International Journal of Health Sciences and Research
[Indexed, Peer-Reviewed Journal]
Volume 15; Issue: 9; September 2025
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Gap Analysis: Nutrition Knowledge Assessment and Practical Application Evaluations among College Nutrition Students at a Middle-Level Institution, Kenya

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DOI: https://doi.org/10.52403/ijhsr.20250929

ABSTRACT

Introduction: Globally, there has been an upsurge of obesity and overweight among college students. In 2022, two and a half billion adults aged 18 years and above (43%) were overweight, among which, 890 million people were obese (16%). Furthermore, a prevalence of 16.5% of overweight was reported among Kenyatta University students in Nairobi, Kenya in 2024. There is scarcity of information on eating habits, physical activity level and the nutrition status of college students in Kenya, particularly those pursuing nutrition programmes. Thus, this study's purpose was to establish the physical activity and nutrition knowledge levels, eating habits and nutrition status among nutrition and dietetics students in middle-level institutions in Kenya.

Materials and Methods: This research employed a mixed methods cross-sectional analytical study design that collected both quantitative and qualitative data. Two hundred and ninety-three (293) third- and second-year nutrition students at Karen, Molo, and Nyandarua Campuses were randomly sampled. Content-validated, semi-structured, self-administered questionnaires were used to collect data on social and physical environmental factors, individual factors, and eating habits. Observation checklist and Focus Group Discussion guides were also used to collect qualitative data. Eating habits was determined using dietary diversity score and meal frequency. Weight, height, waist and hip circumference measurements were collected and the weight status established using Body Mass Index (WHO 2000 cut-off points) and Waist Hip Ratio. Global Physical Activity Questionnaire (GPAQ) (WHO 2022) was used to collect physical activity data. Qualitative data was transcribed and coded for common themes, from which conclusions were drawn. SPSS version 25.0 was used for data analysis. The relationships between study variables were established using a number of tests, including Chi- square test, Man Whitney U test, one-way ANOVA, Bivariate Spearman's rank order correlation, and Multivariate logistic regression analysis. A $p< 0.05$ was used as the statistical significance level.

Results: Majority of the participants were females (76%). The mean age of the participants was 22.7(±2) years. Majority of the respondents (57.7%) had moderate nutrition knowledge (41–69%). The college students' meals majorly constituted of *ugali,* kales, rice beans/green

grams, *chapati* beans/ green grams, and rice, carrot, peas, ugali and cabbage. Majority of the respondents (87%) had diverse diets, where they consumed a daily minimum recommended meal frequency of five meals. However, Sub-optimal eating habits were reported in some respondents, such as consumption of unhealthy snacks, skipping meals, and poor dietary diversity. 20.5% of the respondents were overweight and 7.5% obese. 26.3% and 46.1% of the respondents engaged in vigorous and moderate physical activity respectively. Higher nutrition knowledge was associated with the practice of recommended eating habits (AOR = 0.265, p = 0.006).

Conclusion: In conclusion, this study has shown that there was no association between nutrition knowledge and nutrition status of the study participants. There were also inadequate physical activity levels among the nutrition students. Nonetheless, active physical activity promotes an acceptable nutrition status. Hence, there is a need to sensitize nutrition students to ensure that their knowledge is translated to healthy eating habits. This will help in preventing overweight and obesity, and therefore, chronic conditions. The management should also ensure that the college environment supports physical activity and healthy eating.

Keywords: Eating habits, Overweight, Obesity, Nutrition students, Nutrition knowledge, Physical activity, Middle- level institutions

INTRODUCTION

Background Information

The prevalence of obesity and overweight has risen more than double globally between 1990 and 2022 (WHO, 2024). In 2022, according to WHO (2024), 2.5 billion adults aged 18 years and above (43%) were overweight, and of these, 890 million people were obese (16%). Worldwide, 4.72 million deaths every year are attributable to obesity (The World Counts, 2024). Ndung'u, Waudo and Kobia (2024), noted that in the college-age population (18- 29 years), 24.1% were obese or overweight.

Oluyombo et. al., (2021) reported that in sub-Saharan Africa, constituting majorly of developing nations, obesity rates have been on a rapid rise compared to other places worldwide. the fastest-rising adult obesity rates are in Africa. Oluyombo et al. (2021) notes that obesity consequently leads to the increased burden of chronic conditions. Adult obesity prevalence in Burkina Faso has risen by almost 1,400% within the previous thirty-six years. In Benin, Togo, Ghana and Ethiopia, it has risen by over 500%. A study in Ghana by Obirikorang et al. (2024) that adopted the cross-sectional design, it was established that the prevalence of overweight and obesity among young adults (16- 25 years) was 33.8% and 17.0 % among female and male students respectively. Olatona et al. (2018) studied three universities in Lagos, Nigeria and established that NCDs' (Non-Communicable Diseases) metabolic risk factors and unhealthy diets were prevalent.

According to Kiragu et al. (2022) and KEMRI (2024), NCDs accounted for over half of the inpatient admissions as well as 39% of all mortalities annually. Moreover, Kiragu et al. (2022) observed that NCDs account for over 55% of the hospital mortalities. KEMRI (2024) revealed that NCDs are responsible for 27% of all the mortalities in Kenya. Moreover, a study by Ndung'u, Waudo and Kobia (2024) conducted among Kenyatta University students in Nairobi, Kenya, using the cross-sectional analytical design among 260 participants reported a 24.1% overall prevalence of obesity and overweight. This study also reported a prevalence of 7.6%, 16.5%, 8.4% and 67.5% of obesity, overweight, underweight, and normal weight respectively (Ndung'u, Waudo & Kobia, 2024). Obesity is a substantial risk factor for the gradually increasing NCDs (Ejigu & Tiruneh, 2023).

In a study by Bhawna, Sharma and Sharma (2022) that adopted the cross-sectional design, it was reported that college students

in Delhi engaged in unhealthy behaviours, more so unhealthy eating behaviours. Healthy eating habits influence not only the feelings of students but also the manner in which they achieve and learn (Khan, Zada & Ismael, 2022). Absence of physical activity and poor eating habits promote poor health that led to premature death, obesity, and coronary heart disease (The World Counts, 2024). Oluyombo et al. (2021) attributes obesity to increased physical inactivity in addition to unhealthy diets.

World Health Organization (WHO) provides recommendations on different foods' intake for young adults (Kim, 2023). Nevertheless, Awoke et al. (2022) noted that for both college men and women, the recommended daily intake was way below the recommendations. Founded on this rationale, this study aimed at establishing if individual factors among nutrition students at Kenya Medical Training College (KMTC) had an influence on their eating habits and nutrition status.

Problem Statement

Research studies document that inappropriate dietary habits result to chronic conditions. In the college population (18-29 years), 24.1% are obese or overweight (Ndung'u, Waudo & Kobia, 2024), and demonstrate unhealthy eating habits. Regardless of the fact that nutrition students have knowledge on healthy eating and its benefits, there are apparent difficulties with healthy dietary practices. College students face great challenges with eating, and acquiring healthy foods at an affordable price is crucial for them. Although studies have been carried out to assess the eating behaviors among college students (Kariuki, 2021), there is limited information on the dietary practices among nutrition students at KMTC campuses. Moreover, research has not explored adequately on whether possessing nutritional knowledge translates to recommended eating habits. Therefore, this research study aimed at exploring the individual factors, eating habits, overweight and obesity among college students pursuing pre-service diploma nutrition courses from Karen, Molo, and Nyandarua KMTC campuses.

Specific Objectives

1. To establish socio-demographic and -economic characteristics of KMTC nutrition students.
2. To assess the eating habits of KMTC nutrition students.
3. To assess individual factors (nutrition knowledge, economic food access and food preferences) associated with eating habits of KMTC nutrition students.
4. To determine the nutritional status of the KMTC nutrition students using Body Mass Index.
5. Establish the relationship between individual factors, eating habits and nutrition status among the students.

MATERIALS & METHODS

Research Design

A cross-sectional analytical study design was adopted to assess the prevalence of overweight and obesity and eating habits among the study participants. Data collection occurred at one point in time. The study design allowed for exploration of relationships between variables.

Study Variables

Table 1: **The Dependent, Independent and Confounding Variables**

Dependent Variables	**Indicators**
Eating habits (WHO, 2008)	a) Eating healthy foods b) Frequency of food consumption c) Types of foods eaten
Nutrition status- Overweight and Obesity based on WHO 2000 cut-off points	BMI
Independent Variables	
Individual factors	

• *Food preferences as influenced by time demands and convenience* • *Nutrition knowledge* *Socio-economic &- demographic characteristics*
Confounding Variable – Physical activity; **Indicators:** Intensity and Duration (WHO, 2022)

Location of the Study

The study was conducted in KMTC Karen, Nyandarua and Molo campuses. The state corporation offers 36 different health-related courses, among them Nutrition and Dietetics. The institution has students pursuing higher diploma, diploma and certificate levels. The Nutrition and Dietetics department trains students on healthy eating behaviour as well as the consequences of unhealthy eating. The Nutrition and Dietetics department has two categories of students, one in-service and the other pre-service. The approximate number of nutrition students in one campus during a semester is 300.

Study Population

The study was conducted among nutrition students at the KMTC- Karen, Molo, and Nyandarua Campuses. This study focused on the pre-service diploma students, who are normally fresh graduates from high school. The third- and second- year pre-service students were the focus of this study as their content coverage from the curriculum is enough to enable assessment of nutritional knowledge.

Inclusion and Exclusion Criteria

The respondents, either in their second or third year of study, were boarders in the campuses, and were undertaking a pre-service diploma nutrition course at KMTC Nyandarua, Molo, or Karen campuses. All respondents gave an informed consent and were willing to participate in the study. However, nutrition students having chronic conditions, on special dietary regimes, and those pursuing other programs other than nutrition and dietetics were excluded from the study.

Sampling Techniques and Sample Size

Sampling Technique

The sampling frame was composed of the 13 KMTC campuses that offer nutrition, with a total population of 1643 students. KMTC campuses in Karen, Molo, and Nyandarua were selected purposively based on having larger numbers of 2nd and 3rd year pre-service diploma nutrition students, and their close vicinity to urban areas, where transitions in lifestyle and dietary behaviours has been observed recently. Proportionate sampling was used to determine the student numbers from each campus and class. 160 participants were sampled from Karen campus (76 3rd year and 84 2nd year). 46 participants were from Molo campus (20 3rd year and 26 2nd year), while there were 40 3rd year and 47 2nd year respondents from Nyandarua campus. Consequently, simple random sampling was done to select the respondents from each class using the table of random numbers (Fig. 1.1).

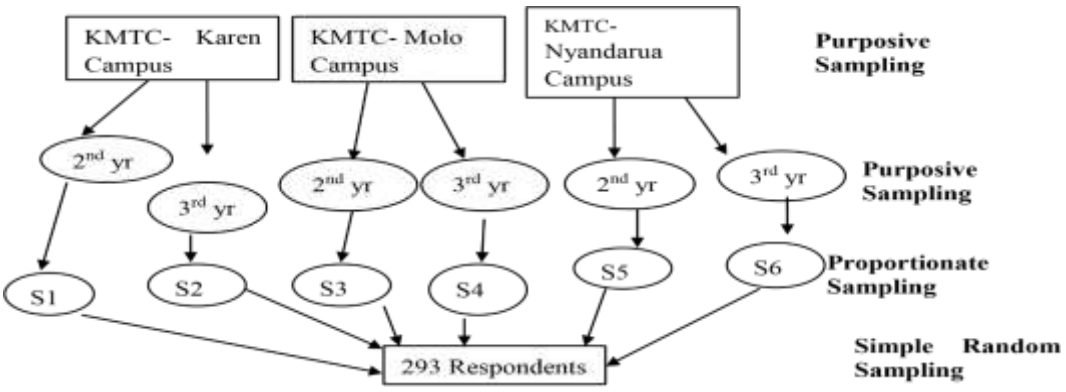

Figure 1.1*: The Sampling Methodology*

Sample Size Determination

The sample size was determined using the Cochran formula (Cochran, 1977). Based on Peltzer et al. (2014), the prevalence of overweight or obesity among university students aged 16 to 30 years in low and middle-income countries is 22%. This prevalence was used considering that the age of participants in this sample was similar to what is being studied, and Kenya is also a middle-income country.

$= (1.96^2)\ (0.22)\ (0.78)/\ 0.05^2$

$=$ 264 respondents. Considering a 10% non-response rate;

Desired sample size (total) = sample size obtained/ (1- non-response rate)

n= 264/ (1-0.1) = 293

Data Collection Instruments and Tools

A content-validated, semi-structured, self-administered questionnaire was used in collecting information on individual factors, and eating habits. Other instruments were observation checklist that collected information on types of foods consumed and how diverse it was, and Focus Group Discussion guide for qualitative data such as how various factor influence eating habits in college. Assessment of physical activity was done using self-reported Global Physical Activity Questionnaire (GPAQ) by WHO (2022).

Research Assistants' Selection and Training

There was recruitment of two research assistants to help with data collection. The recruitment criteria were; an undergraduate or diploma graduate in nutrition course, with previous research experience. The assistants were trained on different data collection components to ensure proficiency and accuracy.

Pretesting of Data Collection Instruments and Calibration of Weighing Scales

Pretesting was done at Thika School of Medical and Health Sciences with 10% of the sample size (30 participants). Their feedback aided in improving the validity, reliability and accuracy of the data collection instruments. Issues identified included content, length, language level, and wording and these were reviewed and modifications were done. The weighing scale was calibrated every time before its use and after movement by placing a known 1KG item on it.

Validity and Reliability of Tools

A panel of nutrition experts scrutinised the questions thoroughly for validity. Reliability was tested using the test-retest method for reproducibility of results, with a reliability of 0.8- 0.9. Cronbach's alpha was also used, with a range of 0.7 to 0.9. The pre-test subjects' feedback guided improvements on the data collection instruments.

Data Collection Techniques

Two research assistants, supervised directly by the principal researcher, assisted in data collection. After, the participants were briefed about the research study and their informed consent was sought. Respondents responded to the questionnaires at their respective colleges in spacious halls. The questionnaires were checked for completeness before being collected.

Anthropometric Measurements

Data on the nutrition status was collected using the weighing scale and height scale. The measurements were taken twice, after which the average was obtained. If measurements were too apart, a third measurement was taken. Measures were taken to avoid errors when taking the weight and height. These two measurements were used to calculate the BMI (Body Mass Index). The instruments were also calibrated prior to and during the data collection process. The brand name of the equipment used was Seca.

Focus Group Discussions

The facilitator started by briefing the participants on the research study, and sought their informed consent. Recorded FGDs were used in collecting qualitative

information on eating habits and the influencing factors. The FGDs consisted of 6-12 respondents from each of the classes. A total of six FGDs were conducted in the three campuses; two from each campus. The FGDs were conducted in the campuses' lecture halls that were comfortable and free from disturbance. The facilitator conducted the sessions with the help of a recorder using the FGD guide during discussions while observing for non-verbal communication. Each discussion took an average of 60- 90 minutes. One research assistants recorded the discussion.

Observations

Observation guide was used for collecting additional data on the eating habits. The nutrition students were observed at the food kiosks and their areas of residence as they took their meals. A total of 30 students were observed (10% of the total sample), and proportionate sampling was used in selecting the number from each campus. An observation checklist guided the data collection on dietary intake and their diversity.

Data management and Analysis

Quantitative data was cleaned first and then coded. It was entered into the Ms Excel for BMI calculations. It was then entered into SPSS version 25.0 for the analysis. Descriptive statistics was done for general data characteristics. Outliers were identified through dispersion, means, frequencies, and cross tabulation. Extreme values were all set at the mean value by being transformed.

A knowledge score was used in determining the knowledge level of the students, where an incorrect response scored 0 and correct response 1. The overall knowledge score was the total of correct responses expressed as a percentage. There was a total of 17 questions and therefore the total possible score was 17. A score of 40 % was categorized as low nutrition knowledge, 41-69 % moderate, and >70 % high nutrition knowledge (Kigaru et al*.,* 2015). The higher the knowledge score, the higher the competence. Dietary diversity score was calculated on the foundation of the food groups consumed in a 7 days reference period. The food groups considered were starchy staples, legumes – Beans and peas, nuts and seeds, all dairy, meat and meat products, fish and fish products, eggs, dark green leafy vegetables, other vegetables, and fruits (WHO, 2008). A consumption of 3-4 times per week was considered a regular, and consumption of more than 4 food groups was considered to be dietary diverse, as spelt out by WHO (2008). Observation was also done to determine the eating habits. WHO physical activity recommendations were used, that is, 150 minutes for moderate-intensity and 75 minutes for vigorous-intensity throughout the week, and MET values were used during analysis, where moderate MET (Metabolic Equivalents) value was equated 4.0 and vigorous MET value equated 8.0 (WHO, 2022). For nutrition status assessment, BMI (Body Mass Index) was calculated and BMI cut-off points according to WHO (2000) used.

Thematic analysis was used for analyzing the qualitative data on the individual factors and eating habits. The qualitative data collected from the guides and FGDs was transcribed then coded by assigning labels to the variable categories. Common themes were established then clustered in some patterned order, and conclusions were derived.

STATISTICAL ANALYSIS

Chi square test helped in determining the associations and relationships between observed and expected frequencies of nutrition knowledge, nutrition status, and eating habits. Man, Whitney U test aided in comparing differences between independent (individual) for variables not normally distributed and dependent variables (eating habits and nutrition status) in the three campuses. Statistical differences between campuses' means were tested using one-way ANOVA tests.

Bivariate Spearman's rank order correlation was used for determining the direction and strength of associations between the nutrition knowledge and eating habits, eating habits and nutrition status. Multivariate logistic regression analysis was used to determine the predictor of eating habits and nutrition status. A $p< 0.05$ was set as the statistical significance level.

RESULTS

Socio-demographic and socio-economic characteristics

A total of 293 students participated in the study; Karen (54.8%), Nyandarua (29.8%), and Molo (14.7%) campuses. The respondents' socio-demographic and -economic characteristics are presented in Table 3. Over half of the participants (62.5%) were aged between 22- 25 years. A majority of the participants were females (76%). Most of the guardians were married (69.8%) whereas 28.4% were single. The minority were the divorced and widowed (0.3%). Nearly a third of the guardians were either unemployed (34.5%) or in permanent formal employment (35.4%). Over half of the guardians to the participants were university or college graduates (51.2%), while 6.1% never attended school. The participants' mean age was 22.7 (±2) years. The mean pocket money for the month preceding the interview was 2533.27 (±1740.65) Kshs (Table 2).

Table 2: **Respondents' Socio-demographic and Socio-Economic Characteristics**

Characteristics		**(N=293) n (%)**
The campus of the respondents		
Karen	160	(54.6)
Molo	46	(15.7)
Nyandarua	87	(29.7)
Age Mean (SD)	22.7 (± 2)	
Age by categories 18-21 22 – 25 26-29	 87 183 23	(29.7) (62.5) (7.8)
Gender		
Male	71	(24.2)
Female	222	(75.8)
Monthly pocket money (Kshs) Mean (SD)	2533.27 (±1741)	
Guardian's marital status		
Married	203	(69.3)
Divorced	1	(0.3)
Single	84	(28.7)
Separated	4	(1.4)
Widow	1	(0.3)
Occupation of the guardian		
Permanent formal employment	104	(35.5)
Contract employment	42	(14.3)
Casual labourer	46	(15.7)
Unemployment	101	(34.5)
Education level of the guardian		
Primary	32	(10.9)
Secondary	93	(31.7)
University/ College	150	(51.2)
Never attended school	18	(6.2)

Eating Habits among KMTC Nutrition Students

Generally, the findings clearly show that there was a high consumption of starches, and the adequacy and variety diet principles were not observed. Water and fruit juices were also consumed with meals. Larger portion sizes were consumed for the

starches, and respondents would take snacks such as fruit salads or fruit juices in place of the main meals.

Timing of Snacks

While 23.5% of the respondents consumed the afternoon snack about twice weekly, 28.1% never consumed the snack. One the same note, 26.0% of the respondents took the mid-morning snack about twice weekly whereas 21.5% never took the snack (Table 3).

Table 3: **Timing of snacks among nutrition students**

Characteristics	**Weekly Food Consumptions Habits (N= 293)**					
	Always (≥once daily) n (%)	**Often (5-6 times weekly n (%)**	**Sometimes (3-4 times weekly n (%)**	**Rarely (Twice weekly) n (%)**	**Once n (%)**	**No n (%)**
Frequency of mid-morning snack in a week	30(10.2)	33(11.3)	46(15.6)	76(26.0)	45(15.4)	63(21.5)
Frequency of afternoon snack in a week	29(9.9)	18(6.1)	37(12.6)	69(23.5)	58(19.8)	82(28.1)

Type of snacks and frequency of consumption

Table 4 indicates the type of snacks and frequency of consuming them. Less than a half of the respondents (43.3%) rarely consumed commercial juice as a snack. However, 10.9% regularly consumed the commercial juice 3-4 times a week. While 31.7% of the respondents never snacked on chips, 5.1% consumed the chips 3-4 times a week. Nearly half of the participants (52.6%, 48.8%, and 49.5%) rarely snacked on chocolate, doughnuts/ locally deep-fried dough snacks, and popcorns respectively. However, these food items were consumed as snacks by a considerable proportion of the respondents, as many as 3-4 times a week by 5.4%, 10.2% and 7.8% respectively. Nonetheless, this was contrary to fruit consumptions where only 21.2% and 37.2%, consumed them as a snack 3-4 times a week and daily respectively (Table 4).

Consumption of fast foods, fruits and vegetables

Table 5 presents the consumption of fast food, fruits and vegetables among the study respondents. About a third (32.4%) of the respondents reported consumption of fast foods twice weekly. A few (17.4%) consumed the fast food more than once daily while only 6.1% never consumed. Slightly over a third of the respondents (34.2%) consumed fruits and vegetables 3-4 times weekly. Slightly over a quarter (26.6%) both consumed the fruits and vegetables more than once daily and 5-6 times weekly. Fruits and vegetables were consumed 3-4 times as a snack by about a quarter (25.3%) of the respondents in a week. Less than a quarter (23.2%) of the respondents had consumed more than one kind of vegetable 3-4 times in 7 days. A quarter (25%) of the respondents consumed more than a single kind of fruit more than once daily, while 24.2% had consumed 3-4 times a week (Table 5).

Table 4: **Frequency of consumption of particular snacks**

N= 293	**Never/rarely n (%)**	**1-2 times per week n (%)**	**3-4 times/ week n (%)**	**5-6 / week n (%)**	**Once Daily n (%)**	**2-3 times/ day n (%)**	**5 times+ per day n (%)**
Commercial juices/ soft drinks (such as quencher, *afia, delmonte,* minute maid, tree top)	127(43.3)	34(11.6)	32(10.9)	15(5.1)	13(4.4)	7(2.4)	9(3.2)
Chips	93(31.7)	61(20.9)	15(5.1)	9(3.1)	4(1.4)	3(1.1)	9(3.2)
Chocolate	154(52.6)	31(10.5)	16(5.4)	9(3.1)	9(3.1)	5(1.7)	7(2.4)
Sausages/ smokies	101(34.5)	64(21.7)	19(6.5)	17(5.8)	15(5.1)	11(3.8)	4(1.4)
Doughnuts/ KDF (locally deep-fried dough snacks)	143(48.8)	47(16.1)	30(10.2)	10(3.4)	23(7.9)	3(1.0)	6(2.0)
Sweets	122(41.6)	43(14.7)	25(8.5)	22(7.6)	29(9.9)	5(1.7)	5(1.7)
Popcorns	145(49.5)	27(9.2)	23(7.8)	13(4.4)	10(3.5)	7(2.4)	7(2.4)
Cakes	83(28.3)	57(19.5)	42(14.3)	15(5.1)	16(5.5)	8(2.7)	9(3.1)
Fruits	14(4.8)	33(11.3)	62(21.2)	42(14.3)	109(37.2)	6(2.0)	9(3.1)

Table 5: **Fast Food, Fruits and Vegetable Consumption habit**

Characteristics	**Weekly Food Consumptions Habits (N= 293)**					
	Always (≥once daily) n (%)	**Often (5-6 times weekly n (%)**	**Sometimes (3-4 times weekly n (%)**	**Rarely (twice weekly) n (%)**	**Once n (%)**	**No n (%)**
Weekly consumption of fast foods	51(17.4)	21(7.2)	26(8.9)	95(32.4)	82(28)	18(6.1)
Weekly consumption of fruits and vegetables	78(26.6)	78(26.6)	100(34.2)	21(7.2)	8(2.7)	8(2.7)
Weekly consumption of fruits or vegetables as snack	61(20.8)	47(16)	74(25.3)	47(16)	35(12)	29(9.9)
Weekly consumption of more than one kind of vegetable	44(15)	41(14)	68(23.2)	52(17.7)	32(11)	56(19.1)
Weekly consumption of more than one kind of fruit	73(25)	42(14.3)	71(24.2)	52(17.7)	33(11.3)	22(7.5)

Individual factors associated with eating habits among KMTC students

Nutrition knowledge of nutrition students

Nutrition knowledge of the students based on healthy eating guidelines was assessed. Table 6 presents the knowledge scores based on the proportion of the respondents who gave the correct answers for every question. Low scores (<50%) were also noted on consequences of unhealthy dietary habits among adolescents and recommended physical activity guidelines. However, the highest score was observed on sources of high biological value proteins (96.9%). Majority (>80%) of the students were knowledgeable on the percentage contribution of fat/oils to total energy needs in young adults, nutrition and health conditions associated with diets rich in sugar and fats, and tools for successful meal planning as highlighted (Table 6).

***Table 6*: Nutrition knowledge of KMTC students**

S/No.	Aspects of knowledge	% of respondents with correct answers per question
1	High biological value protein	96.9
2	Source of recommended healthy fats/oils	55.3
3	% contribution of fat/oils to total energy needs in young adults	84.3
4	Unhealthy type of fat	65.2
5	Recommended amount of water intake per day	59.7
6	Nutrition and health conditions associated with diets rich in sugar and fats	80.9
7	Recommended servings of animal proteins, fruits and vegetables from the food guide pyramid	67.2
8	Tools for successful meal planning	90.4
9	Basic diet planning principles	82.9
10	Consequences of unhealthy dietary habits among adolescents	42.7
11	Recommended dietary practices for the prevention of overweight and obesity	52.9
12	Recommended physical activity guidelines	46.1
13	Dietary habits helpful in the prevention of overweight	56.7
14	Coping with food shortage in college	78.8
15	Reason why fast foods and soft drinks are considered unhealthy	72.7

The overall knowledge score was the total correct responses per a respondent, expressed as a percentage. Majority of the respondents (57.7%) possessed moderate knowledge levels (low ≤40 %, moderate 41–69 %, and high ≥70 % knowledge (Kigaru et al*.,* 2015) (Table 7).

***Table 7:* Nutrition Students' Knowledge by Categories**

Level of knowledge	Frequency (N= 293)	Percent
Low (less than 40%)	32	10.9
Moderate (41 – 69%)	169	57.7
High score (> 70%)	92	31.4

Economic Food Access

The institution never permitted cooking in the students' hostels, leaving the respondents with the options of either purchasing food from kiosks outside the campus, or eating at the college cafeteria. Students had the sole responsibility of making food choices. The cost of food at the college cafeteria was high. Moreover, the portions were small and lacked variety. Lack of variety in foods was attributed to finances, seasonality of some foods such as

vegetables, time spent waiting to be served (as much as one hour), long distances to kiosks, and other times, later comers never got food. One respondent noted that consuming healthy food was a big challenge due to inadequate funds. Another respondent indicated that food choice was highly dependent on the purchasing power. the pocket money reported in the FGD ranged between Kshs. 200 to 9500. This indicates that some students never had adequate money to enable them engage in proper eating habits. Nonetheless, even some respondents with adequate money never engaged in healthy eating habits. This indicates that possessing nutrition knowledge does not always translate to optimal nutrition habits. Acquiring nutritious foods was also highly dependent on one's finances and choice.

The Nutrition Status of KMTC Nutrition Students

A majority of the participants (65.8%) had a normal BMI. However, 20.5% were overweight, 5.5% obesity I and 2.0% obesity II. 1.7% of the students had severe malnutrition. Male students had higher levels of severe and mild malnutrition, both at 8.5%, compared to females who had 0% and 1.8% respectively. However, levels of moderate malnutrition (1.8%), obesity I (6.8%) and obesity II (2.7%) were higher among female students (Table 8).

Table 8: **Nutrition Status Based on BMI and Gender**

	TOTAL N= 293		**Female**		**Male**	
	Frequency	**%**	**Frequency N=222**	**%**	**Frequency N=71**	**%**
Severe underweight (BMI <16)	5	1.7	0	0.00	6	8.5
Moderate underweight (BMI 16-16.9)	4	1.4	4	1.8	0	0.00
Mild underweight (18.5- 24.9)	9	3.1	4	1.8	6	8.5
Normal (25- 29.9)	193	65.8	146	65.7	42	59.2
Overweight (>/equal 30)	60	20.5	47	21.2	15	21.1
Obese 1 (30- 34.9)	16	5.5	15	6.8	2	2.7
Obese 2 (35- 39.9)	6	2.0	6	2.7	0	0.00
Obese 3 (>40)	0	0	0	0	0	0

***WHO (2000) BMI classification**

Physical Activity

The majority of the respondents (46.1%), their work entailed of moderate-intense activities that lead to small increases in the heart rate (Table 20). Slightly less than a third of the respondents engaged in vigorous-intensity activities that leads to huge increases in the heart rate (26.3%) and low- intensity activities (27.5%). Therefore, 27.5 % of the participants led a sedentary lifestyle, therefore at risk of chronic diseases. Nonetheless, 53.2% used a bicycle or walk for a continuous ten minutes, at least, to get to or from places. However, majority (59.7%) never engaged in vigorous-intensity fitness, sports, or leisure activities that led to huge increases in the heart rate for at least ten minutes (Table 9).

Table 9: **Physical activity levels among nutrition students**

	%
High physical Activity	77 (26.3)
Moderate physical activity level	135 (46.1)
Low physical activity level	81 (27.5)
Use of a bicycle or walking for a continuous ten minutes	156 (53.2)
Engagement in any vigorous- intensity fitness, sports, or leisure activities	118 (40.3)

Relationship between individual factors, eating habits and BMI

Association between individual factors and nutrition status

A positive correlation was observed between BMI and the present employment status of the parents (x^2=30.364, p=0.034), where being employed was associated with better nutrition status (Table 10). A significant association was also observed between gender and BMI (p=0.001). No association was established between BMI and age, and the marital status (p=< 0.001). The current study established a positive correlation between the BMI of nutrition students and the reasons quoted for skipping meals (p=0.009). There was also a positive correlation between nutrition knowledge and BMI (p=0.001).

Table 10: **Association between nutrition status and students' individual factors**

Associations between	Chi-square Value (χ^2)	df	p-value (Chi-square)
Gender and BMI	23.606	6	0.001
Marital status and BMI	278.128	24	< 0.001
Present employment status of guardian and BMI	30.364	18	0.034
Age and BMI	105.089	60	< 0.001
Reasons for skipping a meal and BMI	43.192	24	0.009
Skipped breakfast in the last 24 hours and BMI	3.260a	6	0.775639
Nutrition knowledge and BMI	33.768	12	0.001
Dietary diversity and BMI	6.776	10	0.746

***BMI= Body Mass Index**

Association between nutrition status and physical activity levels

There was positive correlation between the physical activity and BMI (x^2=25.198, df=12, p=0.014) (Table 11). There was a significant relationship between the BMI and moderate intense fitness (p=0.001).

Table 11: **Association between nutrition status and physical activity levels**

Variables	Chi-square Value (χ^2)	p-value
Associations between BMI and use of a bicycle or walking for a continuous ten minutes, at least, to get to or from places	25.198	0.014
Associations between BMI and engagement in any moderate- intensity fitness, sports, or leisure activities which cause a small increase in heart rate for at least ten minutes	72.604	0.001
	r	**p-value**
Associations between BMI and number of days one engages in moderate -intense activities in an ordinary week	-0.126	0.035
Associations between BMI and the total amount of time spent sitting or travelling [exclude sleeping] in a typical day	-0.142	0.018

***BMI= Body Mass Index**

Relationship between nutrition knowledge and eating habits

A simple linear regression was used to assess whether nutrition knowledge significantly predicted the eating habits of the study participants (dietary diversity, consumption of water, and weekly fast-food consumption). The results of regression suggested that nutrition knowledge explained 1.6% of the variance (R^2 = 0.016, F (1,291) = 4.6975, p = 0.031). This means nutrition knowledge significantly influenced the food habits (β = - 0.008, t = 2.167, p = 0.031). The study showed that when the level of knowledge increased by one unit, there was a reduction by 0.008 in bad/poor food habits.

A binary logistics regression established an association between nutrition knowledge and some selected food habits. Respondents who were more knowledgeable were 26.5% (AOR = 0.265, p = 0.006), and were more likely to be adequately rehydrated compared to those with less knowledge (Table 12).

Table 12: **Relationship between nutrition knowledge and eating habits**

Factor	**Characteristics**	**N=293**	**P****	**N=293**	
Nutrition knowledge vs		**COR (CI)***		**AOR (CI)*****	**P-value**
Frequency of fast-food consumption	None Ref.		0.231		0.4
	Once	0.247 (0.026 - 2.306)	0.22	0.284(0.033 - 2.451)	0.252
	Rarely (twice weekly)	0.783(0.076 - 8.078)	0.837	0.899(0.091 - 8.868)	0.927
	Sometimes (4-3 times weekly	0.208(0.018 - 8.078)	0.207	0.263(0.025 - 2.789)	0.267
	Often (5- 6 times weekly	0.683(0.034 - 13.648)	0.803	0.757(0.04 - 14.306)	0.853
	Almost always (greater than once daily)	1.382(0.072 - 26.521)	0.83	0.488(0.049 - 4.907)	0.543
Hydrated as recommended	Yes, adequate	4.626(1.602 - 13.36)	0.005	0.265(0.103 - 0.68)	0.006
	Yes	0.574(0.201 - 1.643)	0.301	0.532(0.209 - 1.354)	0.185
Dietary diversity	< 4 food groups			0.757(0.04 - 14.306)	0.853
	>/ equal 4 food groups		0.998	0.899(0.091 - 8.868)	0.998

COR [CI]*: acronym for the crude odds ratio and the confidence intervals
**** p = p-value: p < 0.05 significance level**
*****AOR [CI] =adjusted odds ratio with the confidence intervals. Adjustments were made for the employment status of parents, amount of pocket money, gender and age**

Relationship between nutrition knowledge and nutrition status (BMI)

Nutrition status was regressed on predicting variable nutrition knowledge. A binary logistics regression did not establish an association between the nutrition knowledge and nutrition status of the study participant (Table 13). Nutrition knowledge was not a significant predictor of nutrition status.

Table 13: **Relationship between nutrition knowledge vs nutrition status**

Characteristics	**N=293**	**P****	**N=293**	**P**
	COR (CI)*		**AOR (CI)*****	
Nutrition Knowledge Vs BMI				
Low (less than 40%) REF.		0.79		0.530
Moderate (41 - 69%)	0.645(0.053 - 7.866)	0.731	1.385(0.151 - 12.715)	0.774
A high score (greater than 70)	0.796(0.064 - 9.865)	0.859	1.891(0.201 - 17.769)	0.577

COR [CI]*: acronym for the crude odds ratio and the confidence intervals
**** p = p-value: p < 0.05 significance level**
*****AOR [CI] =adjusted odds ratio with the confidence intervals. Adjustments were made for food habits, gender and physical activities**

Relationship between eating habits and nutrition status

Significant statistical associations were established between the nutrition status and consumption of fast food and consumption of snacks (Table 14).

Table 14: **Relationship between eating habits and nutrition status**

Characteristics	**N=293**	**P value**
	AOR (CI)***	
Nutrition status (BMI) vs fast food consumption	1.382(0.072 - 26.521)	0.001
BMI vs Consumption of snacks	9.563(0.972 – 3.079)	0.032

COR [CI]*: acronym for the crude odds ratio and the confidence intervals
**** p = p-value: p < 0.05 significance level**
*****AOR [CI] =adjusted odds ratio with the confidence intervals. Adjustments were made for gender and physical activities**

DISCUSSION

Socio-Demographic and Socio-Economic Characteristics of KMTC Nutrition Students

The mean age of the respondents was 22.7 (±2) years, with the majority (62.5%) being between 22- 25 years. This conquers with the findings of Ndung'u, Waudo and Kobia (2024) who reported that college-age students were aged between 18 and 29 years. More females (76%) pursued the Nutrition and Dietetics diploma course compared to males, which was similar to findings by Annamalai and Gopichandran (2022). Socio-economic characteristics such as guardian's marital status, present employment status, and education level had an association with the eating habits of college students, since they influenced the amount of pocket money sent to a student. This agrees with Hoque, Hoque and Thanabalan (2018) who noted that the incomes of parents had a significant association with healthy eating habits among students.

Eating Habits of Nutrition Students

Majority of the students do not meet the recommended healthy eating habits according to the Kenyan guidelines for healthy diets (2017). This was confirmed in the current study, where main meals among students constituted of *ugali* kales, rice beans/green grams, *chapati* beans/ green grams, rice carrot peas and *ugali* cabbage. Moreover, the students' food choices were greatly determined by the purchasing power. Based on the findings of our study, the students' meals did not reflect the 'My Plate Model', as starches constituted the larger portion of their diets. In the current study, variety and adequacy principles were ignored. A majority of the respondents consumed water or fruit juice during or immediately after meals, and fruit salads/ juices were often consumed in place of the main meals. Similarly, Almoraie et al. (2024), in a study among university students established that 96.33% of the students in first year exhibited suboptimal feeding habits. Other studies also established similar findings, where college students consumed fewer whole grains (Awoke et al., 2022), vegetables and fruits daily, and reported higher high-calorie, high fat foods' intake (Kriaucioniene, et al., 2021; Ferrara et al., 2022; Almansour, Allafi & Al-Haifi, 2020). This indicates the need for college institutions to offer an environment where the healthy eating guidelines can be attained.

The Frequency of Snacking among Nutrition Students

In the current study, artificial juice and chips were consumed over five times in a day by 3.2% of the respondents. Carbonated drinks, chocolate, sausages/ smokies, doughnuts/ KDF, sweets, popcorn and cakes were consumed as snacks by a considerable proportion of the respondents, as many as more than five times daily. Similar findings were reported by Almasi and Rakicioglu (2021) who established that college students exceed maximum level intakes suggested for trans and saturated fats, refined sugars, and sodium through energy-dense snacks' over- consumption. Fruits were consumed by only 37.2% of the respondents as a snack on a daily basis.

Snacking, Fast Food and Soft Drinks, Fruits and Vegetable Consumption habits

In the current study, about a third (32.4%) of the respondents reported consumption of fast food twice weekly. Nearly a fifth (17.4%) of the respondents consumed fast foods more than once daily. For the soft drinks, only 17.4% of the respondents declined consumption. About a third 34.2% of the respondents consumed fruits and vegetables 3-4 times weekly, while 26.6% consumed them more than once daily and 5-6 times weekly. While 23.5% of the respondents consumed the 4 PM snack about twice weekly, 28.1% reported never to consume the 4 PM snack. Similarly, 26.0% of the respondents took the 10 AM snack about twice weekly whereas 21.5% never took the snack. This implies that

majority of the college students did not value the importance of snacking in their diets. About a third of the respondents (34.2%) consumed fruits and vegetables 3-4 times a week. This implies to the majority, fruits and vegetables were not consumed regularly. Variety in the consumption of fruits and vegetables was also limited. Less than a quarter (23.2%) of the respondents had consumed more than one kind of vegetable 3-4 times in 7 days. A quarter (25%) of the respondents consumed more than a single kind of fruit more than once daily. Tiwari, Singh and Chaudhary (2023) established that personal preferences for fast food and vending machine snacks are identified as barriers to healthy eating among adolescents.

Nutrition Knowledge of KMTC Nutrition Students

The current findings established that a majority of the respondents (57.7%) possessed moderate knowledge levels. Knowledge scores, are likely to favour healthy eating habits. Therefore, considering the moderate knowledge levels observed, suboptimal eating habits were expected from the respondents. Considering the upsurge in alternative nutrition information sources such as peer interactions (Maunder, 2018) and advertising mass media (Mogeni & Ouma, 2022), emphasis needs to be laid to ensure college students acquire and possess accurate nutrition information. Akujobi (2022) further noted that nutrition knowledge plays a very crucial role in promoting positive attitudes that ultimately influence the dietary habits. According to Coman et al. (2024), raising the levels of accurate nutritional knowledge can help in reducing the burden of lifestyle conditions among young adults. Therefore, the connection between accurate nutritional knowledge, positive attitudes, eating habits, and chronic lifestyle conditions should not be ignored by college institutions. However, other factors that influence the eating habits needs to be understood and addressed since Akujobi (2022) noted that nutrition knowledge does not consistently translate to appropriate dietary practices among students in university colleges.

Nutritional Status of KMTC Nutrition Students

Majority of the respondents (65.8%) had a normal BMI, followed by overweight at 20.5%. There was a 1.7% severe malnutrition, 5.5% obesity I and 2.0% obesity II. The statistics from this study compare closely with by Ndung'u, Waudo and Kobia (2024), who established 24.1% of obesity and overweight. The prevalence of overweight from the current study also compares closely to the 16.5% prevalence by Ndung'u, Waudo and Kobia (2024) among students from KU. However, while the current study established a 7.5% of obesity, which compares closely to the 7.6% of prevalence documented by Ndung'u, Waudo and Kobia (2024), Rotich et al. (2023) reported a 19.7% prevalence of general obesity.

The male students had higher levels of severe and mild malnutrition (8.5%) compared to the females. These findings agree to the results by Ndung'u, Waudo and Kobia (2024) who reported a higher underweight prevalence (57.1%) among the males. There was a higher prevalence of moderate malnutrition (1.8%), overweight (21.2%), obesity I (6.8%) and obesity II (2.7%) among female students. These findings agree to those of Ndung'u, Waudo and Kobia (2024), who reported that female adolescents from KU had higher obesity (63.2%) and overweight (73.2%). Based on the current research, while males were more likely to suffer from undernutrition, females were more predisposed to overnutrition. This is also similar to the findings by Awoke et al. (2022) among 1st and 2nd year students in food, nutrition, and exercise in Virginia, who established that women had significantly higher body fatness compared to the males. Therefore, the nutrition students suffer from under- and over-nutrition, despite possessing nutrition

knowledge. There is a direct relationship between poor dietary habits and BMI.

Physical Activity among the Nutrition Students

In the current study, exercise levels were quite limited among the participants, and majorly a sedentary lifestyle. Slightly less than three- quarters (73.7%) and about a half (53.9%) of the participants never engaged in vigorous- and moderate- intense activities respectively. Physical activity influences the nutrition status and health condition (Person & Flodmark, 2017), and therefore needs to be promoted in college institutions. In college, study-related activities hinder engagement in physical activity. Absence of physical activity promote poor health records that lead to premature death, obesity, and coronary heart disease (The World Counts, 2024).

Relationship Between Individual Factors, Eating Habits and Weight Status of the Nutrition Students

A relationship was observed between nutrition status and physical activity (p=0.014). There was a significant relationship between the BMI and moderate intense fitness (p=0.001), whereas one increased the other decreased. Therefore, weight decreased with physical activity and increase in the time used for travelling. Moreover, spending more time on exercise led to a smaller BMI. This indicated that physical activity promoted the acceptable nutrition status. Nutrition knowledge significantly influenced the food habits, which was also pointed out by Waweru (2020), and it also significantly predicted the nutrition status of the study respondents (p=0.022). Some of the respondents with nutrition knowledge could have a low nutrition status, just as those without nutrition knowledge. The attitude possessed by the nutrition students, which was not assessed in this study, can influence the nutrition knowledge. This indicates that in addition to nutrition knowledge, there is a wide range of other factors that can influence the nutrition status. Many factors also affect the eating habits, including the nutritional goals and objectives.

Respondents with more knowledge were more likely to engage in the recommended eating habits compared to their counterparts (AOR = 0.265, p = 0.006). A binary logistics regression did not establish an association between the nutrition knowledge and nutrition status of the study participant. This indicates that nutrition status was determined by a myriad of factors, in addition to nutrition knowledge.

CONCLUSION

The socioeconomic and socio-demographic characteristics of the guardians were key determinants of the college students' meals. Parents played a crucial role to college students through sending pocket money for purchasing food. The current employment status of a parent was related to the respondents' nutrition status.

The nutrition students from KMTC campuses portrayed poor eating habits including taking water and fruit juices during/ immediately after meals, taking fruit salads/ juices in place of main meals, and over-consumption of high energy- dense and fast foods.

Majority of the nutrition students did not possess high levels of accurate nutrition knowledge, which is highly recommendable, since it can greatly be linked to the eating habits. Nutrition knowledge did not have a significant association with the nutrition status, since other factors, such as physical activity, are likely to influence the nutrition status, despite the nutrition knowledge levels possessed. This was despite the fact that nutrition knowledge had a significant impact on the eating habits.

Based on the findings of the current study, 8 in every 29 KMTC college students were overweight and obese. Despite possessing nutrition knowledge, some nutrition students at KMTC were either overweight or underweight. While the males were majorly underweight, the females were

mainly overweight. With the limited physical activity levels and a sedentary lifestyle, the participants were at risk of chronic conditions.

There was a significant relationship between the nutrition status and eating habits. Students who engaged in inappropriate eating habits were likely to be overweight and obese. PAL (Physical Activity Level) were significantly associated with the nutrition status. Active physical activity promotes an acceptable nutrition status. Having pocket money can boost the nutrition status of a college student, but can also lead to obesity. Even though possessing nutrition knowledge leads to recommendable eating habits, it might not predict the nutrition status, which is impacted upon by different factors. This still indicates that the eating habit of college nutrition students is determined by varying factors.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: None

Source of Funding: None

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

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How to cite this article: Bridget Nduta Mwaniki, Sophie Ochola, Juliana Kiio. Gap analysis: nutrition knowledge assessment and practical application evaluations among college nutrition students at a middle-level institution, Kenya. *Int J Health Sci Res.* 2025; 15(9):246-263. DOI: *https://doi.org/10.52403/ijhsr.20250929*

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