azizi, F. (2005). Dietary diversity score is favorably associated with the metabolic syndrome in Tehranian adults. *Int J Obes (Lond)*; 29:1361-1367.
- Beghin, L., Dauchet, L., De Vriendt, T., Cuenca-Garcia, M., Manios, Y., Toti, E., Plada, M., Widhalm, K., Repasy, J., Huybrechts, I. & Kersting, M. (2014). Influence of parental socio-economic status on diet quality of European adolescents: results from the HELENA study. *British Journal of Nutrition*, 111(07), 1303-1312.
- Belachew, T., Hadley, C., Lindstrom, D., Gebremariam, A., Lachat, C., and Kolsteren, P. (2011). Food insecurity, school absenteeism and educational attainment of adolescents in Jimma Zone Southwest Ethiopia: a longitudinal study. *Nutrition Journal*, 10(1), 1.
- Bezerra, I. N., and Sichieri, R. (2011). Household food diversity and nutritional status among adults in Brazil. *International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 1.
- Bukania, Z. N., Mwangi, M., Karanja, R. M., Mutisya, R., Kombe, Y., Kaduka, L. U., and Johns, T. (2014). Food insecurity and not dietary diversity is a predictor of nutrition status in children within semiarid Agro-Ecological zones in Eastern Kenya. *Journal of nutrition and metabolism*, 2014. Article ID 907153, 9 pages, 2014. doi:10.1155/2014/907153
- Ejike, C. E., Onyemairo, J. N., and Onukogu, I. A. (2013). Co-existence of child and adolescent obesity and thinness in a city in Nigeria: Comparison of results derived from different reference standards. *International Journal of Nutrition, Pharmacology, Neurological Diseases*, 3(3), 276.

Food and Agriculture Organisation of the United

- Nations (2007). Guidelines for Measuring Household and Individual dietary diversity. FAO Nutrition and consumer Protection Division, with Support from the EC/FAO Food Security Information for Action Programme and the Food and Nutrition Technical Assistance (FANTA) Project. 2007.
- Golden, M. H. N. (1994). Is complete catch-up possible for stunted malnourished children? *European journal of clinical nutrition*, 48(1), 58-71.
- Hatloy, A., Torheim, L., & Oshaug, A. (1998). Food variety is a good indicator of nutritional adequacy of the diet? A case study from an urban area in Mali, West Africa. *European Journal of Clinical Nutrition*, 52, 891-8.
- Jayawardena, R., Byrne, N. M., Soares, M. J., Katulanda, P., Yadav, B., and Hills, A. P. (2013). High dietary diversity is associated with obesity in Sri Lankan adults: an evaluation of three dietary scores. *BMC Public Health*; 13: 314.
- Kant, A.S., Schatzkin, A., Harris, T.B., Ziegler, R.G., and Block, G. (1993). Dietary diversity and subsequent mortality in the First National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. *Am J Clin Nutr*; 57:434-40.
- Kennedy, G.L., Pedro, M.R., Chiara Seghieri, C., Nantel, G. and Brouwer, I. (2007). Dietary Diversity Score Is a Useful Indicator of Micronutrient Intake in Non-Breast-Feeding Filipino Children. *J. Nutr.* 137: 472-477, 2007.
- Kim, Y., Park, J. Y., Kim, S. B., Jung, I. K., Lim, Y. S., and Kim, J. H. (2010). The effects of Internet addiction on the lifestyle and dietary behavior of Korean adolescents. *Nutrition research and practice*, 4(1), 51-57.
- Labadarios, D., Steyn, N. P., & Nel, J. (2011). How diverse is the diet of adult South Africans?. *Nutrition journal*, 10(1), 1.
- Mirmiran, P., Azadbakht, L., Esmailzadeh, A., and Azizi, F. (2004). Dietary diversity score in adolescents - a good indicator of the nutritional adequacy of diets: Tehran lipid and glucose study. *Asia Pacific J Clin Nutr.*; 13 (1): 56-60.
- Montgomery, K. S. (2003). Improving nutrition in pregnant adolescents: recommendations for clinical practitioners. *The Journal of perinatal education*, 12(2), 22-30.
- NPC and ICF International (2013). Nigeria Demographic and Health Survey, Abuja
- Ogechi, U. P., Akhakhia, O. I., and Ugwunna, U. A. (2007). Nutritional status and energy intake of adolescents in Umuahia urban, Nigeria. *Pakistan journal of Nutrition*, 6(6), 641-646.
- Ogunkunle, M. O., and Oludele, A. S. (2013). Food intake and meal pattern of adolescents in school in Ila Orangun, south-west Nigeria. *South African Journal of Clinical Nutrition*, 26(4), 188-193.
- Oldewage-Theron, W., and Kruger, R. (2011). Dietary diversity and adequacy of women caregivers in a peri-urban informal settlement in South Africa. *Nutrition*, 27(4), 420-427.
- Olumakaiye, F. M. and Ajayi, A. (2007). Determinants of food choices of adolescents in south-western Nigeria. *African Journal of Food, Agriculture, Nutrition and Development*, 7(6).
- Olumakaiye, M. F. (2013). Adolescent Girls With Low Dietary Diversity Score Are Predisposed to Iron Deficiency in Southwestern Nigeria. *Journal of Infant, Child and Adolescent Nutrition* Vol. 5 (2), 85-91.
- Patton, G. C., Coffey, C., Cappa, C., Currie, D., Riley, L., Gore, F., Degenhardt, L., Richardson, D., Astone, N., Sangowawa, A.O. & Mokdad, A. (2012). Health of the world's adolescents: a synthesis of internationally comparable data. *The Lancet*, 379(9826), 1665-1675.
- Rathnayake, K. M., Madushani, P. A. E., and Silva, K. D. R. R. (2012). Use of dietary diversity score as a proxy indicator of nutrient adequacy of rural elderly people in Sri Lanka. *BMC research notes*, 5(1), 1.
- Ruel, M. T. (2003). Animal source foods to improve micronutrient nutrition and human function in developing countries. *J. Nutr.* 133, 39118-39268.
- Sanusi, R. A., Yusuf, F. K., and Ejoh, S. I. (2014). Assessment of Dietary Diversity of In-School Adolescents in Ibadan, Oyo State, Nigeria. *West Africa Journal of Food and Nutrition*, 12(2), 70-77.
- Sanusi, R. A. (2011). Nigeria: Assessment of dietary diversity in six states. *African Journal of Biomedical Research*, 13(3), 161-167.
- Savy, M., Martin-Prevel, Y., Sawadogo, P., Kameli, Y., and Delpuech, F. (2005). Use of variety/diversity scores for diet quality measurement: relation with nutritional status of women in a rural area in Burkina Faso. *Eur J Clin Nutr.*; 59:703-16.
- Steyn, N. P., Nel, J., Labadarios, D., Maunder, E. M. W., & Kruger, H. S. (2014). Which dietary diversity indicator is best to assess micronutrient adequacy in children 1 to 9 yr. *Nutrition*, 30(1), 55-60.
- Torheim, L. E., Ouattara, F., Diarra, M. M., Thiam, F. D., Barikmo, I., Hatloy, A. and Oshaug, A. (2004). Nutrient adequacy and dietary diversity in rural Mali: association and determinants. *European Journal of Clinical Nutrition* 58, 594-604.
- Vakili, M., Abedi, P., Sharifi, M., and Hosseini, M. (2013). Dietary diversity and its related factors among adolescents: a survey in Ahvaz-Iran. *Global journal of health science*, 5(2), 181.
- Vandevijvere, S., De Vriese, S., Huybrechts, I., Moreau, M., & Van Oyen, H. (2010). Overall and within-food group diversity are associated with dietary quality in Belgium. *Public health nutrition*, 13(12), 1965-1973.