Original

Development, and Validation of a Triple Benefit Health Education Intervention Module and Questionnaire to Improve Adolescent Girls' Knowledge, Attitude, and Practice Toward Malnutrition

[1,2]Ruth Shapu Charles, [1]Suriani Ismail, [1]Lim Poh Ying, [1]Norliza Ahmad, [3]Hussaini Garba, [4]Emmanuel Mshelia Williams

[1]Department of Community Health, Faculty of Medicine and Health Science, Universiti Putra Malaysia, Serdang 43400, Selangor, Malaysia;
[2]College of Nursing and Midwifery, Damboa Road, Maiduguri, Maiduguri 600252, Borno State, Nigeria.
[3]Department of Physical and Health Education, University of Maiduguri, Maiduguri, 600230, Borno State, Nigeria
[4]Borno State Ministry of Water Resources, P.M.B. 1188, Maiduguri, Borno State, Nigeria

Corresponding author: Ruth Charles Shapu, College of Nursing and Midwifery, Damboa Road, Maiduguri, Maiduguri 600252, Borno State, Nigeria.
ruthyshapu52@gmail.com; +2348062928582

Article history: Received 10 October 2025, Reviewed 21 November 2025, Accepted for publication 11 December 2025

ABSTRACT

Background: Malnutrition among adolescent girls in conflict-affected regions of Nigeria remains a pressing public health concern.

Method: This study developed and validated the Triple Benefit Health Education Intervention Module and a corresponding questionnaire to improve knowledge, attitude, and practice (KAP) toward malnutrition. The questionnaire was adapted from established nutrition assessment tools and validated through expert review and face validity testing among adolescent girls. Reliability was confirmed via Cronbach's alpha and test-retest analysis. The module underwent rigorous face and content validation, achieving a 93% content validity score. An Independent t-test (student test) was used to compare the means of two groups of continuous variables.

Result: A pilot study involving 43 adolescent girls demonstrated significant improvements in knowledge, attitude, practice, information, motivation and behavioural skill scores in the post-intervention test, with mean knowledge rising from 6.3 to 26.4 (p-<0.001), attitude from 44.1 to 71.9 (p-<0.001), and practice from 35.6 to 45.0 (p-<0.001).

Conclusion: These results underscore the effectiveness of the module and questionnaire in promoting nutritional awareness and behavior change. The validated tools offer a promising framework for scaling adolescent health education interventions in similar settings.

Keywords: Triple benefit, Health education, Intervention, Validity, Questionnaire, Adolescents, Malnutrition, Knowledge, Attitude, Practice, Kobo Collect

How to cite this article

Charles RS, Ismail S, Poh Ying L, Ahmad N, Garba H, Williams EM. Development, and Validation of a Triple Benefit Health Education Intervention Module and Questionnaire to Improve Adolescent Girls' Knowledge, Attitude, and Practice Toward Malnutrition. The Nigerian Health Journal 2025; 25(4):1444 – 1455.
https://doi.org/10.71637/tnhj.v25i4.1207

INTRODUCTION

Malnutrition remains a critical public health challenge among adolescent girls in Nigeria, particularly in conflict-affected regions such as Borno State [1,2]. The compounded effects of displacement, food insecurity, and limited access to health education have exacerbated vulnerabilities in this population, necessitating targeted interventions that address both knowledge gaps and behavioral change [3,4,5].

In response to this need, the Triple Benefit Health Education Intervention Module was developed to improve the knowledge, attitude, and practice (KAP) of adolescent girls toward malnutrition [2]. The module integrates evidence-based content with culturally relevant delivery methods, aiming to empower participants with practical skills and motivation to adopt healthier nutritional behaviors [6, 7, 8, 9, 10].

To ensure the effectiveness and credibility of the module, rigorous validation and reliability assessments were conducted [11]. Face validity was assessed through feedback from senior students not involved in the main study, while content validity was evaluated by subject matter experts to confirm the appropriateness, relevance, and clarity of the module [12]. A pilot study was also implemented to determine the reliability of the intervention in improving KAP outcomes among adolescent girls [13].

This study presents the findings from the validation and pilot phases, providing a foundation for the broader implementation of the Triple Benefit Health Education Intervention module and the questionnaire. The results offer valuable insights into the modules and questionnaire potential to contribute meaningfully to adolescent health education in reducing malnutrition.

METHODOLOGY

Study location

The study location was Maiduguri, the Borno state capital, Nigeria, usually called Yerwa by its citizens. It is one of the 27 local government council of Borno state, situated at latitude 11.85, longitude 13.16, altitude 30 m and 325 m above sea level with a land area of about 69,435 square kilometers, operating on the West African time zone [14, 15].

Questionnaire

Study Design

Reliability test for the questionnaire was a cross-sectional study among adolescent girls from Lamisula Senior Secondary School and Yerwa Practice School (UBE) situated in the same compound [16].

Study Population and Sample Size

Reliability of the Questionnaire: The test retest for the questionnaire was conducted among 60 adolescent girls aged 10 to 19 years old 10% (of 612 calculated sample size for the phase I, a cross-sectional study), shown in figure I.

The test re-test for knowledge consisting 28 items, attitude 17 items, practice was based on two subsections including meal frequency and food frequency questionnaire based on 24 hours dietary recall of respondent consumption of 12 food groups within the pass 24 hours using the United Nations Food and Agricultural Organization guidelines, food security 9 items, hygiene 5 items information 7 items, motivation 4 items, and behavioural skills 5 items. The test retest was conducted among 60 respondents (10%), within two weeks [17], shown in table 2. The detailed result from the test retest is shown in table 3,4,5,6.

Face Validity: Face validity of the questionnaire was conducted among 20 adolescent girls aged 10 to 19 years old who were randomly selected to assess the questionnaire. They were asked to first complete the questionnaire on knowledge, attitude, practice, food security, hygiene, information, motivation and behavioural skills, then they were asked to assess each section based on the order of each question with options (good, average, or poor), language clarity (clear, average, confusing), and appropriateness (good, average, poor), table 1.

Triple Benefit Intervention Module

Study Design

The pilot study determined the reliability of Triple Benefit Health Education Intervention Module was conducted to confirm the reliability of the Triple Benefit Health Education Intervention module. The pilot study design was a quasi-experimental pre and post without a control group to determine the effect of Triple Benefit Health Education Intervention on knowledge, attitude and practice of adolescent girls towards malnutrition, shown in figure I.

Print ISSN: 0189-9287 Online ISSN: 2992-345X

Study Population and Sample Size

The number of participants involved in the study was 43 adolescent girls aged 10 to 19 years old (10%) of the sample size for the Intervention study from Government Girls Secondary School (GGSS). The participants were selected based on simple random sampling. Inclusion and exclusion criteria of the real trial were applied to them. Permission was obtained from the Ministry of Education and the school respectively. The duration between the pre- and post-intervention was 7 days. Pre-test data collection was done on day 1, intervention (module 1 to 6) took place within six days, each module per day, and then finally the post-test immediately at the end of module 6, as shown in table 10.

Face Validity: The face validity of the Triple Benefit Health Education Intervention Module was conducted among 10 adolescent girls aged 10 to 19 years old who were senior students from Government Girls Secondary School (GGSS) Maiduguri, who were not part of the study. These 10 senior students were given the Triple Benefit Health Education Intervention module to go through and a checklist to ensure the face validity of the module [18] based on the appearance, readability, content, information, willingness to attend, and how organized the module. The checklist contained nine questions modified to suit the current study, with alternative answers as 1) strongly disagree, 2) disagree, 3) unsure, 4) agree, 5) strongly agree. Table 7. shows the face validity results in mean and standard deviation (SD).

Content Validity: The content validity of the Triple Benefit Health Education Intervention module was evaluated by experts to confirm the appropriateness, relevance and clarity of the module, taking into account the learning skills to meets the needs of the participants under local conditions [19]. In this study three experts evaluated the content of the module based on four Likert scales ranged from strongly disagree to strongly agree (strongly disagree 1, disagree 2, agree 3 and strongly agree 4). The researcher arranged for a meeting with each of the expert for their comments and feedback. To assess the content of the module, the number of scores filled in by the experts (x), was divided by the actual scores (y), then multiplied by one hundred. Content validity = [number of scores filled in by the experts (x)/ actual scores (y)] *100.

A module achieving more than 70% shows that the module has high authenticity and is considered to achieve a high level of success [20, 21, 22], as shown in table 8 and 9.

Criteria for Assessing the Delivery of Lecture: Criteria for assessing the delivery of lectures was adapted for the pilot study [23]. The criteria included questions with yes and no options, where Yes was scored '1' and No was scored '0'. Criteria for assessing the facilitator during the delivery of the lecture consisted of 9 questions as shown in table 11.

Adherence of Respondents to Triple Benefit Health Education Intervention: To ensure the adherence of respondents to the Triple Benefit Health Education Intervention, a checklist was used to assess the quality of the intervention in terms of lectures and practicals. Participants who attended the lecture during the pilot study were given the checklist adapted from [24]. The result in Table 12. showed that the respondents attended the lecture fully, it also shows that the respondents fully understood the lecture and are putting it into practice in their daily routine activities.

Study Tool

The instrument for data collection used was a questionnaire through a respondent interview by enumerators using the KoBo Toolbox. The questionnaire was developed in English by the researcher based on previous research that was relevant to the study. The questionnaire was adapted from the guidelines for assessing nutrition related knowledge, attitudes and practices from the Food and Agricultural Organization of the United Nations [25], FFQ was based on 24-hour dietary recall of respondent's consumption of 12 food groups within the past 24 hours from food and agricultural organisation of the united nation (FAO) guidelines [26, 27], Food security was based on food security of older children [28], Hygiene was based on the role of nutrition education in improving the nutritional status of adolescent girls in North West areas of Bangladesh [29], and development of a theory-driven nutrition education measurement instrument using information motivation behavioural skills model [30].

Data Collection

Data collection was in line with the study objectives. Before data collection, permission was obtained from

Print ISSN: 0189-9287 Online ISSN: 2992-345X

the Ministry of Education and the respective school management for self-introduction and to notify them of the purpose of the study, followed by a sampling. Before obtaining the informed consent from the participants, we took attendance of all eligible participants based on their sets and class for easy identification and follow up. Data collection was done using a questionnaire (respondent interview) in KoBo Toolbox.

Ethical Considerations and Consent

Ethical approval was obtained from the Jawatankuasa Etika Universiti Putra Malaysia UPM UPM/TNCPI/RMC/JKEUPM/1.4.18.2 (JKEUPM). Permission was obtained from the Ministry of Education, Maiduguri, Borno State. The study was then registered with the Pan African Clinical Trials Registry (PACTR201905528313816). Informed consent was provided to each participant and their parents, before participating in the study

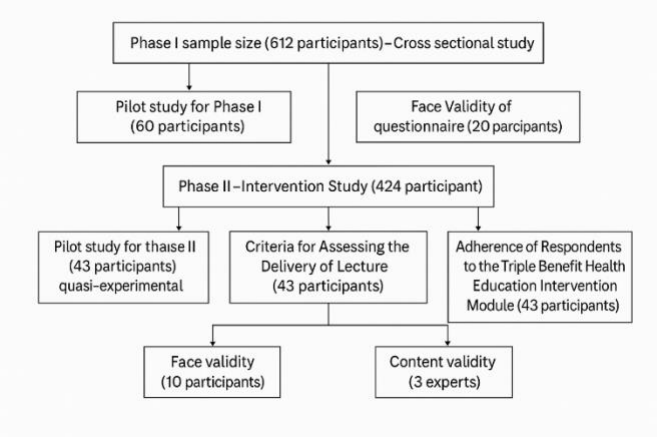

Figure 1: Flow Chart of the Quality Control

RESULT

Face Validity of the Questionnaire

The result of the face validity conducted among 20 adolescent girls aged 10 to19 years shows that for the knowledge section, 17(85%) rated the order of the questions as good, 18(90%) rated the language clarity as clear, and 15(75%) rated the appropriateness for the construct as good. For the attitude section, 17(85%) rated the order of the questions as good, 16(80%) rated its language clarity as clear, while 17(85%) rated its appropriateness as good. For the practice section, 17(85%) rated the order of the questions as good, 16(80%) rated the language clarity as clear, and 18(90%) rated its appropriateness as good.

In the food security section, 17(85%) rated the order of the questions as good, 16(80%) rated language clarity as clear while 17(85%) rated its appropriateness as good. For the hygiene section, 16(80%) rated the order of the questions as good, 17(85%) rated language clarity as clear, and 15(75%) rated its appropriateness as good.
For the information section, 18(90%) rated the order of questions as good, 17(85%) rated language clarity as clear, while 19(90%) rated its appropriateness as good. Motivation section, 18(90%) rated the order of the question as good, 17(85%) rated language clarity as clear, and 16(80%) rated its appropriateness as good. In behavioural skills, 18(90%) rated the order of question as good, 18(90%) rated language clarity as clear, while 15(75%) rated its appropriateness as good Table 1.

Table 1: Face Validity

Variable	Freq (n)	Percent (%)
Knowledge		
Order of questions		
Good	17	(85)
Average	3	(15)
Poor	0	(00)
Total	**20**	**(100)**
Language clarity		
Clear	18	(90)
Average	2	(10)
Confusing	0	(00)
Total	**20**	**(100)**
Appropriately measure the level of knowledge		
Good	15	(75)
Average	5	(25)
Poor	0	(00)
Total	**20**	**(100)**
Attitude		
Order of questions		
Good	17	(85)
Average	3	(15)
Poor	0	(00)
Total	**20**	**(100)**
Language clarity		
Clear	16	(80)
Average	4	(20)
Confusing	0	(00)
Total	**20**	**(100)**
Appropriately measure the level of attitude		

Print ISSN: 0189-9287 Online ISSN: 2992-345X

Variable	Freq (n)	Percent (%)
Good	17	(85)
Average	3	(15)
Poor	0	(00)
Total	**20**	**(100)**
Practice		
Order of questions		
Good	17	(85)
Average	3	(15)
Poor	0	(00)
Total	**20**	**(100)**
Language clarity		
Clear	16	(80)
Average	4	(20)
Confusing	0	(00)
Total	**20**	**(100)**
Appropriately measure the level of practice		
Good	18	(90)
Average	2	(10)
Poor	0	(00)
Total	**20**	**(100)**
Food security		
Order of questions		
Good	17	(85)
Average	3	(15)
Poor	0	(00)
Total	**20**	**(100)**
Language clarity		
Clear	16	(80)
Average	4	(20)
Confusing	0	(00)
Total	**20**	**(100)**
Appropriately measure the level of food security		
Good	17	(85)
Average	3	(15)
Poor	0	(00)
Total	**20**	**(100)**
Hygiene		
Order of questions		
Good	16	(80)
Average	4	(20)
Poor	0	(00)
Total	**20**	**(100)**
Language clarity		
Clear	17	(85)
Average	3	(15)
Confusing	0	(00)
Total	**20**	**(100)**
Appropriately measure the level of hygiene		

Variable	Freq (n)	Percent (%)
Good	15	(75)
Average	5	(25)
Poor	0	(00)
Total	**20**	**(100)**
Information		
Order of questions		
Good	18	(90)
Average	2	(10)
Poor	0	(00)
Total	**20**	**(100)**
Language clarity		
Clear	17	(85)
Average	3	(15)
Confusing	0	(00)
Total	**20**	**(100)**
Appropriately measure the level of information		
Good	18	(90)
Average	2	(10)
Poor	0	(00)
Total	**20**	**(100)**
Motivation		
Order of questions		
Good	18	(90)
Average	2	(10)
Poor	0	(00)
Total	**20**	**(100)**
Language clarity		
Clear	17	(85)
Average	3	(15)
Confusing	0	(00)
Total	**20**	**(100)**
Appropriately measure the level of motivation		
Good	16	(80)
Average	4	(20)
Poor	0	(00)
Total	**20**	**(100)**
Behavioural skills		
Order of questions		
Good	18	(90)
Average	2	(10)
Poor	0	(00)
Total	**20**	**(100)**
Language clarity		
Clear	18	(90)
Average	2	(10)
Confusing	0	(00)
Total	**20**	**(100)**
Appropriately measure the level of practice		

Print ISSN: 0189-9287 Online ISSN: 2992-345X

Variable	Freq (n)	Percent (%)
Good	15	(75)
Average	5	(25)
Poor	0	(00)
Total	**20**	**(100)**

Reliability of the Questionnaire

The Cronbach's alpha result on the reliability of the questionnaire among 60 adolescent girls aged 10 to 19 years old was found to be acceptable within the range of 0.70 to 0.95 [31], as presented in Table 2.

Table 1: Result of Cronbach's alpha of the Questionnaire

Section	No of item	Cronbach's alpha
Knowledge[a]	28	0.784
Attitude[b]	17	0.751
Practice 1[b]**(meal frequency)**	5	0.777
Practice 2[a] **(FFQ)**	25	0.825
24-hour dietary recall	4	0.715
Nutritional status	2	0.798
Food security[b]	9	0.862
Information[b]	7	0.761
Motivation[b]	4	0.844
Behavioural skills[b]	5	0.878

[a]Kuder–Richardson Formula 20; [b] chronbach's alpha

Cohen kappa was used to determine the test re-test reliability between the first and the second interview conducted within two weeks on knowledge, attitude, food security, information, motivation and behavioural skills. The result was found to be within the acceptable standard value range of 0.6 to 0.99 [32, 33] Table 3, 4, 5, and 6.

Table 3: Test Re-test Reliability for Each Knowledge Item

S/N	Item	Cohens kappa
1.	Malnutrition refers to deficiencies in an individual nutritional intake	**0.830**
2.	Undernutrition is a form of malnutrition	**0.952**
3.	One of the causes of malnutrition is not eating enough food	**0.965**
4.	Slow growth in adolescence is a sign of malnutrition	**0.907**
5.	Muscle wasting is a sign of malnutrition	**0.963**
6.	Stunted growth can be a result of malnutrition	**0.870**
7.	One of the ways through malnutrition can be prevented is by eating frequently.	**0.933**
8.	Carbohydrates, protein, fats are essential nutrient that the body needs in large amount for growth	**0.967**
9.	Cereals are a good source of carbohydrate	**0.933**
10.	Carbohydrates are energy giving food	**0.932**
11.	Beans are sources of protein	**0.928**
12.	Proteins are body building food	**0.929**
13.	The body uses fat as a source energy	**0.889**
14.	Butter, oil, nuts, meat, fish, milk do not contain fats	**0.891**
15.	Vitamins and minerals are essential nutrients that the body needs in small amounts to function properly	**0.864**
16.	Fruits and vegetables are sources of minerals and vitamins	**0.964**
17.	Anaemia can be caused by insufficient iron in the body.	**0.792**
18.	Lack of iron in diet can cause anaemia	**0.792**
19.	Slow physical growth can be caused by insufficient iron in the body	**0.880**
20.	Meat is a source of iron	**0.952**
21.	Pumpkin, (kabewa), carrots, green vegetables are good sources of vitamin A	**0.933**
22.	Night blindness is not a sign of insufficient vitamin A in the body	**0.942**
23.	Iodine deficiency can be caused by eating or preparing foods with salt that is not iodized	**0.932**
24.	Goitre is a sign of lack of iodine in the body	**0.900**
25.	Calcium is a mineral that makes the bones strong and healthy	**0.958**
26.	Milk or green vegetables or beans are good sources of calcium	**0.963**

Print ISSN: 0189-9287 Online ISSN: 2992-345X

S/N	Item	Cohens kappa
27.	Eating different kinds of food can make us healthy	**0.921**
28	Breakfast is the most important meal of the day	**0.815**

Table 4: Test-Retest Reliability for Each Attitude Item

S/NO	Item	ICC
1.	I think I may be malnourished	0.960
2.	I think poverty is one of the causes of malnutrition.	0.903
3.	Malnutrition is a serious problem in adolescents	0.977
4.	I think noodles have more nutrients than food cereals	0.948
5.	I think adolescent girls do not need food containing fat at this stage	0.959
6.	I think I can get energy from protein only	0.903
7.	I think I may be iron deficient	0.922
8.	I think I may not have sufficient vitamin A in my body	0.940
9.	I think processed juices (e.g. chivita, five alive, faro etc.) are more nutritious than fresh fruits (e.g. oranges, water melon, pineapple, mango etc.)	0.915
10.	I think it is good to prepare meal with iodized salt	0.844
11.	I think it is only older people that suffer from calcium deficiency	0.862
12.	I think the performance of adolescent's girls who eat breakfast is better than that of those who do not eat breakfast always.	0.945
13.	I think eating three times in a day is good	0.929
14.	I think the taste of food is more important than its nutritional quality	0.894
15.	I think expensive foods are the most healthy foods	0.932
16.	I think I can be healthy even if I don't eat variety of food	0.910
17.	Girls should be malnourished because they need to have a slim figure	0.904

Table 5: Test-Retest Reliability for Each Food Security Item

S/NO	Item	ICC
1.	Did you worry that food at home would run out before your family got money to buy more?	**0.992**
2.	Did the food that your family bought run out, and you didn't have money to get more?	**0.982**
3.	Did your meals only include a few kinds of cheap foods because your family was running out of money to buy food?	**0.955**
4.	How often were you not able to eat a balanced meal because your family didn't have enough money?	**0.983**
5.	Did you have to eat less because your family didn't have enough money to buy food?	**0.952**
6.	Has the size of your meals been cut because your family didn't have enough money for food?	**0.930**
7.	Did you have to skip a meal because your family didn't have enough money for food?	**0.920**
8.	Were you hungry but didn't eat because your family didn't have enough food?	**0.912**
9.	Did you not eat for a whole day because your family didn't have enough money for food?	**0.898**

Table 6: Test-Retest Reliability for each Information, Motivation and Behavioural Skill Item

S/NO	Information	ICC
1.	The best way to prevent malnutrition is to eat different kinds of food	**0.985**
2.	What I eat makes me malnourished or not	**0.893**
3.	There is no food that can help prevent malnutrition	**0.821**
4.	If you are malnourished, there is nothing you can do about it	**0.776**
5.	Malnutrition makes people to be tired always	**0.862**
6.	I do not care about eating the right foods for malnutrition	**0.966**
7.	I don't care about eating foods that can prevent me from being malnourished	**0.970**
	Motivation	
8.	I think I like eating different kinds of foods	**0.997**
9.	I think the people who are important to me (family and friends) like eating different kinds of food	**0.994**
10.	I think the people who are important to me (family and friends) always	**0.994**

Print ISSN: 0189-9287 Online ISSN: 2992-345X

S/NO	Information	ICC
	encourage me to eat different kinds of food	
11.	I think the people who are important to me (friends and family) always encourage me to buy nutritious food	**0.986**
	Behavioural skill	
12.	How hard or easy is it for you to buy nutritious food?	**0.996**
13.	How hard or easy is it for you to buy nutritious food within your current budget for food?	**0.998**
14.	How hard or easy is it for you to buy and store fish, rice, meat, or fruits at home?	**0.993**
15.	How hard or easy is it for you to cook nutritious food?	**0.991**
16.	How hard or easy is it for you to cook nutritious food for your family members	**0.988**

Face and Content Validity of Triple Benefit Health Education Intervention Module. The face validity of the intervention module reveals the mean and standard deviation (Mean ± SD) based on the appearance, readability, content, information, willingness to attend, and how organized the module was as shown in table 7.

Table 7: Face Validity of the Intervention Module (n = 10)

Variable (Questions)	Mean ± SD
Is the appearance of the lecture note good	4.60(0.516)
If the lecture note is placed in your class, will you pick it up to read	4.70(0.483)
Will you take the lecture notes home to read later	4.70(0.483)
Is the content of the lecture easy to read and understand	4.70(0.483)
Will the information from the lecture note help improve the knowledge attitude and practice of adolescent girls towards malnutrition	4.90(0.316)
If the health education programme is organized in your school, will you attend	4.70(0.483)
Do the pictures in the lecture notes assists you in understanding malnutrition	4.90(0.316)
Based on the information in the lecture note, will you have good knowledge, attitude and practice towards malnutrition	4.80(0.422)
Are the lecture notes well organized	4.90(0.316)

The content validity of the Triple Benefit Health Education Intervention module was evaluated by experts to confirm the appropriateness, relevance and clarity of the module, taking into account the learning skills to meets the needs of the participants under local conditions (Russell, 1974).

Content validity = [number of scores filled in by the experts (x)/ actual scores (y)] *100
= (67/72) *100
= 93%

Triple Benefit Health Education Intervention module achieved 93% overall. Table 8. shows that the relevance of the module to the target population had a minimum value of 92%.

Table 8: Evaluation of Expert Based Appropriateness, Relevance and Clarity

Items	Percentage (%)	Expert view
Appropriate	94%	Accepted
Relevance	92%	Accepted
Clarity	93%	Accepted

Module 4 had the minimum value of 87% based on the content of the module as shown in Table 9. The findings from the experts showed that the content of the module is appropriate, relevant and clear to the target population.

Table 9: Evaluation of Expert Based Module Session

Items	Percentage (%)	Expert view
Module 1	98%	Accepted
Module 2	92%	Accepted
Module 3	93%	Accepted
Module 4	87%	Accepted
Module 5	93%	Accepted
Module 6	95%	Accepted

Reliability of Triple Benefit Health Education Intervention Module

The result shows that the mean knowledge at pre-test was 6.5 (SD 4.1), increased to 26.4 (SD 3.9) at post-test. The mean attitude at pre-test was 44.1 (SD 4.3), increased to 71.9 (SD 4.8) at post-test. The mean practice at pre-test was 35.6 (SD 10.5), increased to 45.0 (SD 4.6) at post-test. The mean information was 20.1 (SD 3.3) at pre-test and increased to 29.4 (SD 2.6) at post-test. The mean motivation was 14.9 (SD 3.0) and increased to 16.6 (SD 1.9). The mean behavioural skill was 13.6 (SD 4.7), increased to 18.0 (SD 4.1). There was a significant difference in the mean scores of all the study variables $p<0.05$. The results of pre and post-test are shown in Table 10. All the participants included in the pilot study were given the lecture material after each lecture.

Print ISSN: 0189-9287 Online ISSN: 2992-345X

Table 10: Change in Knowledge, Attitude, Practice and Theory Construct

Variable	Mean	SD	Mean difference (95%CI)	t	P
Pre-knowledge	6.3	4.1	-20.09	-5717	<0.001
Post-knowledge	26.4	3.9			
Pre-attitude	44.1	4.3	-27.88	-5.715	<0.001
Post-attitude	71.9	4.8			
Pre-practice	35.6	10.5	-9.34	-4.385	<0.001
Post-practice	45.0	4.6			
Pre-information	20.1	3.3	-9.28	-5.717	<0.001
Post-information	29.4	2.6			
Pre-motivation	14.9	3.0	-1.65	-2.888	0.004
Post-motivation	16.6	1.9			
Pre-behavioural skills	13.6	4.7	-4.39	-4.119	<0.001
Post-behavioural skills	18.0	4.7			

Criteria for Assessing the Delivery of Lectures and Adherence of Respondents to the Triple Benefit Health Education Intervention Module

Criteria for assessing the delivery of lectures was adapted for the pilot study (Thornton et al., 2002). The criteria included questions with yes and no options, where Yes was scored '1' and No was scored '0'. Criteria for assessing the facilitator during the delivery of the lecture was shown in Table 11.

Table 11: Criteria for Assessing Facilitator During the Delivery of Lecture in Pilot Study

Questions	Yes
At the beginning of the lecture, did the facilitator introduced the objective and content of the module?	1
Did the facilitator adhere to the objective and content of the module?	1
Did the facilitator adhere to the timeline in the module?	1
Did the facilitator motivate the participants to actively involved in interaction and giving feedback during the health education delivery?	1
Did the facilitator use different types of teaching methods?	1
Did the facilitator deliver the whole content of the module?	1
Did the facilitator link the theoretical part of the study with the practice skills?	1
Was the facilitator's voice clear?	1
Was the facilitator able to attract the attention of the participants during the health education delivery?	1

To ensure the adherence of respondents to the Triple Benefit Health Education Intervention, a checklist was used to assess the quality of the intervention in terms of lectures and practical. Participants who attended the lecture during the pilot study were given the checklist adapted from (Paul et al., 2003). The result in Table 12. showed that the respondents attended the lecture fully, it also shows that the respondents fully understood the lecture and are putting it into practice in their daily routine activities.

Table 12: Adherence of Respondents to Triple Benefit Health Education Intervention

No	Variable (Questions)	Response
1.	Did you attend the health education lecture?	
	Yes	43(100.0)
	No	0(0.00)
2.	Did you attend the health education lecture full time?	
	Yes	43(100.0)
	No	0(0.00)

Print ISSN: 0189-9287 Online ISSN: 2992-345X

No	Variable (Questions)	Response
3.	Did you understand the whole lecture content	
	More than half	39(90.7)
	Less than half	4(9.3)
	Didn't understand the lecture	0(0.00)
4.	Do you use what you have learnt from the lecture daily?	
	Yes	41(95.3)
	Yes, but not much	2(4.7)
	No, not all	0(0.00)

Strengths of the Study

1. Robust multi-phase design: The study combined a cross-sectional study with a quasi-experimental experimental design for the pilot for both phase I and Phase II, strengthening internal and external validity.
2. Systematic instrument development: The questionnaire and Triple Benefit Health Education Module underwent face validity, content validity (CVI 0.87–0.98), and reliability testing (Cronbach's α 0.70–0.95), ensuring strong psychometric properties.
3. Pilot testing: Feasibility and acceptability were confirmed through a structured pilot study prior to full implementation of both cross sectional and intervention study.
4. Theory-driven intervention: Use of the IMB Model provided conceptual clarity and enhanced behavioural impact. This was the first intervention module on malnutrition developed based on the IMB model in the region.
5. Significant changes have been revealed to improve knowledge, attitude and practice towards malnutrition which was accomplished with a low-intensity intervention that can be implemented within the existing school curriculum.
6. To the best of our knowledge, there was no previous research among adolescent girls aged 10 to 19 years on nutrition-related knowledge, attitude and practice in the northeastern part of Nigeria.
7. The data collected from this study was via KoBo Collect Toolbox using an android tablet, which has so many advantages such as high response rate, few errors, few missing data, few omissions and minimal time frame.
8. Malnutrition (definition, forms, causes, sign, and consequences), food frequency questionnaire (FFQ), meal frequency, 24 hours dietary recall, WASH, food security, practical's such as (cooking demonstration, identification of food groups and handwashing practice) that were not found in previous studies in Nigeria and other parts of the world were examined in this study.

Limitations

1. The study included adolescent girls from government secondary schools.
2. This does not represent all adolescent girls in Borno State (comprising of 27 districts), the result from this study may not be the true representation of adolescent girls in Borno state since some of the communities are urban in settings while some are semi-urban and rural in settings.
3. 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 knowledge, attitude, and practice towards malnutrition.

Implications of the findings of the study

1. The intervention demonstrates that structured, theory-based health education can improve adolescent nutrition-related behaviours.
2. The validated module is suitable for wider adoption in schools, youth programmes, and community health initiatives.
3. Findings support integrating IMB-based nutrition education into school health curricula and national adolescent health policies.
4. The study provides a foundation for longitudinal research assessing sustained behavioural change and biological outcomes.
5. Enhancing adolescents' nutrition literacy has potential long-term benefits for reducing micronutrient deficiencies and improving future maternal health.

Print ISSN: 0189-9287 Online ISSN: 2992-345X

CONCLUSION

The development and validation of the Triple Benefit Health Education Intervention Module and its accompanying questionnaire demonstrated strong effectiveness in enhancing adolescent girls' knowledge, attitude, and practice toward malnutrition in conflict-affected regions of Nigeria. Both tools showed high face and content validity, with expert and participant feedback confirming their clarity, relevance, and appropriateness. Reliability testing through Cronbach's alpha and test-retest methods yielded acceptable values, while the pilot study revealed significant improvements in all measured variables post-intervention. These findings affirm the module's potential for broader implementation in adolescent health education programs aimed at combating malnutrition.

DECLARATION

Author's contribution: "Conceptualization, R.C.S. and P.Y.L.; methodology, R.C.S. and P.Y.L.; software, R.C.S. and P.Y.L.; validation, R.C.S., S.I., P.Y.L., N.A., H.G and E.W.M.; formal analysis, R.C.S., P.Y.L., and S.I.; investigation, R.C.S.; resources, R.C.S.; writing original draft preparation, R.C.S.; writing review and editing, R.C.S., P.Y.L., S.I., N.A., H.G and E.W.M.; visualization, R.C.S., P.Y.L., S.I., N.A., H.G and E.W.M.; supervision, S.I., P.Y.L., N.A.

Conflict of interest: The authors declare no conflict of interest.

Funding: This research received no external funding.
Acknowledgement: The authors wish to appreciate Prof. Hussaini Garba Dibal, (Department of Physical and Health Education, University of Maiduguri, Borno State, Nigeria) and Mrs Elizabeth Tanko (Department of Nutrition, College of Nursing and Midwifery, Maiduguri, Borno State, Nigeria) who assisted in validating the study instruments. The authors want to acknowledge Dr. Emmanuel Williams Mshelia (Ministry of Water Resources) for his technical input. The authors also want to appreciate the management of the four Secondary Schools (Government Girls College Maiduguri, Government Girls Secondary School Yerwa, Zajeri Day Secondary School and Bulabulin Day Secondary School), their enumerators and the respondents who participated in the study.

REFERENCE

1. Charles Shapu R, Ismail S, Ahmad N, Lim PY, Abubakar Njodi I. Systematic review: Effect of health education intervention on improving knowledge, attitudes and practices of adolescents on malnutrition. Nutrients. 2020 Aug 13;12(8):2426.
2. Shapu RC, Ismail S, Lim PY, Ahmad N, Garba H, Njodi IA. Effectiveness of triple benefit health education intervention on knowledge, attitude and food security towards malnutrition among adolescent girls in Borno State, Nigeria. Foods. 2022 Jan 5;11(1):130.
3. Makinde OA, Olamijuwon E, Mgbachi I, Sato R. Childhood exposure to armed conflict and nutritional health outcomes in Nigeria. Conflict and health. 2023 Mar 29;17(1):15.
4. Integrated Food Security Phase Classification, Acute Malnutrition Analysis May 2024 – April 2025 Published on 27 November 2024. (IPC) Global Support Unit www.ipcinfo.org.
5. Abubakar HA, Shahril MR, Mat S. Nutritional status and dietary intake among Nigerian adolescent: a systematic review. BMC Public Health. 2024 Jul 2;24(1):1764.
6. Charles Shapu R, Ismail S, Ahmad N, Ying LP, Abubakar Njodi I. Knowledge, attitude, and practice of adolescent girls towards reducing malnutrition in Maiduguri metropolitan council, Borno State, Nigeria: cross-sectional study. Nutrients. 2020 Jun 4;12(6):1681.
7. Shapu, Charles Ruth. Effectiveness of triple benefit health education intervention on knowledge, attitude and practice towards malnutrition among adolescent girls, Borno State, Nigeria. 2021; Doctoral thesis, Universiti Putra Malaysia.
8. Charles Shapu R, Ismail S, Ahmad N, Lim PY, Abubakar Njodi I. Food security and hygiene practice among adolescent girls in Maiduguri metropolitan council, Borno state, Nigeria. Foods. 2020 Sep 10;9(9):1265.
9. Moitra P, Madan J, Verma P. Impact of a behaviourally focused nutrition education intervention on attitudes and practices related to eating habits and activity levels in Indian adolescents. Public Health Nutrition. 2021 Jun;24(9):2715-26.
10. Haider H. Adolescent girls in LMICs: evidence on development outcomes, approaches, opportunities and challenges.
11. Kania N, Kusumah YS, Dahlan JA, Nurlaelah E, Gürbüz F, Bonyah E. Constructing and providing content validity evidence through the Aiken's Vindex based on the experts' judgments of the instrument to measuremathematical problem-solving skills. REID (Research and Evaluation in Education). 2024;10(1):5.

Print ISSN: 0189-9287 Online ISSN: 2992-345X

12. Shafie S, Abd Majid F, Damio SM, Hoon TS. Evaluation on the face and content validity of a soft skills transfer of training instrument. International Journal of Academic Research in Business and Social Sciences. 2020;10(10):1054-65.
13. Raut S, Kc D, Singh DR, Dhungana RR, Pradhan PM, Sunuwar DR. Effect of nutrition education intervention on nutrition knowledge, attitude, and diet quality among school-going adolescents: a quasi-experimental study. BMC nutrition. 2024 Feb 27;10(1):35.
14. World Atlas. Where is Maiduguri, Nigeria. Borno Map WorldAtlas. 2018. Available online: https://www.worldatlas.com/webimage/countrys/africa/ng.htm (accessed on 10 March 2020).
15. National Population Commission. Federal Republic of Nigeria official gazette. Legal Notice on Publication of. 2006.
16. O'Neill B. Sample size determination with a pilot study. PLoS One. 2022 Feb 15;17(2):e0262804.
17. Jalambo MO, Sharif R, Naser IA, Karim NA. Improvement in knowledge, attitude and practice of iron deficiency anaemia among iron-deficient female adolescents after nutritional educational intervention. Global Journal of Health Science. 2017 Jan;9(7):15-23.
18. Hurst CS, Hagensee ME, Ahmed SA, Smith JS. Validation of educational tools for use in a human papillomavirus intervention study. Cancer Oncol Res. 2015;3(3):35-43.
19. Russell JD. Modular Instruction: A Guide to the Design, Selection, Utilization and Evaluation of Modular Materials.
20. Tuckman BW, Waheed MA. Evaluating an individualized science program for community college students. Journal of research in science teaching. 1981 Nov;18(6):489-95.
21. Fuad RA, Arip MA, Sa'ad F. Validity and reliability of the HM-Learning module among high school students in Malaysia. International Journal of Academic Research in Business and Social Sciences. 2019 Jan;9(1):773-87.
22. Kob CG, Rakib MK, Shah A. Development and Validity of TIG Welding Training Modules Based on the Dick and Raiser Model Design in the Subject (DJJ3032) of Mechanical Workshop Practice 3 in Polytechnic Malaysia.
23. Thornton TN, Craft CA, Dahlberg LL, Lynch BS, Baer K. Best practices of youth violence prevention: a sourcebook for community action. June 2002 (Revision).
24. Paul CL, Redman S, Sanson-Fisher RW. Print material content and design: is it relevant to effectiveness? Health Education Research. 2003 Apr 1;18(2):181-90.
25. Marías YF, Glasauer P. Guidelines for assessing nutrition-related knowledge, attitudes and practices. 2014 Sep 24.
26. Indicators CF. FOOD AND NUTRITION TECHNICAL ASSISTANCE. Indicators. 2007 Sep.
27. Kennedy G, Ballard T, Dop M. Guidelines for measuring household and individual dietary diversity. FAO;; 2011.
28. Carol LC, Nord M, Kristi LL, Yadrick K. Self-administered food security survey module for children ages 12 years and older. J. Nutr. 2006;134:2566-72.
29. Razzak MA, Al Hasan SM, Rahman SS, Asaduzzaman M, Juliana FM, Hossain MS. Role of nutrition education in improving the nutritional status of adolescent girls in North West areas of Bangladesh. Int. J. Sci. Eng. Res. 2016;7:1340-6.
30. Holliday RB. Anemia Prevention: Development of a Theory-Driven Nutrition Education Measurement Instrument. University of Connecticut; 2011.
31. Tavakol M, Dennick R. Making sense of Cronbach's alpha. International journal of medical education. 2011 Jun 27;2:53.
32. McHugh ML. Interrater reliability: the kappa statistic. Biochemia medica. 2012 Oct 15;22(3):276-82.
33. Viera AJ, Garrett JM. Understanding interobserver agreement: the kappa statistic. Fam med. 2005 May 1;37(5):360-3.

Print ISSN: 0189-9287 Online ISSN: 2992-345X