



Research

Impact of Health Education Intervention on Dietary Practice among Adolescent Girls in Government Secondary Schools Maiduguri: A Cluster Randomised Control Trial

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Abstract

Background: Dietary deficiencies among adolescent girls have far-reaching consequences. The study aimed to evaluate the impact of health education intervention on dietary practice among adolescent girls in government secondary schools Maiduguri Metropolitan Council (MMC).

Methods: The study was a cluster randomized control trial among 417 adolescent girls aged 10-19 years old. Data were collected from October 2019 to March 2020 using KoBo collect toolbox. Chi-square and Fisher exact were used to compare baseline differences between intervention and control group, a generalized estimating equation was used to evaluate the impact of health education intervention.

Results: There was no significant difference in dietary practice between the intervention and control groups at baseline. There was a statistically significant difference at three and six months post-intervention for dietary practice; $p = 0.003$ and $p = 0.011$ between the intervention and control groups. There was a significant interaction at three and six months post-intervention; $p = 0.005$, and $p = 0.025$ respectively.

Conclusions: The study's outcome reveals that health education intervention greatly impacted dietary practice among adolescent girls in MMC.

Keywords: Dietary practice, Health education intervention, Adolescent girls, Cluster randomized control trial, KoBo collect toolbox

Introduction

Adolescent girls are an important connection between the current and the future generation, hence health care and nutrition are a global concern in all. Adolescents require distinctive consideration because they are the future workforce, global leaders and parents. The extent to which adolescents can be able to respond to future challenges and economic development depends on their health and development during their adolescent phase, there is a need to pay adequate attention to the dietary practice of adolescents¹. Sufficient nutrition is an essential cornerstone in the health of an individual, particularly important for adolescent girls and young women, as malnutrition wreaks havoc to them and their

unborn children, more so, a sustainable healthy dietary practice has the potential of mitigating growth delay and also a nutritional deficit in early life thereby reducing the burden of non-communicable disease during their adult life. Healthy adolescents are well protected from disease and infection and are less likely to develop malnutrition in all its forms^{2,3}. Poor nutrition-related practices were found to be higher in low and middle-income countries with more risk of malnutrition⁴. Factors associated with dietary practice among adolescent girls include school type, family residence, living with whom, access to gardening, the decision for food preparation, school club, occupation of father, education of mother and household economic status^{5,6}. Since poor dietary



practice negatively impacts adolescents' physical growth and development, it is important to ensure healthy dietary practices among these age groups through dietary diversification and a nutrient-rich diet. The key barriers to education and a productive future in low and middle-income countries were poor health and nutrition among adolescents which have been ignored by the nutrition strategy and policies of such countries^{6,7}. As a result of the dearth of intervention on health and nutrition-related intervention, the study aims at evaluating the impact of health education intervention on dietary practice among adolescent girls in government secondary schools in Maiduguri, a cluster randomised control trial using information motivation and behavioural skill model (IMB).

Methods

Study setting and area

This research study was conducted from October 2019 to March 2020 in four government secondary schools in MMC. MMC is the capital and one of the twenty-seven local government areas of Borno State, located at latitude 11.85, longitude 13.16 operating in the West African time zone, with a population of 4,171,104 million, out of which 872,105 were adolescents aged 10 to 19 years old⁸⁻¹⁰. Trading and agriculture are the main livelihood activities of the state, the agricultural activities of the state produce (a) cereals such as maize, millet, sorghum, rice and wheat, (b) legumes and seeds such as groundnut, Bambara nut, sesame seeds, beans, soya beans, (c) fruits like orange, lemon, mango, guava, (d) vegetables including tomatoes, okra, pumpkin, cucumber, onions, melon, pepper, (e) dairy products, (f) fishing and livestock farming such as fish that are of different varieties, poultry, sheep, rabbits, pigs, cattle and goats, (g) cash crops like cotton, ginger and Arabic gum among others¹¹⁻¹².

Study design and sampling

The study was a cluster randomised control trial used to evaluate the impact of health education intervention on dietary practice among adolescent girls in government secondary schools. The study was conducted in four randomly selected secondary schools, two schools were randomly assigned to the intervention group and two to the control group using opaque envelopes respectively. The intervention group were given health education intervention on how to prevent malnutrition through information on macronutrients, micronutrients, dietary diversity and healthy eating, motivation on the prevention of malnutrition among adolescent girls and

lessons learnt, and behavioural skills on practical cooking demonstration and identification of food groups. While the control group were given malaria education. The sample size was calculated using two population proportion formula¹³, $p_1 = 0.938$, $p_2 = 0.803$, $Z_{1-\alpha/2} = 1.96$ (0.05, 95% confidence interval), $Z_{1-\beta} = 1.282$, effect size 1.3, attrition factor of 20%, total sample size calculated was 424 (212 each) in the intervention group and control group respectively.

Education Intervention

The health education intervention module was developed using the IMB theory format, the pictures used were taken from the local settings, taking into consideration the local values and norms of the people. The health education for the intervention group included prevention of malnutrition, food groups (macro and micronutrient), intergenerational cycle of malnutrition, food groups by Food and Agriculture Organisation of the United Nations (FAO), dietary diversity and healthy eating habit, participant's experiences and those of other adolescent girls, preventive measures, community norms, and how best they can continue with what they have learnt spreading the information to their peers. The strategies for the intervention group includes lecture, discussion, role-play, brainstorming and practical's such as matching food and cooking demonstration. The intervention module was pilot tested for six days, in one of the secondary schools that was not part of the study with the same strategies and activities as was done in the main study. The intervention duration was three months comprising of six modules, the frequency of contact was bi-weekly for one hour 30 minutes (1:30) each session. The impact of the health education intervention was assessed by comparing the dietary practices between intervention and control at three- and six-months post-intervention data collection.

Data collection and analysis

Data collection was done using KoBo collect toolbox through respondent interview. Data were collected at baseline, three-, and six-months post-intervention by trained enumerators. Data on the dietary practice of respondents were collected using a structured questionnaire in English. The dietary practice was categorised into two-level, scores that were below the mean score were considered poor dietary practice, while scores above the mean score were considered good dietary practice. To avoid possible contamination, it was a single-blinded study where the enumerator and the

facilitator were blinded to the study objectives and randomisation process. Dietary practice in this study comprises of dietary diversity using the food frequency questionnaire (FFQ) and meal frequency. The item that was used in assessing dietary practice was adapted from Food and Agricultural Organisation of the United Nations (FAO) guidelines, for individual dietary diversity and meal frequency¹⁴⁻¹⁶. Cronbach's alpha result for nutritional status and practice was found to be acceptable within the range of 0.70 to 0.95¹⁷. Data were transferred from KoBo collect toolbox to SPSS for

Ethical approval

Universiti Putra Malaysia Ethics Committee UPM gave the ethical approval UPM/TNCPI/RMC/JKEUPM/1.4.18.2 (JKEUPM). The research was also registered with Pan African Clinical Trials Registry (PACTR201905528313816). There was a written authorization from the ministry of education, Borno State. Consent was obtained from both parents/guardian and the respondents.

Results

Baseline Characteristics of Respondents

Dietary Practice of Respondents at Baseline

Food Frequency Questionnaire of Respondents at Baseline

Data were collected at baseline, three-, and six-months post-intervention as shown in the CONSORT flow chart in Figure 1, intention to treat analysis (ITT) was also conducted.

Table 1 shows the food frequency questionnaire (FFQ) consumed among respondents in the intervention and control group at baseline. More than half of respondents in both groups consumed cereals 391(93.8%), vegetables 308(73.9%), legumes 230(55.2%), oil and fats 282(67.4%). While tubers and roots 114(27.43), fruits 61(14.6%), meats and meats products 97(23.3%), milk and milk products 127(30.5%), fish and other seafood's 162(38.8%), egg 89(21.3%), sweet 162(38.8), Spices, condiments, snacks, and beverages 159(38.1) were consumed by less than half of respondents. There was no significant difference between the intervention and control group at baseline in all the twelve food groups (cereals, tubers and roots, vegetables, fruits, meats and meat products, legumes and nuts, milk and milk products, fish and other kinds of seafood, egg, oil and fats, sweets and spices, condiments, snacks, beverages).

analysis. SPSS version 25 was used for data analysis. Bivariate analysis was conducted using Chi-square and Fisher exact compare baseline differences between intervention and control group, independent t-test and paired t-test was used to assess the between and within differences between intervention and control groups at three months and six months post-intervention respectively. Multivariate analysis was conducted using a generalised estimating equation to evaluate the effectiveness of health education intervention, $p < 0.05$ were considered statistically significant.

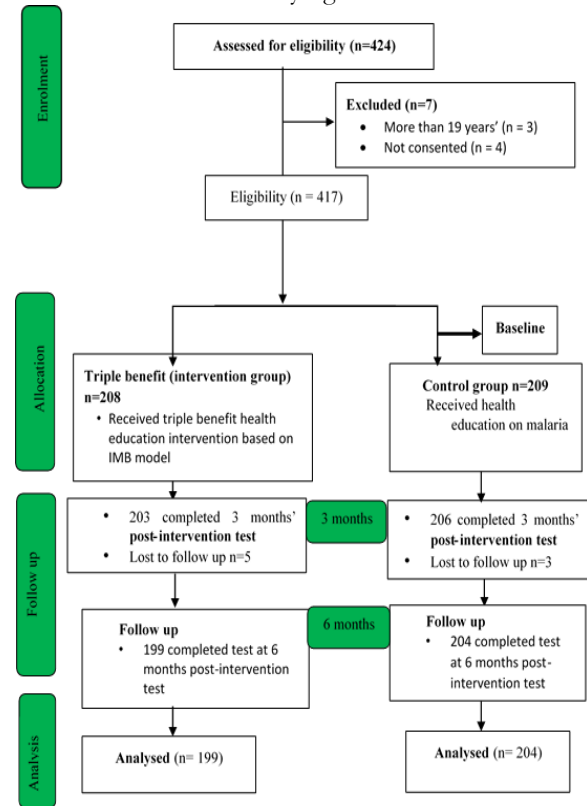


Figure 1: Consort Flow chart of the Study



Table 1: Food Frequency Questionnaire of Respondents at Baseline

Items	Response	Intervention N (%)	Control N (%)	Total N (%)	X ²	P-value
Cereals	No	12(5.8)	14(6.7)	26(6.2)	0.154	0.695
	Yes	196(94.2)	195(93.3)	391(93.8)		
Tubers and roots	No	150(72.7)	153(73.2)	303(72.7)	0.910	0.635
	Yes	58(27.8)	56(26.7)	114(27.3)		
Vegetables	No	54(26.0)	55(26.3)	109(26.1)	0.144	0.931
	Yes	154(74.0)	154(73.7)	308(73.9)		
Fruits	No	180(86.5)	176(84.2)	356(85.4)	1.359	0.507
	Yes	28(13.5)	33(15.8)	61(14.6)		
Meats and meats products	No	158(76.0)	162(77.5)	320(76.7)	0.216	0.898
	Yes	50(24.0)	47(22.5)	97(23.3)		
Legumes and nuts	No	90(43.3)	97(46.4)	187(44.8)	1.015	0.602
	Yes	118(56.7)	112(53.6)	230(55.2)		
Milk and milk products	No	147(70.7)	143(68.4)	290(69.5)	0.439	0.803
	Yes	61(29.3)	66(31.6)	127(30.5)		
Fish and other seafood	No	119(57.2)	136(65.1)	255(61.2)	2.783	0.249
	Yes	89(42.8)	73(34.9)	162(38.8)		
Egg	No	165(79.3)	169(80.9)	334(80.1)	0.244	0.885
	Yes	43(20.7)	40(19.1)	89(21.3)		
Oil and fats	No	64(30.8)	71(34.0)	135(32.4)	3.531	0.171
	Yes	144(69.2)	138(66.0)	282(67.6)		
Sweets	No	121(58.2)	134(64.1)	255(61.2)	1.566	0.457
	Yes	87(41.8)	75(35.9)	162(38.8)		
Spices, condiments, snacks, beverages	No	123(59.1)	135(64.6)	258(61.9)	3.059	0.217
	Yes	85(40.6)	74(35.4)	159(38.1)		

N = Frequency, % = Percentage, X² = Chi-square

Table 2: Meal Frequency of Respondents in Seven Days at Baseline

Items	Frequency	Intervention N (%)	Control N (%)	Total N (%)	X ²	P-value
Breakfast	0	39(18.8)	41(19.6)	80(19.2)	1.860	0.932
	1	11(5.3)	6(2.9)	17(4.1)		
	2	24(11.5)	25(12.0)	49(11.8)		
	3	32(15.4)	36(17.2)	68(16.3)		
	4	20(9.6)	22(10.5)	42(10.1)		
	5	33(15.9)	36(17.2)	69(16.5)		
	6	8(3.8)	6(2.9)	14(3.4)		
School break	7	41(19.7)	37(17.7)	78(18.7)		
	0	54(26.0)	60(28.7)	114(27.3)		
	1	20(9.6)	15(7.2)	35(8.4)		
	2	16(7.7)	12(5.7)	28(6.7)		



Items	Frequency	Intervention N (%)	Control N (%)	Total N (%)	X ²	P-value
	3	34(16.3)	38(18.2)	72(17.3)		
	4	19(9.1)	20(9.6)	39(9.4)		
	5	39(18.8)	38(18.2)	77(18.5)		
	6	0(0.0)	0(0.0)	0(0.0)		
	7	26(12.5)	26(12.4)	52(12.5)		
	0	1(0.5)	0(0.0)	1(0.2)	5.616	0.585
	1	17(8.2)	9(4.3)	26(6.2)		
	2	3(1.4)	3(1.4)	6(1.4)		
	3	18(8.7)	18(8.6)	36(8.6)		
	4	58(27.9)	70(33.5)	128(30.7)		
	5	37(17.8)	43(20.6)	80(19.2)		
Lunch	6	27(13.0)	26(12.4)	53(12.7)		
	7	47(22.6)	40(19.1)	87(20.9)		
	0	4(1.9)	5(2.4)	9(2.2)	3.192	0.867
	1	18(8.7)	13(6.2)	31(7.4)		
	2	20(9.6)	28(13.4)	28(11.5)		
	3	22(10.6)	21(10.0)	43(10.3)		
	4	44(21.2)	47(22.5)	91(21.8)		
	5	48(23.1)	51(24.4)	99(23.7)		
Dinner	6	13(6.3)	12(5.7)	25(6.0)		
	7	39(18.8)	32(15.3)	71(17.0)		
	0	100(48.1)	106(50.7)	206(49.4)	0.772	0.998
	1	21(10.1)	18(8.6)	39(9.4)		
	2	30(14.4)	28(13.4)	58(13.9)		
	3	19(9.1)	19(9.1)	38(9.1)		
	4	14(6.7)	16(7.7)	30(7.2)		
	5	10(4.8)	10(4.8)	20(4.8)		
	6	1(0.5)	1(0.5)	2(0.5)		
Snacks	7	13(6.3)	11(5.3)	24(5.8)		

N = Frequency, % = Percentage, X² = Chi-square

The practice comprises dietary diversity and meal frequency (Table 2). There was no significant difference in overall practice towards malnutrition among respondents between the intervention and control group at baseline (p = 0.262) as shown in Table 3.



Table 3: Dietary Practice between Intervention and Control at Baseline

Variables	Intervention N (%)	Control N (%)	Total N (%)	X ²	P- value
Dietary Practice				-	0.262
Poor Dietary Practice	101(48.6)	109(52.2)	210(50.4)		
Good Dietary Practice	107(51.4)	100(47.8)	207(49.6)		

N = Frequency, % = Percentage, X² = Chi-square, - = Fisher exact

Evaluation of the Effectiveness of Health Education Intervention on Dietary Practice of Respondents

Comparison of Dietary Practice between Groups (intervention and control) and Time Points (baseline, three and six-months post-intervention) respectively using a Generalised estimating equation

A generalised estimating equation (GEE) was used to assess the level of dietary practice of respondents after the Health Education Intervention between groups

(intervention and control) and time points (baseline, three and six-months post-intervention respectively).

Table 6 shows that respondents in the intervention group were more likely to have good dietary practices compared to respondents in the control group (AOR = 2.234, 95% CI: 1.774 – 2.814, p < 0.001). Respondents at three and six-months post-intervention were more likely to have good dietary practice compared to respondents at baseline respectively (AOR = 1.545, 95% CI: 1.164 – 2.051, p = 0.003; AOR = 1.422, 95% CI: 1.083 – 1.867, p = 0.011).

Table 6: Comparison of Dietary Practice of Respondents between Groups (intervention and control) and Time Points (baseline to three and six-months post-intervention) respectively using GEE

Variables	B	SE	Crude odd ratio Exp (B)	Wald square	chi- square	95% CI Lower bound	Upper bound	p-value
Groups								
Control	Ref							
Intervention	0.804	0.118	2.234	46.572		1.774	2.814	<0.001*
Time points								
Baseline	Ref							
Post-intervention	0.435	0.145	1.545	9.066		1.164	2.051	0.003*
Follow up	0.352	0.139	1.422	6.402		1.083	1.867	0.011*

*Significant <0.05; SE = Standard error; CI = Confidence Interval; Ref = Reference category; B = Unstandardized beta.

Interaction and Factors Associated with Dietary Practice of Respondents

GEE was used to assess sociodemographic characteristics, source of information, carbohydrate, protein, fats, nutritional status, mid-upper arm circumference (MUAC) level, information, motivation, and behavioural skill level on dietary practice at univariable analysis. Ten factors were statistically significant including group, time, religion, age of mother, education of mother, family type, energy, carbohydrate, motivation, and behavioural skills on dietary practice at univariable analysis.

Nineteen factors with p < 0.25 in univariable analysis were tested in GEE, including group, time, class, ethnicity, religion, education of father, occupation of father, age of mother, education of mother, occupation

of mother, family type, source of information, nutritional status, MUAC, energy, carbohydrate, information, motivation and behavioural skills.

Table 7 shows that five factors had a statistically significant effect on the dietary practice of respondents. There was a significant interaction at three- and six-months post-intervention, respondents at three- and six-months post-intervention were more likely to have good dietary practice compared to respondents in the control group at baseline respectively; three months post-intervention (AOR = 2.309, 95% CI: 1.282 – 4.159, P = 0.005), six months post-intervention (AOR = 1.896, 95% CI: 1.082 – 3.321, p = 0.025) respectively.

Respondents from the Islam religion were more likely to have good dietary practices compared to the respondent from the Christian religion (AOR = 1.373, 95% CI:



1.042 – 1.810, $p = 0.024$). Respondents whose mothers ages were between 35 to 44 years were more likely to have good dietary practices compared to respondents with mothers aged >45 years (AOR = 1.407, 95% CI: 1.027 – 1.928, $p = 0.033$). Respondents whose mothers had tertiary education were more likely to have good dietary practices compared to respondents with no mothers' education (AOR = 1.621, 95% CI: 1.085 – 2.421, $p = 0.018$). Respondents whose mother's

occupations were trading/business were more likely to have good dietary practices compared to respondents whose mothers were civil servants (AOR = 1.490, 95% CI: 1.089 – 2.038, $p = 0.013$). Respondents with good motivation were more likely to have good dietary practices compared to respondents with poor motivation (AOR = 1.513, 95% CI: 1.163 – 1.970, $p = 0.002$).

Table 7: Factors Associated with the Dietary Practice of Respondents

	B	SE	Adjusted odd ratio	Wald square	chi-	95% CI		P-value
						Lower bound	Upper bound	
Intercept	0.202	0.379						
Groups								
Control	Ref							
Intervention	0.123	0.200	1.131	0.377		0.764	1.673	0.539
Time points								
Baseline	Ref							
Post-intervention	0.012	0.196	1.012	0.004		0.689	1.511	0.952
Follow up	0.030	0.195	1.031	0.024		0.703	1.485	0.877
Interaction								
Control *baseline	Ref							
Intervention *post-intervention	0.837	0.300	2.309	7.768		1.282	4.159	0.005*
Intervention*follow up	0.640	0.286	1.896	5.002		1.082	3.321	0.025*
Religion								
Christianity	Ref							
Islam	0.317	0.141	1.373	5.068		1.042	1.810	0.024*
The age group of the mother (Years)								
Equal or less than thirty-five	0.209	0.150	1.232	1.934		0.918	1.655	0.164
Thirty-five to forty-four	0.342	0.161	1.407	4.522		1.027	1.928	0.033*
Equal or greater than forty-five	Ref							
Mothers' education								
No education	Ref							
Informal education	0.138	0.186	1.143	0.553		0.797	1.654	0.457
Primary education	-0.365	0.285	0.694	1.634		0.397	1.215	0.201
Secondary education	0.290	0.166	1.336	3.031		0.964	1.851	0.082
Tertiary education	0.483	0.205	1.621	5.560		1.085	2.421	0.018*
Mothers' occupation								
Civil service	Ref							
Business/trading	0.399	0.160	1.490	6.232		1.089	2.038	0.013*
Farming	0.248	0.234	1.282	1.126		0.810	2.028	0.289
Housewives	0.302	0.161	1.353	3.537		0.987	1.854	0.060
Motivation								
Poor motivation	Ref							
Good motivation	0.414	0.134	1.513	9.505		1.163	1.970	0.002*

*Significant <0.05; SE = Standard error; CI = Confidence Interval; Ref = Reference category; B = unstandardized beta; BMI = Body mass index, QIC = 1642.201; QICC = 1643.485.

Discussion

Malnutrition among adolescents has been linked to poor dietary intake and suboptimal dietary quality. Improved information and effective implementation of interventions on dietary practice in both food quality and dietary intake, food system, and nutrition programs are key opportunities for improving adolescent health and well-being at all stages of their life particularly looking at the adverse effect of malnutrition on early pregnancy on maternal and child health and the nutritional outcomes, especially in developing countries such as Nigeria¹⁸.

The baseline result from this study for the food frequency questionnaire among respondents reveals no significant difference between the intervention and control groups at baseline for the twelve food groups consumed within the past 24 hours. The study further showed no significant difference in cereals, tubers and roots, fruits, vegetables, legumes and nuts, meat and meat products, milk and milk products, fish and other seafood, egg, sweets, oil and fats, condiments, spices, beverages and snacks between intervention and control at baseline. This was in line with an intervention study in Ethiopia which reported no significant difference in fruits, vegetables, cereals, dairy products and soft drinks, the study in Ethiopia further reported a significant association in protein sources of food (beef, eggs, nuts, mutton, fish, chicken, legumes) and oil (butter, oil)¹⁹. More than half of respondents in both the intervention and control groups consumed cereals, vegetables, legumes, oil and fats. While tubers and roots, fruits, meats and meats products, milk and milk products, fish and other seafood, egg, sweets, Spices, condiments, snacks, and beverages were consumed by less than half of the respondents. This finding was consistent with findings in Ethiopia in fruits, vegetables, dairy products, soft drinks, and oil and fats. But contrary to protein source of food. This may be due to less consumption of protein sources of food as a result of the cost of food and inaccessibility of animal source food, socioeconomic status and sociodemographic characteristics (19). There was no significant difference in meal frequency between intervention and control groups at baseline. There was no significant difference in breakfast consumed between intervention and control groups, this was in line with a study in China that reported no significant difference between intervention and control at baseline²⁰. There was no significant difference between the intervention and control group in dinner consumed by respondents at baseline, this concurs with a study in Malaysia, but contrary to the result on school break, lunch and snacks. This may be associated with sociodemographic characteristics, socioeconomic status and parents' knowledge of dietary intake²¹.

The impact of the health education intervention has significantly improved the dietary practice of

respondents in the intervention group ($p < 0.001$) compared to the control group. There was statistically significant change in the dietary practice of respondents at three-months post-intervention ($p = 0.003$) and sustained these changes through six months ($p = 0.011$) post-intervention, revealing significant differences between and within the intervention and control groups. This agrees with studies in Bangladesh, China, India, Canada, Palestine, Iran and Malaysia²⁰⁻²⁹. But contrary to a study in California that reported that there was no significant improvement in the behavioural practice of respondents³⁰. This may be associated with the absence of a theory of behavioural change in the program, the instructive nature of the intervention and the post-intervention data collected three months after the intervention which most of the respondents might have forgotten about the intervention. In this study the health education intervention using the IMB model has instilled awareness of good dietary practice through the consumption of diverse diets, having the information on healthy choices, understanding macro (carbohydrate, protein and fats) and micronutrients (vitamins and minerals), dietary diversity using the FAO food groups, food preparation, healthy food storage system and frequency of meals consumed daily. Individual features and the surrounding environment tend to influence the characteristics, beliefs and personal values in the form of support from family and friends on varieties of food are associated with various health behaviours that are capable of improving the practice of adolescents (31). There was a significant interaction at three- and six-months post-intervention for dietary practice, respondents at three and six-months post-intervention were more likely to have good dietary practice compared to respondents in the control group at baseline. This was contrary to a study in Canada, these differences may be a result of the generated significant sociodemographic difference between the intervention and control group at baseline, a large drop out (63.6%) in the control group and the achieved sample size was short of the calculated sample size thereby giving rise to differences in the recruitment of respondents²². The generalised estimating equation in this study reveals the factors associated with the dietary practice of respondents. Religion that is faith towards one's religion can influence their practice on choice and selection of food to be consumed³². The age of mother, as the age of the mother increases, it can increase their ability to recognise malnutrition in their household, influence the dietary practice of the household in both quality and quantity, also ability to keep to health-related best practices for the well-being of the entire household². Mothers' education could be associated with good knowledge of the definition, causes, consequences and future implications that tend to change and shape their behaviour thereby influencing their dietary practice. Occupation of mothers (business/trading), mother's occupation contributes to



increasing the income of the household, improves their socioeconomic status, adds up to the purchasing power of the household, and helps in diversifying their food, thereby enabling them to good dietary practice. Motivation, Individual features and the surrounding environment tend to influence the characteristics, beliefs and personal values in the form of family and friends' support of varieties of food are related to several health behaviours that are capable of improving the dietary practice of adolescents³³.

The health education intervention has improved dietary practice significantly among adolescent girls. The strength of the study includes cluster randomised controlled trial to avoid contamination of the respondents within each group, there was an active control group, with three and six-months post-intervention data collection, the study used theory, there were no significant differences in the study outcome and sociodemographic characteristics, internal consistency of the study outcome was > 0.7 , the use of KoBo collect toolbox and there was high retention rate of greater than 90%. The limitation of the study may include recall bias.

There was great support from the four-school management involving both intervention and control groups by creating an enabling environment for the research to be successful. Based on the findings from this study, stakeholders can re-strategize school feeding programs placing more emphasis on dietary diversity in school menu with the inclusion of nutrient-rich food such as animal source, legumes, fruits and vegetables that were less consumed in the baseline result to address malnutrition among this age group in the boarding schools in Borno state and Nigeria at large.

Implications of the findings: Health Education Intervention module on Dietary Practice has successfully thrived in improving dietary practice among adolescent girls in reducing the risk of malnutrition. Since there are no effective preventive measures in place, stakeholders should try and adapt the Health Education Intervention on Dietary Practice module and make it available to Nigerian children, particularly adolescent girls. The utilization of such an education intervention module by the general public can promote healthy living, empower them to be in charge of their nutritional well-being, thereby reducing the risk of malnutrition among adolescent girls and their future offspring.

Limitation of the study: Limitation of the intervention includes non-inclusion of schools with married women,

schools with boys only, private schools, primary schools with early adolescents, the school dropped out, adolescents not attending any school at all and married adolescents who may be at risk of malnutrition due to inadequate nutritional information's. The study included a self-reported questionnaire. Other limitations of our intervention include limited time, lack of funding, inability to strategize for a PTA meeting before the onset of the intervention to enable full participation of all eligible participants.

Conclusion

The outcome of the health education intervention reveals a statistically significant improvement in the dietary practice of respondents. The study reveals that there was a significant difference between and within intervention and control at three- and six-months post-intervention. However, given the poor eating practice among respondents, future studies should explore the use of more diverse food in a more participatory and interactive intervention using IMB for more sustainable change in their dietary practice. There is also a need for multiple-sector collaborations including health, agriculture, and education, as well as community engagement involving adolescents, their parents and the communities to improve their dietary practice. Most importantly there is a need for involving adolescents in research design to ensure youth-friendly intervention and participation. More so, during national and regional surveys there is a need to track nutrition and health indicators across full age of adolescence as greater investment to advance adolescent nutrition, as this is important and has a lifelong impact for them and their future families.

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