Effect of emotion-based nutrition messages on consumption of calcium-rich foods among early adolescents in Ogbomoso, Nigeria

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A B S T R A C T

Introduction: Calcium is a vital micronutrient for several physiological processes, yet it remains one of the significant shortfall nutrients among Nigerian adolescents.
Objective: This study was designed to assess the effect of emotion-based nutrition messages on the consumption of calcium-rich foods among early adolescents in Ogbomoso, Nigeria.
Methodology: The quasi-experimental study involved 220 adolescents (experimental: 110 and control: 110) selected using a three-stage sampling procedure. A semi-structured, interviewer-administered questionnaire was used to collect socio-demographic characteristics, dietary practice, calcium-rich foods consumption pattern, calcium intake, and anthropometric parameters. Second, calcium-rich foods consumption pattern was assessed using a food frequency questionnaire, and intake was evaluated using the multi-pass 24-hour dietary recall to define adequacy at intake level ≥ 1,300 mg per day. Third, the experimental group had five weeks of nutrition education using emotion-based nutrition messages. Data were analyzed using descriptive statistics and the Chi-square test at $p < 0.05$.
Results: The age of respondents (years) in experimental (12.88 ± 1.41) and control (13.4 ± 1.03) groups was similar. Primary dietary calcium sources were meat, chicken, egg, white beans, cheese, soy milk, oranges, and locust beans at baseline. At post-intervention, intake of other calcium-rich foods such as milk, yogurt, ice cream, okra, sardine, and unripe plantain increased, however, calcium intake remains similar in both control (238.41 ± 92.4 mg; 235.40 ± 92.92 mg) and experimental groups (239.76 ± 51 mg; 241.46 ± 100.89 mg) at baseline and post-intervention, respectively. The overall calcium intake of the adolescents remains below the recommended intake level of 1,300 mg.
Conclusion: Emotion-based nutritional messages did not significantly increase the total calcium intake among early adolescents.

1. Introduction

According to the World Health Organization (WHO), adolescents are individuals between the ages of 10 – 19 years [23]. Adolescence is the transitional phase between childhood and adulthood, characterized with rapid physical, physiological, social, mental development. The rapid growth spurt during this phase requires increased nutrients intakes [49]. Healthy eating habits during adolescence is essential for both physical and cognitive growth and development to the fullest potential and also guard against immediate and long-term health issues. The increasing energy and nutrient needs may have an effect on adolescents' dietary preferences, nutrient intake, and consequently nutritional status [50]. Often times, adolescents' nutrient intake is high in carbohydrates, sodium, sugars, and fats, and low in proteins, essential vitamins and minerals such as vitamin C, folate, Calcium, iron [4,7,51] in both developed countries and low-and middle income

countries. This unhealthy dietary pattern has become a major concern as over nutrition can lead to overweight and obesity which is a predisposing factor for non-communicable diseases [51,52] and low calcium status could predispose to osteoporosis [53]. Calcium is one of the essential nutrients that is important during adolescence, however, it remains one of the significant shortfall nutrients among Nigerian adolescents [54]. It is acrucial micronutrient with several physiological importance, including formation and metabolism of bone, mediation of vascular contraction and vasodilation, muscle function, nerve transmission, intracellular signaling, and hormonal secretion [1,2,9]. During the phases of adolescence and young adulthood, calcium needs are more significant due to the dramatic increase in skeletal growth such that 90% of the total body's peak bone mass is attained by the age of 18 years [2,8,9]. Therefore, where dietary intake is consistently insufficient to meet the body's requirement, calcium-dependent biochemical functions are sustained at the expense of bone

health. Therefore, to achieve body's peak of bone mass, it is imperative that adolescents consume calcium rich foods during this phase. Previous studies have reported low consumption of milk, cheese, yoghurt and soy milk which are excellent source of calcium among Nigerians adolescents and consequently inadequate calcium status [5,7]. Dietary choices of adolescents is usually characterized by high consumption of breads, cereal, legumes, soft drinks, sweets, salty snacks, and fast foods and low intakes of milk and products, meat, fish and poultry, fruits and vegetables [4,51,55]. This implies that aside from the empty caloric foods choices of Nigerian adolescents, majority of their diet is plant-based food sources. Many of these high fiber foods such as cereals, nuts and legumes frequently consumed by the adolescents are cheap, readily available and constitute the staple of an average Nigerian diet, however they contain high amount of phytate which inhibit intestinal calcium absorption [39]. Also, previous studies have associated frequent consumption of sugar-sweetened beverages with reduced intake of milk and its products, thus inability of adolescents to meet their daily reference intakes for calcium [3,56]. This continuous calcium deficiency state during adolescence could lead to depletion of calcium stores thereby resulting to osteoporosis which is characterized by low bone mass and deterioration in the microarchitecture of bone tissue, leading to an increased risk of fracture in later years [12]. Though osteoporosis is not considered a childhood disease, early onset at 10 to 13 years old has been reported [10,11], and it has become an emerging public health problem in Nigeria because of its complications and attendant morbidity and mortality [13,14]. This finding suggests the need to focus on early lifetime measures to prevent bone loss and degradation later in life. To this end, adolescents are considered the appropriate target population to prevent osteoporosis and calcium intake promotion campaigns [16–19]. Therefore, it is imperative to devise ways to improve dietary intake of these nutrients and sustain such habits. However, limited public health or nutrition campaigns promote calcium intake in Nigeria.

Emotion-based messages refer to those messages that appeal to values and emotional states to persuade the individual to adopt a belief or perform a specific action [20]. Emotion-based nutrition messages focus primarily on an individual's highly regarded values and beliefs to encourage nutrition behaviour. In emotion-based counselling, emotions are primary triggers, while logic and information follow closely. Once people are self-motivated to change, they need simple, practical information to enact that change; emotions and knowledge work together to cause behaviour change [21]. Since habits acquired during adolescence are known to last a lifetime and influence health in adulthood [22,23], this phase of life constitutes a window of opportunity to promote lifelong bone health, among other functions of dietary calcium. As Nigerian adolescents have low calcium intake, an emotion-based messaging campaign approach was piloted to drive behavior change. Focusing on increasing knowledge of the consequences of inadequate calcium intake and the education of types of calcium-rich foods that can be consumed such as dairy products- cheese, milk, and yogurt; whey protein, fortified foods, tofu, eggs, fruits, vegetables-okra, leafy greens, rhubarb and sweet potatoes, fish- sardines and canned salmon, legumes, beans and lentils, seeds and nuts [4,24,25].

This quasi-experimental study was designed to evaluate the effect of emotion-based nutrition messaging on the in-school consumption of calcium-rich foods among adolescents in Ogbomoso, Nigeria.

2. Methodology

2.1. Study design, settings, and sampling

This quasi-experimental study involved a three-stage sampling procedure conducted between June and November 2017 at Ogbomoso, Oyo State, Nigeria. Ogbomoso is the second-largest city in Oyo state and has a projected population of 1,200,000 people [26]. Ogbomoso is situated between latitude 8°06′98.7 N and longitude 4°14′28.2 E. It is bordered in the north by Ilorin (Kwara state) and in the south by Oyo town (Fig. 1). Majority of Ogbomoso people are Yoruba, however, other ethnic nationalities co-exist with the Yoruba in the city because of its close proximity to North Central region of Nigeria, and the presence of a University, two Teaching Hospitals and several companies. Farming is the major occupation of Ogbomoso people and some of the notable agricultural products of the area include yams, cassava, maize and sorghum".

2.2. Population

Two (Ogbomoso South and Orire) out of five local government areas (Ogbomoso North, Ogbomoso South, Surulere, Orire, and Ogo-Oluwa) in Ogbomoso were selected using a simple random sampling procedure (Fig. 1). In the second stage of sampling, four government-owned secondary schools were selected (two schools per local government area) using a simple random sampling technique and paired to remove location bias. The study had two arms, an intervention group, and a control group. Using a cluster sampling technique, one hundred and ten (110) adolescents aged 10-17 years were recruited per arm/group and local government area to remove any potential bias.

2.2.1. Sample size

The minimum sample size for this study was calculated to be 96 adolescents using Araoye [48] formular and assumed proportion of adolescents with inadequate calcium intake as 93% [4]. After calculation, the sample size was adjusted for 10% non-response. Thus, a total of 220 (110 participants in experimental group and 110 participants in control group) was recruited for the study. An in-school adolescent was considered eligible for the study if he or she was apparently healthy, aged 10-14 years, attending the selected schools, had no dietary restrictions and consented to participating in the study. Exclusion criteria for the study including evidence of speech difficulty and record of high level of absenteeism from school.

2.3. Procedure

Research assistants were recruited and trained for the purpose of this study. Data were collected at baseline and post-study (one week after the

Fig. 1. Map of Ogbomoso showing the four Local Government Areas.

intervention) from adolescents from both control and intervention groups. Adolescents in the intervention had a series of emotion-based nutrition messages delivered over four weeks in the form of lectures supported with the use of posters, drama, and storytelling methodologies. The intervention programme lasted four weeks consisting of one session of approximately 50 minutes per week. The theme of the emotion-based nutrition message was "Stop the robbery, protect the bones!" and this was structured into four sessions including the awareness on the importance of calcium to skeletal health and optimal growth through two short lectures, using posters as communication tool. Emotional story on the theme "Stop the robbery, protect the bones!" was narrated through drama presentations to further present the message in more intense manner in another session. The last session was used for a recap and reinforcement of key messages.

Data were collected using a semi-structured, interviewer-administered questionnaire with four sections including socio-demographic and anthropometric characteristics, calcium-rich foods consumption pattern, and dietary practice with focus calcium intake. The questionnaire was validated by team of experts including nutritionists, epidemiologist, and health education professional. The socio-demographic components include information on age, gender, household size, living situation, living arrangement, and parents' occupation. The weight and height of each adolescent were measured following standard anthropometric techniques [27]. All adolescents were dressed in light clothing before measurements, and each measurement was taken twice, and the mean of measurement was retained for analysis. Weight was assessed to the nearest 0.1 kg using a digital body weighing scale (Seca, Germany model), body height was measured to the nearest one centimeter using a locally fabricated stadiometer. Anthropometric data were analyzed using World Health Organization (WHO) Anthro Plus software. Body mass index for age z-score (BAZ) between $-2SD$ and $+2SD$ scores were considered as well-nourished, those below $-2SD$ were considered as thin, and that above $+2SD$ were considered as overweight adolescents.

The consumption pattern of calcium-rich foods was assessed using a food frequency questionnaire populated with commonly available calcium-rich foods in Nigeria. Commonly available calcium-rich foods were adopted from the National Food Composition Table [28], West African Food Composition Table [29], and the United States Department of Agriculture Food and Nutrition database [30]. This was adapted following non-availability of a standardized and validated food frequency questionnaire in Nigeria.

Dietary intake of calcium-rich foods was assessed using a multi-pass (Quick listing, description of food and drinks and description of quantity consumed) 24-hour dietary recall questionnaire to determine the adequacy of calcium intake from their diets. The use of mineral supplements was probed as part of the 24-hour dietary recall procedure. The dietary practice was assessed using an 11-point questionnaire and a cut-off point of 50% approximated to the nearest whole number was used to categorize as good (≥ 6) and poor (<6). A respondent was categorized as having good dietary practice following satisfaction of any six of regular use of (1) vitamin or (2) mineral supplements, (3) consumption of at least three meals per day, daily consumption of (4) fruits, (5) vegetables and (6) dairy products, (7) regular consumption of breakfast, (8) choice of healthy snacks and reduced consumption of (9) carbonated beverages and (10) fast foods, and reduced frequency of meals skipping. The proportion of respondents that regularly consumed listed foods by group and period is presented in a chart. Calcium intake was calculated using the Nigeria Food Composition Table [28], West African Food Composition Table [29], and the United States Department of Agriculture Food and Nutrition database [30]. Calcium intake was calculated as the sum of the calcium composition of all meals and drinks consumed adjusted for quantity consumed. Calcium intake was considered adequate at an intake level equal to or higher than the recommended 1,300 mg per day for adolescents [31].

2.4. Statistical analysis

The data followed a normal distribution and were analyzed using Statistical Package for Social Sciences (SPSS) version 20.0 at p<0.05. Chi square test was applied to determine variation in the sociodemographic characteristics of respondents and in adequacy of calcium intake. Two sample t-test was used to investigate the difference in the amount of calcium consumed between the two groups while independent t-test and one way analysis of variance were used to analyze factors influencing dietary consumption of calcium rich foods.

2.5. Ethics

Ethical approval for the study was obtained from the University of Ibadan/University College Hospital Institutional Ethical Review Board (UI/EC/17/0257). In addition, approval to conduct the study was obtained from the school authorities, permission was obtained from the Parents Teachers Association and assent was obtained taken from each adolescent.

3. Results and discussion

3.1. Characteristics of study population: adolescents

Socio-demographic characteristics of the adolescents in both control and intervention groups are presented in Table 1. The age of respondents in the control group (13.4 ± 1.03 years) and the intervention group (12.88 ± 1.41 years) was similar with 91.8% and 88.2% belonging to the range of 10-14 years old group, respectively. There was no significant difference in the gender distribution (p = 0.416) with a preponderance of male adolescents in both control (52.7%) and intervention groups (58.2%). However, household size was higher in the control as the majority of the adolescents (60.0%) came from more than five people in the household as compared with those (57.3%) in the intervention groups (p = 0.02). There was no significant difference in the family living status of the adolescents in both groups (p = 0.658), although, more respondents (92.7%) in the intervention group than the control group (83.6%) had their parents

Table 1
Socio-demographic information of adolescent.

Variable	Control group	Intervention group	P-value
Age (years)			
10–14	101 (91.8)	97 (88.2)	0.260
15–17	8 (7.3)	13 (11.8)	
Mean age ± SD	13.4 ± 1.03	12.88 ± 1.41	
Gender			
Male	58 (52.7)	64(58.2)	0.416
Female	52 (47.3)	46 (41.8)	
Family's household size			
One to five people	44 (40)	47 (42.7)	0.021*
>five people	66 (60)	63 (57.3)	
Parents living together			
Yes	92 (83.6)	102 (92.7)	0.06*
No	14 (12.7)	6 (5.5)	
Living situation			
Living with parents	94 (85.5)	97 (88.2)	0.658
Living with others	14 (12.7)	12 (10.9)	
Father's occupation			
Farmer	27 (24.5)	39 (35.5)	
Professional/Formerly Employed	32 (29.1)	16 (14.5)	
Sales/Services	24 (21.8)	2 (1.8)	0.000*
Manual- Skilled/Unskilled	19 (17.3)	47 (42.7)	
Unemployed	1 (0.9)	0 (0.0)	
Others	7 (6.4)	6 (5.5)	
Mother's occupation			
Farmer	11 (10.0)	12 (10.9)	0.003*
Professional/Formerly Employed	37 (33.6)	20 (18.2)	
Sales/Services	13 (11.8)	6 (5.5)	
Manual- Skilled/Unskilled	44 (40.0)	69 (62.7)	
Unemployed	0 (0.0)	2 (1.8)	
Others	5 (4.5)	1 (0.9)	
BMI for Age			
Well-nourished	95 (86.4)	93 (84.5)	0.016*
Thinness	4 (3.6)	14 (12.7)	
Overweight	11 (10.0)	3 (2.7)	

* p<0.05; type of analysis: chi-square.

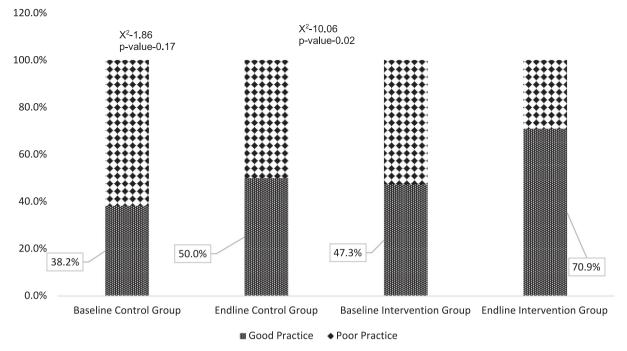Dietary practice of adolescents in control and intervention groups

Fig. 2. Dietary practice of adolescents in control and intervention groups

living together, and more adolescents in the intervention group (88.2%) lived with their parents compared to 85.5% in the control group. The anthropometric indices of the adolescents showed that 86.4% and 84.5% in the control and intervention groups had average body mass index (BMI) for age; thinness was higher in the intervention (12.7%) compared to the control group (3.6%), while overweight was higher in the control group (10.0%) compared to the intervention group (2.7%).

3.2. Effect of emotion-based nutrition messages on dietary practices and consumption of calcium-rich foods

Fig. 2 and Table 2 show the comparison of the dietary practices of adolescents before and after emotion-based nutrition message intervention in both intervention and control groups. In the intervention group, the proportion of adolescents with good dietary practice increased from 47.3% at baseline to 70.9% after the intervention. In contrast, the proportion increased from 38.2% to 50.0% for the control group. In addition, there was no significant difference in the proportion of adolescents with good dietary practice at baseline ($p = 0.17$), while a significant difference was

observed between both groups at post-study ($p = 0.02$). The change in selected dietary practices among the adolescents is presented in Table 2.

Regular use of vitamin supplements significantly increased by 45.3% in the intervention compared to a 2.8% increase in the control group. Likewise, regular use of mineral supplements increased dramatically by 167% in the intervention group compared to 75.6% in the control group.

Consumption of at least three meals per day slightly increased in the intervention group (2.2%) and declined by 8% in the control group. There was a decline in consumption of fruits in both groups, while vegetable intake also decreased in the control group but slightly increased in the intervention group. There is a 54% increase in the proportion of adolescents consuming dairy products daily in the control group, higher than a 7.9% increase in the intervention group.

The proportion of adolescents that regularly consumed breakfast declined by 11% in the intervention group and 2% in the control group. The change in the frequency of consumption of selected calcium-rich foods is presented in Fig. 3. There was a general trend towards increased milk consumption, yogurt, ice cream, egg, white beans, soy cheese, soy milk, potatoes, enriched cereals, vegetables, plantain, fortified cereals, and locust beans, however, this did not translate to substantial increase in calcium

Table 2
Dietary practices of adolescents before and after emotion-based message intervention.

Category of dietary practice	Pre		Post		
	Control Group	Intervention Group	Control Group	Intervention Group	% Δ (control vs intervention)
Regularly used vitamin supplement(s)	35 (31.8)	33 (30.0)	36 (32.7)	48 (43.6)	+ 2.8 vs + 45.3
Regularly used mineral supplement(s)	33 (30.0)	27 (24.5)	58 (52.7)	72 (65.5)	+ 75.6 vs + 167.3
Consumed at least three base meals per day	101 (91.8)	93 (84.5)	93 (84.5)	95 (86.4)	-8.0 vs + 2.2
Daily consumed fruits	70 (63.6)	68 (61.8)	64 (58.2)	58 (52.7)	-8.5 vs. -14.7
Daily consumed vegetables	77 (70.0)	75 (68.2)	70 (63.6)	79 (71.8)	-9.1 vs. + 5.3
Daily consumed dairy products	46 (41.8)	77 (70)	71 (64.5)	83 (75.5)	+ 54.3 vs. + 7.9
Regularly consumed breakfast	85 (77.3)	101 (91.8)	83 (75.5)	90 (81.8)	-2.3 vs -10.9
*Consumed carbonated beverage daily	33 (30.0)	49 (44.5)	46 (41.8)	57 (51.8)	+ 39.3 vs + 16.4
Consumed healthy snacks	72 (65.5)	68 (61.8)	67 (60.9)	72 (65.0)	-7.0 vs. + 5.2
*Frequently consumed fast foods	35 (31.8)	58 (52.7)	31(28.2)	57 (51.8)	-11.3 vs -1.7
*Frequently skipped meals	23 (20.9)	39 (35.5)	34 (30.9)	32 (29.1)	+ 47.8 vs -18.0

* Dietary practices that were expected to reduce; type of analysis: Chi-square.
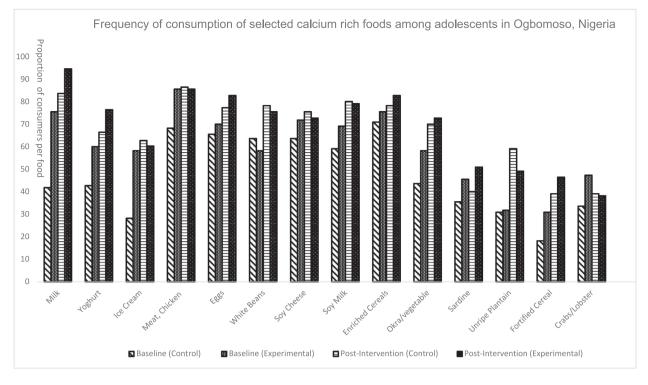
Fig. 3. Frequency of consumption of selected calcium-rich foods among adolescents

intake. Intake of calcium among the adolescents before and after the intervention is presented in Table 3. Calcium intake was similar in both control and intervention groups at baseline (pre) (p = 0.91). There is no statistically significant difference in calcium intake of the adolescents pre and post intervention (Table 3). Despite the intervention, the overall calcium intake of the adolescents remains below the recommended intake level of 1,300 mg.

3.3. Discussion

The importance of calcium for various physiological and metabolic functions is well known, yet studies have mainly shown inadequate intakes among Nigeria's diverse populations across all age groups [3–6]. This study evaluated the effect of emotion-based messages on the consumption of calcium-rich foods among early in-school adolescents in Ogbomoso, Nigeria. In this study, nutrition education using emotion-based nutrition messages did not contribute to significant increase in total calcium consumption. Calcium intake of adolescents in both control and intervention at baseline and end-line fall below the WHO recommendation (1300 mg). The dietary practice and frequency of consumption of calcium-rich foods were deficient, as evident by the dietary practice score. This low calcium intake level corroborates earlier reports of inadequate calcium intake among Nigerian adolescents [3,4,6,32]. Similar low intake levels have been reported among adolescents in South Africa ([33]; Brazil [34], Korea [35], and America [36]. Inadequate calcium intake predisposes adolescents to lower bone mass and osteoporosis later in life [13,37,38]. It could also alter several biological processes which calcium mediates, including

vascular contraction, vasodilation, muscle contraction, nerve transmission, glandular secretion, modulation of body fat, and regulation of blood pressure [39–42].

The widespread inadequacy of calcium intake among adolescents signals the need for concerted global efforts to protect the skeletal growth and development of the future workforce by implementing an appropriate intervention. The slight increase in calcium intake among the adolescents in the intervention group suggests that emotion-based messages could be a promising approach. The increased calcium intake can be attributed to the increased proportions of adolescents who consumed calcium-rich foods, principally milk and yogurt. Dairy products remain one of the most reliable strategies in ensuring adequate calcium intake. However, these products do not constitute part of the regular meal of many Nigerian households. One interesting finding in this study is the increased use and consumption of mineral supplements and dairy foods among respondents in both intervention and control groups, this change in behaviour could be a direct reaction to awareness of benefits of calcium rich foods. This may signify that consistent reminder and effective nutrition education could promote adoption of dietary behaviour that promote improved consumption of calcium-rich foods.

Evidence has shown that it is difficult for an individual to meet calcium adequacy levels without adequate milk and other dairy products [43,44]. The failure of the adolescents to have a substantial increase in calcium intake to meet the physiological requirement suggests that though the frequency of consumption of calcium-rich foods increases, the quantity consumed remains inadequate. It is well known that animal foods, particularly milk and yogurt, are relatively more expensive and potentially

Table 3
Calcium intake among the adolescents.

	Baseline			Endline		
	Control group	Intervention group	p-value	Control group	Intervention group	p-value
Mean intake (mg)	238.4 ± 92.4	239.8 ± 93.5	0.91	235.4 ± 92.9	241.5 ± 100.9	0.64
Calcium adequacy						
Adequate	0 (0)	0 (0)		0 (0)	0 (0)	
Inadequate	220 (100)	220 (100)	1.00	220 (100)	220 (100)	1.00

economically inaccessible to adolescents from poor households. The elevated cost of dairy partly explains the poor representation of milk and dairy products in Nigerian adolescents' meal or snack intake [4,8]. Earlier studies also reported low milk and dairy products consumption among adolescents [24,45]. Therefore, it is imperative to popularize the cheaper sources of calcium in Nigerian diets, such as biscuit bone and locally available kinds of seafood. In addition, the school food environment could be harnessed in promoting healthy dietary behavior, including adequate access and use of calcium-rich foods.

In this study, adolescents in the intervention group showed a significant increase in milk and yogurt consumption which are rich sources of calcium among the in-school adolescents. This increased frequency of consumption is an indicator of an improved practice that can lead to increased calcium status among these adolescents. Earlier studies have reported a similar increase in milk and dairy products consumption following an intervention among adolescents in Iran [46]. However, the rise in consumption levels of other sources such as cereals, tubers, legumes, and vegetables did not increase calcium intake because these alternative plant sources are not good sources of calcium. In addition, calcium from these sources has lower bioavailability than calcium from dairy products and other animal foods [4].

Another notable change in the study is the increase in mineral supplements among the adolescents in the intervention group. Supplementation is one of the popular strategies aimed at addressing micronutrient deficiency. Adolescents' better understanding of dietary sources of calcium-rich foods and diseases (osteoporosis, hypocalcemia, osteopenia, osteomalacia, rickets in Children, and fracture incidence in older persons) associated with inadequate calcium intake during adolescence in the future could influence their decision to protect their health, hence the significance of this nutrition education. The importance of nutrition education in promoting calcium intake has been reported in previous studies of other countries [45,46]. Based on this finding, it is essential to continuously engage adolescents to promote healthy dietary behavior, including adequate calcium intake. Future nutrition education should target adolescents and their parents since they are still dependent on them and living together. The school food environment plays a more significant role in adolescents' dietary intake; hence, calcium-rich healthy snacks should be readily available within schools.

Though this study presents a new dimension of health and nutrition promotion among the in-school adolescents, the use of recall data may be a source of bias among the respondents and other factors such as the financial, contextual, and sociocultural issues that may impact dietary practices are not fully explored. Moreover, study location peculiarities may have influence responses to survey questions.

4. Conclusion

The use of an emotion-based nutrition education approach did not significantly increase the total calcium intake and meeting the recommended calcium intake level among early adolescents, despite increased consumption of calcium-rich foods and the use of mineral supplements. This suggests that strategies that hinge on the emotion and passions of the adolescents could be pointers to promoting behavior change among this population. Furthermore, the strategy shows the importance of adolescents in driving their shift in food consumption behavior. Therefore, the use of emotion-based approaches in driving strategies to reduce micronutrient malnutrition, especially iron, vitamin A, zinc, and calcium, is recommended among Nigerian adolescents. This could be achieved by incorporating emotion-based message approaches in driving nutrition education in school health or nutrition clubs and nutrition and health-related courses or modules for this population group. Furthermore, the effectiveness of the emotion-based approach in driving behavior change among adolescents calls for the need to explore the use of this approach among other population groups such as women of reproductive age, adult males, and older persons.

Declaration of Competing Interest

There is no conflict of interest.

Appendix A

UNIVERSITY OF IBADAN
FACULTY OF PUBLIC HEALTH
DEPARTMENT OF HUMAN NUTRITION
Dear Respondent,
I am a Master's student of the above-named department. This research is essentially for academic purposes and any information provided will be treated with utmost confidentiality.
Please thick or supply honest responses to the questions as much as possible.
Thank you for your cooperation.
INTERVIEWER CODE: _____
DATE OF INTERVIEW: _____

SECTION A: Socio-demographic characteristics

1.	Gender: a. male ( ) b. Female ( )
2.	Religion: a. Christian ( ) b. Mus lin ( ) c. Traditional ( ) d. Others ( )
3.	Age _____
4.	Date of birth:
5.	State of origin:
6.	Class _____
7.	Household size _____
8.	Are you living with your parents? Yes No
9.	If NO specify who you are living with
10.	Are your both parents living together? Yes No
11.	What is your religion? Christianity ⬜ Islam⬜ Others ⬜
12.	What is your primary language: Yoruba Hausa Igbo Others

Parent educational qualification

Parent educational qualification	Father	Mother
Primary school		
Secondary school		
Tertiary institution		
Others		

Parent Career: Father _____   Mother_____

Which of the following best describes the area you live in?

Urban ⬜   Suburban ⬜   Rural ⬜

SECTION B DIETARY PRACTICES

S/N	QUESTIONS	CODE
1	How often do you take vitamin supplements? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
2	How often do you take mineral supplements? 4) Always:5-7 days 3) Often:3-4 days 2)Sometimes:1-2 days 1) Does not occur at all	
3	How often do you eat three base meals per day? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
4	How often do you drink carbonated beverages? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
5	How often do you drink water? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
6	How often do you eat breads, cereals, pasta, potatoes, or rice? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
7	How often do you eat fruits, such as apples, bananas, or oranges? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
8	How often do you eat vegetables, such as tomatoes, carrots, or salad? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
9	How often do you eat dairy products such as milk, yogurt, or cheese? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
10	How often do you eat berry jams, cookies, candies, or other sweets? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
11	How often do you snack on foods like potato chips, cakes, candies, donuts, or soda? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
12	How often do you snack on foods like yogurt, popcorn, or fruits? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
13	How often do you eat fast food? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
14	How often do you eat breakfast in the morning? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
15	Based on three meals per day, how often do you skip at least one meal per day? 4) Always:5-7 days 3) Often:3-4 days 2) Sometimes:1-2 days 1) Does not occur at all	
	What is the reason for skipping meal?	

SECTION C

Food Frequency Questionnaire for the past one month.
How often do you eat the following foods? (Put an "X" on the line.)

	More than Once/day	Once/day	2-3 Times/week	Seldom	Never
Milk					
Yogurt					
Ice cream					
Meat, fish, poultry					
Eggs					
Biscuit bone/Fish bone					
White beans					
Soy cheese					
Soy milk					
Potatoes					
Enriched bread, rice, pasta					
Okra / Green leafy vegetables					
Sardine					
Unripe plantain					
Fortified cereal					
Crabs, lobster					
Edible caterpillar					
Orange					
Cocoyam					
Locust beans					

SECTION D: 24 Hour Dietary Recall Multiple Pass

I would like you to know everything you had to eat and drink after you woke up yesterday morning till this morning, including everything you ate and drank at home and away, even snack, or coffee.

Date: …………   Day of the Week: …………………… Questionnaire No: ………………………..

Wake up time: ……………………

Item No.	Time	Place taken	Food/drink	Description of food/drink	Quantity consumed (How much did you actually eat or drink if it were to be bought)	Weight equivalent in grams
	1st pass			2nd pass	3rd Pass	

1. Was food intake usual? (Y/N). If no, how unusual?	4.Probe for supplements (iron, vitamins, other supplements) (Y/N) If yes, specify
2. Was it a feast day? (Y/N)	
3. Probe for sickness (Y/N): If yes, did sickness affect Appetite (Y/N) If yes, how? Increase or decrease	5.Probe for fermented beverages Consumed.

Fourth Pass is a review.

SECTION E: ANTHROPOMETRIC ASSESSMENT

Height: _____ cm   Waist circumference: _____cm

Weight: _____kg   Hip circumference: _____cm

BMI : _____

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