

Nutrition Awareness and Knowledge and Body Mass Index in Adolescents in Public Junior Secondary Schools

Gaonyadiwe Lubinda

Faculty of Health Sciences, University of Botswana, Gaborone, Botswana

Email: sinombeg@ub.ac.bw

How to cite this paper: Lubinda, G. (2024) Nutrition Awareness and Knowledge and Body Mass Index in Adolescents in Public Junior Secondary Schools. *Food and Nutrition Sciences*, 15, 432-446.
<https://doi.org/10.4236/fns.2024.156029>

Received: January 19, 2024

Accepted: June 23, 2024

Published: June 26, 2024

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Abstract

Background: Non-communicable diseases are increasing among adolescents. The decision about diet is the foundation of eating habits that could persist to adulthood. Dietary decisions, which usually are hard to change later in life, make nutrition education at school paramount to prevent obesity and NCDs, and promote healthy eating. **Objectives:** To assess level of nutrition awareness and knowledge of healthy eating and food intake behaviors and association with Body Mass Index (BMI) and age. **Methods:** A cross sectional study that included measures such as age, gender, socioeconomic status, BMI, and nutrition knowledge was conducted in 264 respondents from 18th June 2015 to 9th July 2015. The nutrition knowledge questionnaire was composed of 24 questions divided into food nutrients, food contents, healthiest foods, and energy expenditure and nutrition benefits. CDC BMI chart for 2-20-year-olds was used to plot respondent's weight and height. **Results:** The mean age of the respondents was 14.3 years (SD 0.79). Most of the respondents (153/252, 53.6%) had a low socio-economic status as categorized by the present study. The mean (SD) BMI was 20.08 (3.90). Most respondents (56.3%, 142/252) failed the knowledge test and scored below 50% and only two respondents (0.8%) had excellent nutrition knowledge. The mean percentage achieved was 46.1% (SD 15.91) ranging from 8.3% to 87.5%. There was a significant correlation between nutrition knowledge and BMI ($p = 0.001$). **Conclusion:** The study shows that adolescents do not have adequate nutrition knowledge, placing them at risk for developing non-communicable diseases later in life. Nutrition education programs are urgently needed for teachers, parents, and children.

Keywords

Adolescents, Nutrition, Knowledge, BMI, Botswana

1. Introduction

Adolescence is a rapid stage of growth and development that is characterized by increased nutrition requirements [1]. Adolescence period is also characterized by independent decisions about diet with limited parental control [2]. The decisions about diet are the foundation of eating habits that could persist and be hard to change in adulthood [3]. Unhealthy eating habits may pose negative child's health status, making nutrition education at school paramount to prevent obesity and NCDs, and promote healthy eating. Given that the adolescent stage is important in the development of adult NCDs, [4] it is vital to study nutrition knowledge of adolescents to help develop school-based intervention programs.

Adolescents compose a large proportion of the population globally. In developed countries they are exposed to media that advertises the Western diet which is composed of too much sugar, fat, and low fiber [5]. Increased fast-food consumption negatively impacts food habits and choices of adolescents [6]. The prevalence of obesity globally was 18% in children and adolescents aged 5 - 19 in 2016 and unhealthy diet cause obesity that is a risk factor for NCDs [6]. In Botswana 33.3% of the population are adolescents [7]. Adolescents in developing countries engage in unhealthy eating habits. Adolescents consume high energy snacks and beverages, and low vegetables and fruit especially in urban areas [8].

Public health approaches to promoting healthy lifestyles can be individual, social, or environmental [9]. At the individual level, nutrition knowledge is important since it promotes a healthy lifestyle. The Information, Motivation and Behavioral Skill (IMBs) model asserts that information is a prerequisite for behavior change [10]. Knowledge is the application of information learned [11]. This means that an individual needs to be equipped with knowledge to impact behavior. Although it is well known that knowledge alone is not adequate to impact behavior, knowledge at adolescent stage is deemed essential, with the hope that it could impact eating habits [9].

Nutrition knowledge and awareness may be affected by many factors, among them being residential area, age, gender, and socioeconomic status [12]. Older students with high academic performance had more nutrition knowledge than younger ones while obese students who were on diet had low nutrition knowledge, however, normal BMI was found to be associated with adequate nutrition knowledge [13]. In addition, taking a course on nutrition or health related subjects might also affect nutrition knowledge and awareness [14]. Students from low socioeconomic status and rural areas had low nutrition knowledge [15] indicating that there is a gap in Botswana literature, hence the need to share the results of this study.

While adolescents are reported to have good nutrition knowledge in South Africa [15] and low in Saudi Arabia, [16]. Adolescents in developing countries generally make wrong food choices because of lack of nutrition knowledge [17]. Further research is needed to evaluate the adolescents' knowledge of nutrients and skills, and its association to Body Mass Index (BMI) and age.

For Botswana, a sub-Saharan developing country, adolescents residing in Gaborone the capital of Botswana exposed to unhealthy foods fast foods that I sold in tuck-shops and street vendors at school, supermarkets, and restaurants that sell fast foods [18]. For eating habits to be modified or changed adolescents should be equipped with adequate nutrition knowledge [11]. However, there is lack of published studies located in the literature that evaluated the level of nutrition knowledge of 13-15-year-old adolescents in public junior secondary schools in Gaborone, Botswana.

Nutrition knowledge and awareness needs to be explored to find out the level of understanding of children about nutrition and nutrients. This study is one of the first to be conducted in Botswana looking at nutrition knowledge and awareness on healthy eating behaviors among children who are 13-15 years. The results of this study may inform school education curriculums in terms of making nutrition subject compulsory to all students as compared to the current situation in schools where nutrition subject is optional in public schools. The study was a baseline for the development and evaluation of an intervention program for the fulfillment of a doctoral degree.

2. Materials and Methods

2.1. Study Design

A cross-sectional descriptive study was used.

2.2. Study Setting

A study was conducted in eight (8) randomly selected schools from 13 public junior secondary schools in Gaborone, Botswana. Public junior secondary schools are owned by the government of Botswana. The education system in Botswana comprises of public and private primary and secondary levels. The duration of public secondary level is three (3) years for junior schools while senior secondary takes two (2) years and the age category for students is 13-15 years and secondary school is 16-18 years.

Food meals for public schools' starch and protein, with vegetables and fruits compose the meals. However, vegetables and fruits are provided twice a week only. There are tuck-shops and street vendors in and around the selected schools which sell sweets, snacks, and fruits.

2.3. The Objectives of the Study Were

- 1) To explore nutrition awareness and knowledge of adolescents in public junior secondary schools.
- 2) To determine the association between nutrition knowledge, BMI, and age.

2.4. Study Population

The target population for this study was all 13 to 15-year-old junior high school students in Gaborone public schools.

2.5. Sampling Strategy

Eight (8) of the 13 junior secondary schools in Gaborone were randomly selected. The head teachers of the 8 schools were approached to solicit permission to recruit participants for the study. There were 12480 students in the 13 public junior secondary schools. To achieve 80% power and a confidence interval of 95%, 264 participants were required for the study. Using stratified random sampling, we selected 33 participants from each school: 11 from each of the three junior school years.

2.6. Data Collection

Data collection was conducted from 18th June 2015 to 9th July 2015 by trained research assistants. 264 randomly selected respondents were met to explain the study's purpose, inclusion and exclusion criteria, and assent and informed consent matters.

2.6.1. Questionnaire Reliability and Validity

A validated questionnaire by Gross and others adapted it for this study was used [19]. Also, the questionnaire was checked for validity and reliability.

Content validity index (CVI) was measured. Six experts in nutrition evaluated the nutrition component of the questionnaire and four physical education experts evaluated the physical activity component of the questionnaire by giving each question a grade between 1 and 4. The result was a CVI of 90%. The questionnaire was adjusted accordingly.

The face validity of the questionnaire was determined. Thirty-three students from schools were not included in the study, using cognitive interviewing. The face validity score was 91% and the questionnaire was remodified to improve the face validity.

The test-retest reliability score was $r = .70$. Based on the results we made the final modification to the questionnaire.

2.6.2. Questionnaire

The questionnaire had seven (7) sections but only the section on nutrition knowledge and BMI and demographic variables is explained for this study. The nutrition knowledge section consisted of 24 items focusing on factors influencing food choices, eating habits, food contents, healthy foods and drinks and energy expenditure. The first section of the questionnaire had four (4) questions asking about knowledge on food nutrients, while the second contained six (6) questions about food contents, then two (2) questions on healthy foods and drinks, seven (7) questions were about the healthiest foods, and lastly there were three (3) questions on energy expenditure and two (2) on nutrition related issues.

1) Grading of the nutrition knowledge scores.

The questions had four (4) options, only one (1) of which was correct. An additional answer of 'not sure' was added to discourage missing data. Each respondent's overall score was calculated out of the total mark of 24 and converted to a

percentage. The categories of fail (0% - 49%), fair (50% - 59%), pass (60% - 69%), very good (70% - 79%) and excellent (80% and above) were used to grade respondents correct answers [20], and respondents who scored a higher percentage were labelled as having high nutrition knowledge.

2.7. Anthropometric Measurements

Weight and height measurements were used to determine Body Mass Index (BMI). A scale set at 0 (Detecto 439 Eye-Level Mechanical Beam Doctor Scale with Height Rod) was used to measure height and weight. Each participant stood erect without wearing shoes against the scale with head facing the examiner. Weight was checked by asking participants to reduce excess clothing such as shoes, jersey, jackets, and cellphone which are heavy. The readings for weight and height were plotted in the CDC growth chart for the 2-20-year-olds.

2.8. Ethical Consideration

Ethical Clearance to conduct the study was obtained from Botswana's Ministry of Education and Skills Development (Ref DPRS 7/1/6 I (5)) and from the Faculty of Health Sciences' Human Research Ethics Committee (HREC REF 631/2014) of the University of Cape Town. Written consent was obtained from participants' parents and written assent from participants.

2.9. Data Management and Analysis

Data was captured in an excel spreadsheet. We cleaned the data and imported it from Microsoft excel spreadsheets into Statistical Package Software System (SPSS) version 22 and significance level was set at $p = 0.005$. Descriptive statistics were used to analyze the data. Demographic data were analyzed to determine proportions, frequencies, means, median and standard deviation. Nutrition knowledge questionnaire and BMI were analyzed for mean, standard deviation, percentages, and range. Pearson correlation was used to determine the significant relationship between nutrition knowledge and BMI.

3. Results

The survey response rate was 95.1% (252/264). The descriptive demographic data are presented in the tables below.

Socio-demographic characteristics of adolescents aged 13-15 years.

Most of the respondents were females (58.3%). Many of the respondents were aged 15 years (47.6%), 53.6% were from low socioeconomic status and 4.0% were from high. Most respondents had normal body mass index (74.6%), and only 10.7% were overweight, 6% obese (**Table 1**).

Nutrition knowledge on food nutrients, food contents, healthy foods and drinks, healthiest food, energy expenditure and nutrition related issues.

The results show 34.1% of respondents knew what food nutrients are, only 13.5% knew what fiber is, while 69% knew the foods that are rich in vitamin C. Most respondents (66.3%) knew what milk is used for and 67.1% were able to

identify the healthiest drink. Most of the respondents were able to identify the healthiest foods ($\geq 50\%$) except for the question on orange juice, orange smoothie or both (40%). Regarding the answer to the question on what the amount of energy depends on, 61.1% knew the answer, while only 15.9% knew what the amount of energy depends on. Many respondents knew (65.1%) the nutrition related diseases and only 29.8% knew the benefits of healthy eating.

Table 1. Socio-demographic characteristics of adolescents.

Features	Frequencies (%) (N = 252)
Gender	Male 105 41.7
	Female 147 58.3
Age (yrs)	13 54 21.4
	14 8 31.0
	15 120 47.6
Socio-economic status	Low 135 53.6
	Middle 107 42.5
	High 10 4.0
Body Mass Index (BMI) ^b	Underweight (<5 th percentile) 22 8.7
	Normal BMI (5 th to <85 th percentile) 188 74.6
	Overweight (85 th to <95 th percentile) 27 10.7
	Obese ($\geq 95^{\text{th}}$ percentile) 15
	6

Table 2. Nutrition knowledge scores.

Categories	Frequencies (%)
Fail	142 56.3
Pass	69 27.4
Fair	22 8.7
Very good	18 7.1
Excellent	2 0.8

The overall pass mark of respondents using nutrition knowledge and awareness categories (N = 252).

According to the overall marks of the respondents to the nutrition knowledge questions, the results show that most of the respondents scored below 50% (56.3%), while only 7.1% got a very good score.

Table 3. Nutrition knowledge and awareness on food nutrients, content, healthiest food and drinks, energy expenditure and nutrition related issues.

Questions	Learners with correct answers (%)	
	Frequencies N = 252	
Food nutrients		
What are macronutrients?	86	34.1
How do you define vitamins	81	32.1
In a balanced diet you should avoid	22	8.7
Which of these is more essential for your body?	53	21.0
Food contents		
Which part of an egg contains fat?	100	39.7
What does fiber mean?	34	13.5
Which fruit contains vitamin c?	174	69
Pasta& bread are rich in	161	63.9
Fruits & vegetables rich in	174	69
Meat is rich in	121	69
Healthy foods and drinks		
Which do you think is a drink better to quench your thirst?	169	67.1
According to you, milk is a food for	167	66.3
According to you, which is the healthiest food?		
Toast with tomato, toast with ham, snack	153	60.7
Fish, hamburger, fried fish	135	53.6
Banana smoothie, yogurt cake or both	140	55.6
A glass of milk, carrot cake, or both	168	66.7
Fresh chips, baked potatoes, or both	147	58.3
Orange, orange juice or both	117	46.4
Fruit smoothie, fruit salad or both	128	50.8
Energy expenditure		
In which activity do you use more energy?	154	61.1
Which food is more energy rich?	98	38.9
What does the amount of food you eat depends on?	40	15.9
Nutrition related issues		
What is the advantage of healthy eating?	75	29.8
Which of the following is the most nutrition related health problems?	164	65.1

Concerning correlation between BMI and nutrition knowledge, the results show a significant correlation ($p = 0.001$).

Table 4. Correlation between BMI and nutrition knowledge.

		Body mass index	Nutrition Knowledge
Body mass index scores	Pearson Correlation	1	0.204**
	Sig. (2-tailed)		0.001
	N	252	252
Nutrition knowledge	Pearson Correlation	0.204**	1
	Sig. (2-tailed)	0.001	
	N	252	252

Concerning correlation between age and nutrition knowledge, the results of this study show that there is no significant correlation between age and nutrition knowledge ($p = 0.103$).

Table 5. Relationship between age and nutrition knowledge.

	Age of participants			Nutrition knowledge		
	Pearson Correlation	Sig. (2-tailed)	N	Pearson Correlation	Sig. (2-tailed)	N
Age of participants	1		252	0.103	0.104	252
Nutrition knowledge	0.103	0.104	252	1		252

4. Discussion

The purpose of the current study was to determine the level of nutrition knowledge and awareness on healthy eating and food intake and if there was an association with age, BMI. To our knowledge this is the first study to determine the level of nutrition knowledge and its association with age and BMI among 13-15 years adolescents in public schools in Botswana. The results in the current study based on scores (**Table 2**) showed that the overall pass grade on nutrition knowledge of adolescents aged 13-15 years in urban junior secondary schools was inadequate. In a total of 252 (95% response rate), most of the respondents had low nutrition knowledge (56.3%) and were not aware of food nutrients, food content healthiest foods and drinks, indicating that adolescents lack nutrition education. Only 7.1% got a very good score. Although nutrition knowledge is spread on social media, at school and families and other platforms [20] [21], nutrition knowledge in adolescents in Gaborone remains low and still needs to be improved. The results are in line with other studies [22] found that adolescents in the urban slum of Dehli had poor knowledge (72%) and 4.15% performed better, while in urban Bengaluru district, adolescents had low nutrition know-

ledge (28%) and 18% had high knowledge [21] and in Ibadan Municipality in Nigeria, 58.7% had poor nutrition level [23].

However, in other countries nutrition knowledge among adolescents was moderate to high. The results of the current study are inconsistent with a study conducted in Eastern Cape South Africa, where 72.9% adolescents got a high score [17], in Italy 57.3% of adolescents had good nutrition knowledge [19], in Brazil 53.6% knew that their diet is healthy [24] and in Bangladesh, Kira 57.3% [25].

Based on the results of individual questions (**Table 3**), most adolescents in the current study responded well except for nutrients found in egg and fiber. The results are in line with other studies where adolescents in secondary school in Al-Khobar, Saudi Arabia had low knowledge on fiber rich diet (27.5% in males and 24.2% in females) [16]. In addition, in Balearic Islands adolescents displayed inadequate knowledge especially on fat, carbohydrate, dietary fiber, foods rich in protein, contents of eggs and meats, milk, and foods that provide most energy [26].

Again, on the aspect of nutrition related diseases (**Table 3**), only 29.8% knew dangers of unhealthy eating, and the results are like [27] where 4.0% males and 4.7% female adolescents knew the dangers of unhealthy eating. Healthy eating messages should be inculcated in children's minds at an early age [22]. Probably implying that nutrition education must be included in the school curriculums, and that parents should also teach their children healthy eating behaviors at home. In the current study, respondents were able to identify healthy foods and drinks. Inconsistent with a study that showed that respondents could not identify healthiest foods [15].

Another question that adolescents answered poorly was on energy rich food (38.9%) (**Table 3**). Few respondents knew energy rich foods and ways of expending energy, which is worrisome because lack of knowledge in this area could predispose respondents to obesity at present and in later life. The results of the current study are like studies [28] [29] reporting that adolescents failed to identify energy rich foods. But in another study, it was reported that adolescents knew the answers to the question on energy rich foods. Inadequate nutrition knowledge may have a negative impact on health. It may affect food choices and in turn food intake may lead to overweight/obesity [30]. Therefore, nutrition education must be promoted at all levels in the communities. One may expect that since adolescents are children of the digital age, and one may assume that they have access to nutrition information from various platforms and will possess adequate information, however the results showed the contrary. It is noteworthy that other factors that may have caused adolescents in this study to have low nutrition knowledge could be that majority of them were from low socio-economic status and public school where nutrition subject is optional. The current study is the first step in pointing out the need to spread information about healthy and unhealthy foods and drinks among adolescents at home, school, and community.

In terms of correlation (**Table 4**), the current study showed that nutrition knowledge significantly correlated with BMI ($p = 0.001$). Adolescents with low nutrition knowledge are at risk of obesity [31]. However, in the current study most adolescents had normal BMI.

This could be the reason for this significant correlation. The current results are like other study in Lebanon [14]. However, inconsistent with other studies that reported an insignificant relationship between nutrition knowledge and BMI [31]-[33].

Nutrition knowledge was not significantly associated with age in the current study (**Table 5**), although [20] reported that nutrition knowledge increases with age. In a study conducted in Bangladesh, age was significantly associated with age ($p = 0.005$) [34]. Few studies were accessed that investigated this association, in Botswana more studies are needed in a larger population to determine this correlation.

5. Conclusion

Adolescents in urban junior secondary schools lacked nutrition knowledge. Nutritional knowledge is significantly correlated with BMI, and this may place these adolescents at risk for developing non-communicable diseases later in life. Nutrition education programs are urgently needed for teachers, parents, and children.

6. Study Limitations

A limitation of the study was that it was conducted in junior secondary schools in one of the urban areas in Botswana. A larger study is needed in junior secondary schools in rural areas and other urban areas.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix 1: Nutrition Knowledge Questionnaire

Nutrition Knowledge Questionnaire

FOOD NUTRIENTS

G1. What are macronutrients?

- carbohydrates and proteins
- carbohydrates, proteins and fats
- carbohydrates and fats
- carbohydrates, proteins, fats and vitamins
- not sure

G3. In a balanced diet you should avoid:

- carbohydrates
- fats
- any of them
- proteins
- not sure

G2. How do you define vitamins?

- essential substances present in small amounts in food
- energy-rich substances
- essential substances synthesized in our body
- useless substances
- not sure

G4. Which of these is more essential for your body?

- vitamins and minerals
- proteins and carbohydrates
- fats
- all of them
- not sure

FOOD CONTENTS

G5. Which part of egg contains fat?

- both
- albumen (whites)
- yolk
- any of them
- not sure

G6. What does “dietary fibre” mean?

- the fibrous part of the meat
- the skin of fruits
- indigestible part of vegetables
- a dietary supplement
- not sure

G7. Which fruit contains the most vitamin C?

- apple
- melon
- orange
- grapes
- not sure

G8. Meat is rich in:

- carbohydrates
- proteins
- fats
- vitamins
- not sure

G9. Pasta and bread are rich in:

- carbohydrates
- fats
- proteins
- vitamins
- not sure

G10. Fruit and vegetable are rich in:

- vitamins
- fats
- proteins
- carbohydrates
- not sure

HEALTHY FOODS AND DRINKS

G11. According to you, milk is a food for:

- children
- people of all ages
- elderly people
- sick people
- not sure

G12. Which do you think is better a drink to quench your thirst?

- water
- fruit juice.
- sugary drink
- energy drink
- not sure

According to you, which is the healthiest food?

G13	£ toast with tomato	£snack (nick-nacks, crisps, peanuts, pop-corn, mabudula)	£toast with ham	£ not sure
G14	£fish	£hamburger	£ fried fish	£ not sure
G15	£ Banana smoothie	£ yyogurt cake	£ both	£ not sure
G16	£ a glass of milk	£ carrot cake	£ both	£ not sure
G16	£ fresh chips	£ baked potatoes	£ both	£ not sure
G17	£ orange	£ orange juice	£ both	£ not sure
G19	£ fruit smoothie	£ fruit salad	£ both	£ not sure

ENERGY EXPENDITURE

G20. In which activity do you use more of energy?

£playing soccer
£reading a book
£playing videogames
£sleeping
£not sure

G22. What does the amount of food you eat depend on?

£energy expenditure
£age
£weight
£height
£not sure

Instruction: For the following questions you may tick more than one (1) answer.

G21. Which of this food is more energy rich?

£bread
£nuts
£rice
£cereals
£not sure

G23. What is/are the advantage/s of a healthy diet?

£ prevention of heart and diabetes diseases
£ Boost immunity.
£ live a longer healthier life
£ gaining weight
£not sure

G24. Which of the following is the most nutrition related health problem?

£ diabetes
£ obesity
£ poor appetite
£ headache
£ painful body
