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Afr. J. Biomed. Res. Vol. 25 (January, 2022); 45- 52

Research Article

Board-Game Based Nutrition Education Enhanced Breakfast Habit of In-School Adolescents in Ile-Ife, Nigeria

Ariyo O.[1], Leshi O.O.[1], Adedipe E.O.[1], Aleru O.O.[2]

[1]*Department of Human Nutrition and Dietetics, University of Ibadan, Nigeria*

[2]*Department of Health Education and Human Kinetics, University of Ibadan, Nigeria*

ABSTRACT

This study was designed to assess the effect of board game-based nutrition education on breakfast knowledge, attitude and habit of in-school adolescents in Ile-Ife, Nigeria. The quasi-experimental study involved 360 in-school adolescents assigned into Participatory Experimental (PEG), Experimental (EG) and Control groups (CG) of 120 each. An interviewer-administered questionnaire was used to collect information on respondents' basic characteristics as well as knowledge, attitude and practices on breakfast consumption. A 'Breakfast Master' board game, developed with PEG was used for a 3-week intervention period among the experimental groups. Knowledge was assessed using 11-point scale, categorized as good (≥9) or poor (<9). Attitude was assessed using 50-point scale, categorized as positive (≥34) or negative (<34). Data were analyzed using descriptive statistics and ANOVA at p=0.05. Age of adolescents (CG:13.3±2.2years, PEG:13.9±2.4years, EG: 13.0±2.4years) was similar. Females constituted 55% in CG, 50.9% in PEG and 54.2% in EG, respectively. Change in adolescents with good knowledge (60.8-61.7%, 80.0-94.2%, and 85.8-92.5%) and attitudes (-10.9%, 11.7% and 5.8%) was significant in CG, PEG and EG, respectively. Regular breakfast intake increased from 45.0-42.5%, 70.0-74.1%, and 56.7-70.0%, in CG, PEG, and EG, respectively. Consumption of staple foods during breakfast and proper timing of breakfast meals increased in interventions groups. Board-game based nutrition education enhanced breakfast habit among in-school adolescents and the use of participatory approach in development of intervention tool heightened knowledge, attitude and practice change.

Keywords: *Nutrition education, adolescents, breakfast consumption; participatory approach; board game*

*Author for correspondence: Email: o.ariyo@ui.edu.ng; ariyoseun@gmail.com; Tel: +234803-795-0483

Received: May 2021; Accepted: December 2021

INTRODUCTION

Adolescence period constitute an important phase of life for cognitive development, physical growth and last opportunity to reverse growth faltering that may have occurred in childhood (Canavan and Fawzi, 2019). The phase is characterized by rapid growth and associated pubertal changes, increased energy and nutrients requirements, specific health and developmental needs and rights. It is also the period to acquire knowledge, skills and practices that will shape food preferences and dietary behaviour in adult life (Yoshida-Montezuma, Ahmed & Ezezika, 2020) and consequently influence health and well-being.

Adolescents' population in Nigeria is about 41 million, representing approximately 21% of the total population (UNFPA 2017), yet, many transit this phase of life without opportunity to learn basic health and nutrition behaviours that are essential to promote and sustain health. Consequently, plethora of studies across Nigeria have documented high burden of malnutrition (Olumakaiye, 2013; Wariri et al., 2020), poor dietary habits (Samuel et al., 2015; Bakare & Olumakaiye, 2016; Otuneye et al., 2017) and poor knowledge of nutrition (Charles Shapu et al., 2020) among adolescents. Malnutrition among adolescents results in severe consequences including underweight, poor learning outcomes, ill health, pregnancy and birth complications, reduced economic productivity and increased susceptibility to many non-communicable diseases (WHO 2004, 2005, 2006; Branca et al., 2015).

Skipping of breakfast has been indicated as one of the common detrimental food habits among Nigerian adolescents (Alphonsus et al., 2013; Adesola et al., 2014; Lateef et al., 2016; Otuneye et al., 2017). Breakfast is considered the most important meal of the day and refers to the first meal consumed in the morning after the long fasting of about 7-10 hours of sleeping. It is particularly beneficial to adolescents as evidence has shown it promotes mental alertness (Arora et al., 2012), and contributes to adequacy of energy and nutrients intakes of nutrients and achieving healthy body weight (Obbagy et al., 2011). Annotated reasons for skipping of breakfast such as insufficient daily feeding allowance or pocket money, busy schedule and weight control measures (Oladapo et al., 2014), reflect poor understanding of the importance of breakfast among adolescents. It is known that skipping of breakfast leads to hunger in mid-morning, and

consequently increases the rate of snacking on energy-dense foods which often results in overweight or obesity (Ajayi et al., 2015; Olumakaiye et al., 2010). In addition, skipping of breakfast has detrimental effects on cognitive function, academic performance, school attendance, psychosocial function, and mood in children and adolescents (Sun et al., 2013).

It is therefore pertinent to promote healthy eating behaviour among Nigerian adolescents and the use of familiar and widely acceptable platform is considered important. Games are considered as innovative channels and have been found to be effective in promoting health dietary behaviours and other lifestyle interventions among adolescents (Liu and Chen, 2013; Alabi and Aniah, 2014; DeSmet, et al., 2014; Viggiano et al., 2015; Fraticelli et al., 2016). Board-games are simple games that can be easily adopted and incorporated into teaching methods as it improves communicative skills and promote active learning through interactions among players (Kordaki et al., 2014). Board games are considered appropriate in the study context following easy accessibility, safe keeping, and non-reliance on electricity which is not readily available in many school settings in Nigeria. Nutrition education can therefore be transformed from information-based and formal lengthy teaching approach to a more involving method (Laverack et al., 1997). This is refer to as participatory learning approach, a method of education which engages students as active participants in the full teaching process. The application in the current study include the involvement of a segment of the respondents in the design of the board game for the nutrition education and assessment of the impact of such participation on these respondents' knowledge, attitude and practices. This study was therefore designed to assess the effect of board-game enhanced nutrition intervention on breakfast knowledge, attitude and practice among in-school adolescents in Ile-Ife, Osun State.

MATERIALS AND METHODS

Study design, settings and sampling: The quasi-experimental study was conducted at Ile-Ife, Osun State Nigeria. Ile-Ife is an ancient, cosmopolitan city in Osun State, South-Western part of Nigeria. The city plays host to more than seven tertiary institutions including the Obafemi Awolowo University, Obafemi Awolowo University Teaching Hospital, Oduduwa University, The Polytechnic, Ile-Ife, two Schools of Nursing and Seventh Day Adventist Hospital. The city has a projected population of about 600,000 people spread across two urban local government areas, namely Ife Central and Ife East local government areas. Geographically, Ile- Ife lies on longitudes 4°30′E and 4°34′E and latitudes 7°28′N and 7°45′N. The climate is tropical, with rainy season between April to October while the dry season lasts October to March. It has average rainfall of 1,000–1,250 mm (39–49 in) and a mean relative humidity of 75% to 100%. Like many other states in South West Nigeria, private schools are fast becoming the preference of the middle and high social classes for primary and secondary education. Thus, three private secondary schools with student population of more than 400 pupils and within same range of tuition fees were selected using simple random sampling technique. These three schools were randomly assigned to Participatory Experimental Group (PEG), Experimental Group (EG) and Control Group (CG). One hundred and twenty (120) in-school adolescents between 10-17 years were recruited per school for the study using cluster sampling technique.

Development of Intervention Tool: A literature review on the benefits of breakfast intake and consequences of skipping among adolescents was conducted and presented to respondents in participatory experimental group. The summary were discussed and 11 basic concepts were generated by the students to reflect six benefits of regular breakfast intake and five consequences of breakfast skipping. These concepts were randomly assigned over 11 of 100 squares of traditional snake and ladder game to develop a "Breakfast Master" board game. The game was played by 2-4 people using throwing of dice and movement across the square could be hindered by a snake bite leading to demotion or loss in position or accelerated progress as represented with a ladder. These activities were used to facilitate discussions and explain the importance of timely and healthful breakfast consumption practices. The game was designed very attractively for people of all age groups ranging from children to adulthood; and lasted for about 15-20 minutes for a round of play.

Data Collection: Data were collected at baseline and end line using a semi-structured, interviewer-administered questionnaire including socio-demographic and socio-economic characteristics, knowledge, attitude and consumption of breakfast. Knowledge, attitude and habit of breakfast consumption questionnaire were adapted from a validated breakfast questionnaire (Tapper et al., 2008). . Knowledge on breakfast was assessed using 11 point scale classified as poor (≤8) and good (>8). Attitude was assessed using a 5 level Likert scale (5= strongly disagree, 4= disagree, 3= neither disagree nor agree, 2= strongly agree and 1= agree) and categorized as poor (≤33) and good (>33) attitude.
The two intervention groups (PEG and EG) were supported and supervised to play the "Breakfast Master" for an average period of 40 minutes, two times per week and for two weeks. The game was designed to facilitate understanding of the importance and benefits of breakfast consumption and the consequences of skipping breakfast. Endline data were collected after the two weeks of intervention.

Statistical Analysis: Data were processed using IBM Statistical Package for Social Sciences (SPSS) Version 21.0 and analysed using descriptive and inferential analyses. The difference in knowledge, attitude and practice at baseline and endline across the three groups were determined using student t-test and ANOVA at $p<0.05$.

Ethical Clearance: Ethical approval for the study was obtained from the University of Ibadan/University College Hospital Institutional Ethical Review Board (UI/EC/17/0257). Approval was obtained from the school authorities and informed consent was obtained from each adolescent

RESULTS

Basic Characteristics of adolescents: The socio-demographic characteristics of the adolescents in both control and intervention groups are presented in Table 1. Age of the in-school adolescents across the three groups was similar. Their mean age was 13.5±2.3 years and majority of them (CG-81.5%; PEG- 67.9%; EG- 76.7%) were between 10-14 years. More than half of the study adolescents (CG-55%; PEG-50.9%; EG- 54.2%) were females. Parents' education levels were found to be statistically significant across the three groups. Fathers with tertiary education accounted for 91.7%, 76.7% and 65.8% in CG, EG and PEG, respectively. Mothers with tertiary education was 84.2%, 67.5% and 56.6% across CG, EG and PEG, respectively. About 8 out of every 10 adolescents (CG-83.3%, PEG-77.5%, EG-80.8%) lived with both parents.

Table 1:
Socio-demographic characteristics of the adolescents

Variable		CG	PEG	EG	TOTAL	p-value
		N (%)	N (%)	N (%)	N (%)	
Age	10-14	88 (81.5)	74 (67.9)	92 (76.7)	254 (70.6)	0.06
	15-19	32 (18.5)	46 (32.1)	28 (23.3)	106 (29.4)	
	Mean ± SD	13.3±2.2	13.9±2.4	13.0±2.4	13.5±2.3	
Sex	Male	54 (45.0)	59 (49.2)	55 (48.8)	168 (46.7)	0.104
	Female	66 (55.0)	61 (50.9)	65 (54.2)	192 (53.3)	
Father's Education	Tertiary	110(91.7)	79 (65.8)	92 (76.7)	281(78.1)	0.00*
	Secondary	9 (7.5)	35(29.2)	24 (20.0)	68(18.9)	
	Primary		3 (2.5)	3 (2.5)	6(1.7)	
	Uneducated	1 (0.8)	3 (2.5)	1(0.8)	5 (1.4)	
Mother's Education	Tertiary	101(84.2)	68 (56.6)	81 (67.5)	250 (69.4)	0.01*
	Secondary	16 (13.3)	48 (40.0)	32 (26.7)	96 (26.7)	
	Primary		2 (1.7)	4 (3.3)	6 (1.7)	
	Uneducated	3 (2.5)	2 (1.7)	3 (2.5)	8 (2.2)	
Adolescents live with	Both parents	100 (83.3)	93 (77.5)	97 (80.8)	290 (80.6)	0.683
	Mother only	6 (5.0)	10 (8.3)	9 (7.5)	25 (7.0)	
	Relatives	10 (8.4)	13 (10.8)	10 (8.4)	33 (9.2)	
	Others	4 (3.3)	4 (3.3)	4 (3.3)	12 (3.3)	

CG: Control Group; PEG: Participatory Experimental Group; EG: Experimental Group

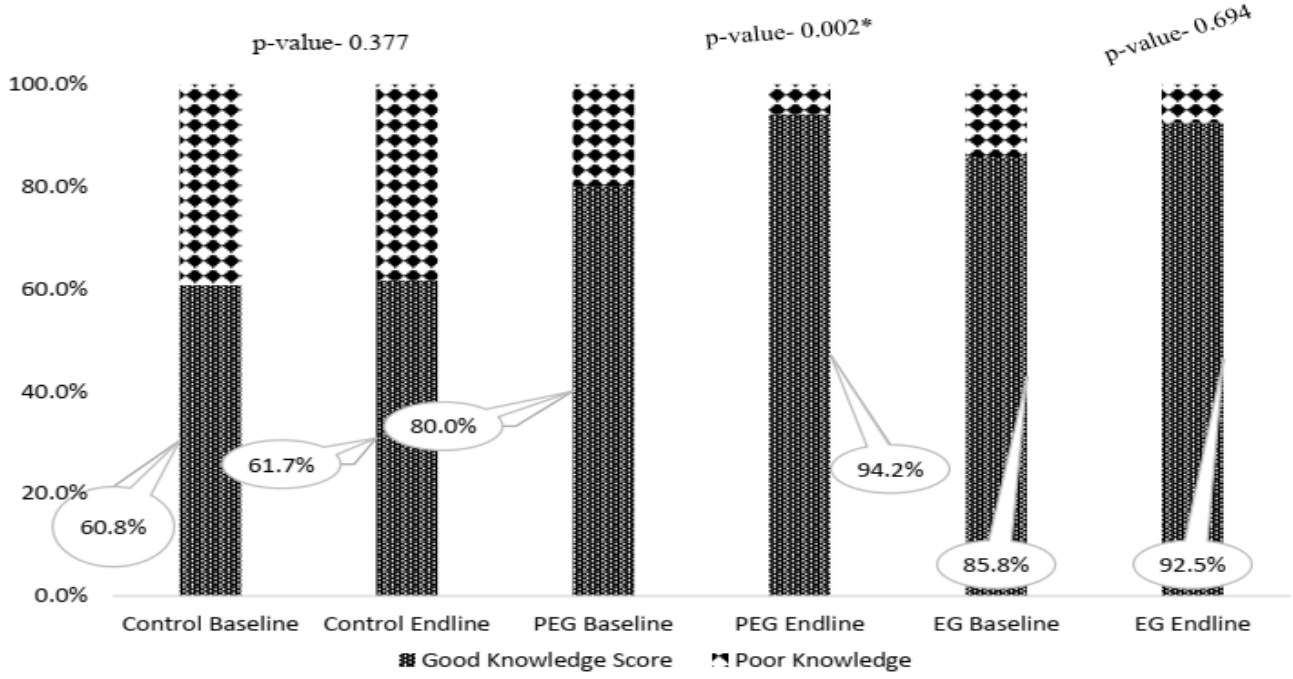

Figure 1
Knowledge score of adolescents in control and intervention groups

Table 2:
Base-line and End-line Knowledge of In-school Adolescents on Breakfast Consumption

	Base-line				End-line				
	CG	PEG	EG		CG	PEG	EG		% Δ
Variables	N (%)	N (%)	N (%)	**P-value**	N (%)	N (%)	N (%)	**P-value**	(CG *vs* PEG *vs* EG)
Knew breakfast as daily most important meal	89 (74.2)	101 (84.2)	98 (81.7)	0.00	91 (81.7)	114 (95.0)	108 (90.8)	0.00*	+10.11 *vs* 12.83 *vs* 11.14
Knew breakfast provides energy to power the day	89 (74.2)	103 (85.8)	107 (89.2)	0.01	82 (68.3)	115 (95.8)	113 (94.2)	0.00*	-7.95 *vs* 11.65 *vs* 5.61
Knew breakfast helps regulate appetite	89 (74.2)	103 (85.8)	107 (89.2)	0.00	93 (77.5)	113 (94.2)	114 (95.0)	0.00*	+4.45 *vs* 9.79 *vs* 6.50
Knew regular breakfast intake promotes healthy & active life	79 (65.8)	96 (80.0)	101 (84.2)	0.00	77 (64.2)	111 (92.5)	104 (86.7)	0.00*	-2.43 *vs* 15.63 *vs* 2.97
Knew breakfast should be consumed in the morning	96 (80.0)	112 (93.3)	112 (93.3)	0.01	100 (83.3)	112 (93.3)	112 (93.3)	0.00*	+4.13 *vs* 0 *vs* 0
Knew proper timing of breakfast intake is essential	108 (90.0)	112 (93.3)	107 (89.2)		113 (94.2)	112 (93.3)	111 (92.5)	0.01*	
Knew breakfast intake could enhance school performance	80 (66.7)	105 (87.5)	105 (87.5)	0.00	77 (64.2)	111 (92.5)	110 (91.7)	0.00*	-3.75 *vs* 5.71 *vs* 4.8
Knew breakfast intake is a component of healthy living	103 (85.8)	106 (88.3)	108 (90.0)	0.47	98 (81.7)	115 (95.8)	112 (93.3)	0.001*	-4.78 *vs* 8.49 *vs* 3.67
Knew skipping of breakfast intake is a poor dietary habit	97 (80.8)	104 (86.7)	104 (86.7)	0.15	96 (80.0)	108 (90.0)	108 (90.0)	0.03*	
Knew skipping of breakfast endangers health & wellbeing	82 (68.3)	90 (75.0)	92 (76.7)	0.36	75 (62.5)	110 (91.7)	108 (90.0)	0.00*	
Knew skipping of breakfast could reduce mental alertness	102 (85.0)	103 (85.8)	104 (86.7)	0.82	97 (80.8)	110 (91.7)	108 (90.0)	0.01*	

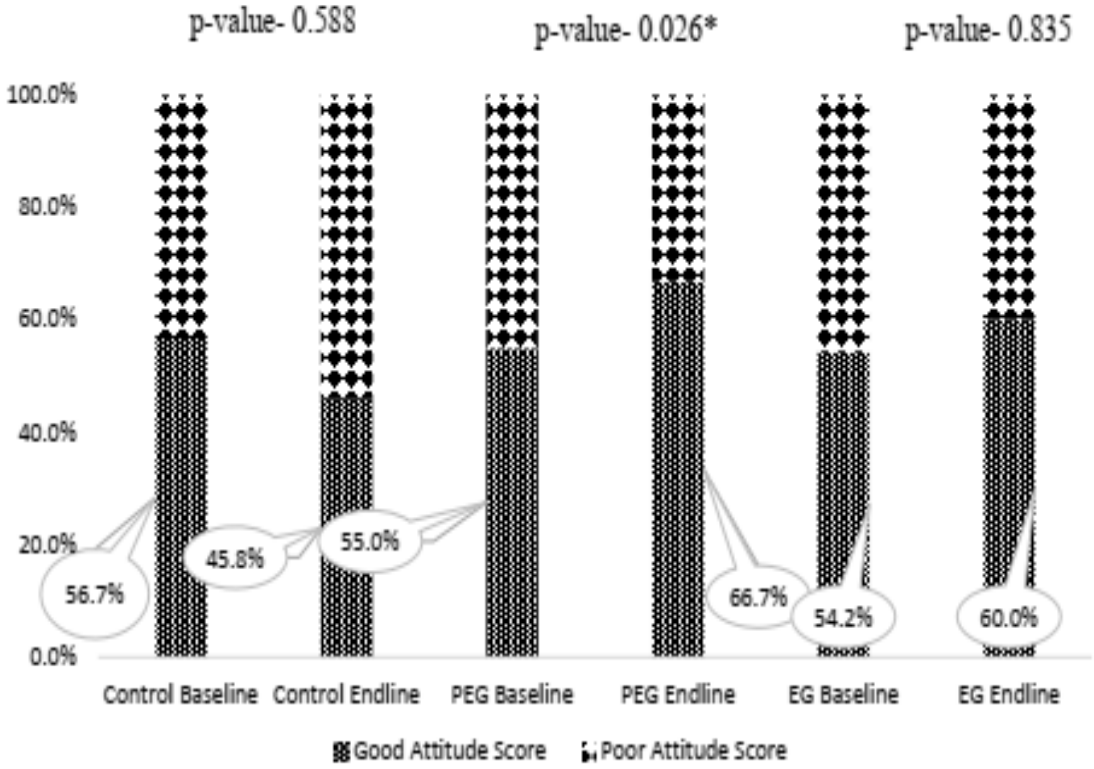

Figure 2
Attitudes of adolescents in control and intervention groups

Knowledge, Attitude and Practice of in-school Adolescents on Breakfast Consumption: The knowledge of the in-school at baseline and endline are indicated in Table 2 and Figure 1. Knowledge of breakfast as the most important meal of the day increase across all the groups with the highest increase among the participatory experimental group from 84.2% at baseline to 95.0% at endline reflecting about 13 percent increase as compared to 10% and 11% increase in the control and experimental groups, respectively. Knowledge of contribution of regular breakfast consumption in promoting healthy life increase from 80.0% to 92.5% in the PEG and from 84.2% to 86.7% in the EG while it declines from 65.8% to 64.2% in the CG. Likewise, knowledge of regular breakfast consumption in enhancing school performance increased by 5.7% and 4.8% among PEG and EG respondents, respectively and declined by 3.8% among the control group respondents. Similar trend was observed for all the variables with largest increase in the participatory experimental group than experimental and control groups. Overall, respondents with good knowledge of breakfast consumption increase from 60.8% to 61.7% in the control group, 80.0% to 94.2% in the participatory experimental group, and 85.8% to 92.5% in the experimental group. This reflects a substantial and significant increase in the participatory experimental group than other groups.

The attitude of the respondents to regular breakfast consumption at baseline and endline is depicted in Figure 2. There was a significant difference ($p<0.05$) across the three groups. In the control group, respondents with good attitude decreased from 56.7% to 45.8% while in the participatory experimental group and experimental groups, respondents with good attitude increased from 55.0% to 66.7%, and 54.2% to 60.0%, respectively.

Table 3:
Baseline and Endline breakfast consumption of the in-school adolescents

		Baseline				Endline			
Breakfast Consumption		**CG**	**PEG**	**EG**	p-value	**CG**	**PEG**	**EG**	p-value
		N (%)	N (%)	N (%)		N (%)	N (%)	N (%)	
Skipped breakfast	Yes	66 (55.0)	36 (30.0)	52 (43.3)	0.00*	69 (57.5)	31 (25.8)	36 (30.0)	0.00*
	No	54 (45.0)	84 (70.0)	68 (56.7)		51 (42.5)	89 (74.1)	84 (70.0)	
Reasons for skipping	Lacked appetite	20 (30.3)	16 (44.4)	24 (46.2)	0.00*	25 (36.2)	9 (29.0)	20 (55.6)	0.01*
	Fasting	14 (21.2)	13 (36.1)	6 (11.5)		20 (29.0)	19 (61.3)	10 (27.7)	
	Lose weight	6 (9.0)	2 (5.6)	9 (17.3)		8 (11.6)	1 (3.2)	4 (11.1)	
	Disliked available foods	12 (18.2)	1 (2.8)	5 (9.6)		7 (10.1)	2 (6.5)	2 (5.6)	
	Woke up late	11 (16.7)	4 (11.1)	6 (11.5)		6 (8.7)			
	Inability to prepare food	3 (4.5)		2 (3.8)		3 (4.3)			
Type of food usually consumed as breakfast	Snacks	1 (1.9)	4 (4.8)	3 (4.4)	0.07	5 (9.8)	2 (2.2)	3 (3.6)	0.06
	Cereals/Tubers/Grains/Pastas	53 (98.1)	80 (95.2)	65 (95.6)		46 (90.2)	87 (97.8)	81 (96.4)	
Location of breakfast consumption	At home	37 (68.5)	53 (63.1)	34 (50.0)	0.04	28 (54.9)	63 (70.8)	41 (48.8)	0.01*
	In school	16 (29.6)	28 (33.3)	29 (42.6)		20 (39.2)	25 (28.1)	40 (47.6)	
	Others	1 (1.9)	3 (3.6)	5 (7.4)		3 (5.9)	1 (1.1)	3 (3.6)	
Usual time of breakfast consumption in school	Before official breaktime	5 (31.3)	15 (53.6)	16 (55.2)	0.02	9 (45.0)	19 (76.0)	32 (80.0)	0.00*
	Breaktime (11am-12pm)	7(43.8)	11 (39.3)	9 (31.0)		7 (35.0)	6 (24.0)	8 (20.0)	
	After breaktime	4 (25.0)	2 (7.1)	4 (13.8)		4 (20.0)			
Has money for school meal	Yes	91 (75.8)	96 (80.0)	82 (68.3)	0.14	87 (72.5)	106(88.4)	96 (80.0)	0.09
	No	29 (24.2)	24 (20.0)	38 (31.7)		33 (27.5)	14 (11.6)	24 (20.0)	
Use of money for School meal	Snacks	71 (78.0)	69 (71.9)	57 (69.5)	0.03	66 (75.9)	72 (67.9)	63 (65.6)	0.05
	Food	10 (11.0)	14 (14.6)	10 (12.2)		12 (13.8)	29 (27.4)	22 (22.9)	
	Savings	10 (11.0)	13(13.5)	15 (18.3)		9(10.3)	5 (4.7)	11 (11.5)	

The breakfast habit of the in-school adolescents at baseline and endline is presented in Table 3. Skipping of breakfast increased from 55% to 57.5% among the respondents in the control group and declined from 30% to 25.8%, and 43.3% to 30.0% in the participatory experimental group and experimental groups, respectively. Notably, skipping of meals for wrong reasons such as to achieving weight loss, waking up late and inability to prepare foods reduced across all the three groups particularly among the PEG and EG respondents. Short term intervention could also contribute to change in dietary behaviour though the need for reinforcement to promote the sustainability of the new practice remain germane. The consumption of traditional staples in place of snacks as breakfast increased across all the two experimental groups with greater increase in PEG (95.2% to 97.8%) than EG (95.6% to 96.4%) while a decline from 98.1% to 90.2% was observed in the control group. There was a notable change in the meal timing among the respondents that packed breakfast to school in all the three groups. Consumption of breakfast before breaktime increased from 31.3% to 45.0%, 53.6% to 76.0%, and 55.2% to 80.0% among respondents in the CG, PEG and EG, respectively.

DISCUSSION

This quasi-experimental study assessed the effect of game-enhanced nutrition intervention on breakfast habit of in-school adolescents in Ile-Ife, Nigeria. In this study, the "Breakfast Master" board game improves the breakfast consumption knowledge, attitudes and practices among the in-school adolescents in the experimental groups compared with the control group. In addition, the use of participatory approach which involved one of the experimental groups in the development and design of the board game heightens knowledge, attitude and breakfast consumption practices compared with the other experimental group. Notably, the board game reduced breakfast skipping and improves meal timing and types of foods consumed as breakfast. The outcome of this study is agreement with earlier studies on the potential of using game-based approach in promoting appropriate dietary behaviour. Viggiano et al. (2015) reported improved nutrition knowledge and dietary habits among Italian children and adolescents using a board game "Kaledo". Rathore and Garima (2016) also reported improved nutrition knowledge among 6th to 8th graders in Sitapur following a game-based nutrition education. The behavioural change within a short period could be attributed to the board-game driven increased learning motivations which is known to enhance learning achievements and effectively promote knowledge (Yun et al., 2010; Alabi and Aniah, 2014). In addition, game learning increases appeal of the learning process, enhances learners' engagement and preserve knowledge for a longer period compared to traditional paper-based intervention methods, all of which contributes chance to positive learning outcomes (Randel et al., 1992). Furthermore, the facilitation which provides instant feedback has been noted to motivate learners and corrects misconceptions (Leach and Sugarman, 2005), which could have hindered understanding.

Attitudinal change to breakfast consumption occurs substantially only in the participatory experimental group possibly due to a longer duration of exposure to the board game following their involvement in the development and design of the "breakfast master". The change in attitude is in agreement with the findings on healthy eating among boarding school students in Malaysia (Roszanadia & Norazmir 2011), and a board game intervention. The result also align with the study by Yien, et al., (2011) where the attitude score of the experimental group was reported to be higher than that of the control group, but there was no significant difference between the two groups after the intervention.

Remarkable improvement in breakfast consumption, timing of meal consumption, and type of foods consumed for breakfast is a reflection of a promising approach the board game offers in addressing skipping of breakfast, delay in breakfast intake and quality of breakfast meals among adolescents. Several studies have documented skipping of breakfast as a common detrimental food habits among Nigerian adolescents (Alphonsus et al., 2013; Ogunkunle and Oludele, 2013, Adesola et al., 2014; Lateef et al., 2016; Otuneye et al., 2017), yet, there is a paucity of intervention to address this menace. The finding in this study is similar to the finding of an earlier study which have reported improvement in healthy dietary practices generally among Nigerian adolescents using a board game (Ogunsile and Ogundele, 2016).

The higher increase in knowledge, attitude and change in breakfast practices among the in-school adolescents in the participatory experimental group compared to the experimental group could be attributed to participants' involvement in the development and design process and extended learning period associated with this involvement which could contribute to deeper understanding of the subject matter. Participatory approach is known to be effective intervention method (Ajayi et al., 2009), though it remains underutilized in nutrition education. Food and Agriculture Organization (1995) reported that individual fully involved in the development and design, implementation, monitoring and evaluation of nutrition education programs; are likely to be more effective and sustainable. This concept when combined with game-based approach promote continuous participation, engagement, reinforcement of positive behaviours, enable behavioural change, habit formation, and maintenance of new behaviors (Nour et al., 2017).

To the best of our knowledge, few studies have adopted the participatory learning approach in the development and design of nutrition education tools and this may be the first application in the promotion of breakfast practices. The participatory learning approach is traditional used in nutrition to promote active community involvement and ownership of intervention programmes. The result of this study indicated that the use of this approach is also effective in promoting adoption of healthy dietary behaviour such as regular and quality breakfast consumption.

In conclusion, the use of board-game is effective in promoting knowledge, attitude and practice of breakfast consumption among in-school adolescents. The involvement of the in-school adolescents in the design and development of the board game heightens breakfast knowledge and practice improvement, thus participatory learning approach should be further explored in promoting dietary behaviour change. Though this study identified the strategy to promote breakfast intake among Nigerian adolescents within a short duration, the gap on longer duration of intervention, quality of breakfast and what should constitute breakfast in Nigeria remains unexplored. Further studies on the quality of breakfast and what should constitute the component of a good breakfast is hereby suggested.

Author Contributions: *All the authors made substantial contribution to the success of this research. AO & AEO conceptualized the work, AEO & AOO prepared the draft proposal, AO & OOL revised the draft proposal. The board game used was designed by AO, AEO & AOO. AO & OOL supervised the data collection, AO, AEO & AOO were responsible for data collection and curation. AEO and AOO prepared the first draft of the manuscript, and AO & LOO revised the manuscript. All the authors were involved in revising the manuscript for publishing*

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