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*Original Article*

# Relationship Between Dietary Intake, Physical Activity and Nutritional Status of Adolescent Girls Attending Junior High School in Sagnarigu Municipality, Tamale, Ghana

Shadrach Abuliko A-obiliya*[1], Portia Maanu Anao[1], Dorzie K. John Baptist[2]

1-Department of Nutritional Sciences, School of Allied Health Sciences, University for Development Studies, Tamale, Ghana, P O Box TL 1883, Tamale, Ghana

2-Department of Environmental Health Sciences, School of Public Health Sciences, University for Development Studies, Tamale, Ghana, P O Box TL 1883, Tamale, Ghana

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## ABSTRACT

**Background and Objectives:** The prevalence of overweight and obesity among adolescent girls has become a major public health concern worldwide. Several factors serve as predictors of overweight: eating habits, dietary intake, and physical activity. However, the complex relationship between diet, physical activity, and nutritional status in these adolescent girls remains poorly understood.

**Materials and Methods:** A cross-sectional study was conducted among a representative sample of adolescent girls between the ages of 13 to 19 years in the Sagnarigu Municipal. Data on dietary intake, physical activity, and nutritional status were collected using structured questionnaires and anthropometric measurements.

**Results:** Physical activity and dietary intake were significantly associated with BMI for age (wasted, overweight, obese). However, the Dietary Diversity Score (DDS) had no significant relationship with BMI for age.

**Conclusions:** The results suggest that the physical activity and dietary intake of the participants were significantly associated with the nutritional status of the girls. Intervention research aimed at improving school-aged adolescent girls' nutritional status should also be implemented; policies to improve the school environment and encourage students to make healthy food choices should be enforced.

**Keywords:** Nutritional Status, Dietary Intake, Physical Activity, Adolescent girls

## Highlights

- A cross-sectional study was conducted among 397 adolescent girls aged 13–19 years in the Sagnarigu Municipality of Tamale, Ghana to assess their dietary intake, physical activity, and nutritional status.
- The prevalence of Overweight and obesity among the adolescent girls were 12.1% and 4.5%, respectively.
- About 50.6% of the adolescent girls were classified as physically inactive, while 49.4% were considered physically active.
- Significant associations were found between physical activity and BMI-for-age ($\chi^2 = 24.865$, $p = 0.003$), as well as between meal frequency and BMI-for-age ($\chi^2 = 20.156$, $p = 0.003$).
- The mean Dietary Diversity Score (DDS) was 6.2 ± 1.4; however, this showed no significant relationship with BMI-for-age ($p = 0.097$).

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***Address for correspondence:** Shadrach Abuliko A-obiliya, Department of Nutritional Sciences, School of Allied Health Sciences, University for Development Studies, Tamale, Ghana, P O Box TL 1883, Tamale, Ghana. E-mail address: natshay10@gmail.com

## Introduction

The prevalence of overweight and obesity among adolescent girls has become a major public health concern worldwide. In recent years, rapid urbanization and lifestyle changes have led to shifts in dietary habits and physical activity levels, contributing to the rising rates of obesity in this population (23). Understanding the complex relationship between diet, physical activity, and nutritional status is crucial for developing effective strategies to address this growing public health issue.

A total of more than 1.9 billion adults are overweight (39% males and 40% females), while 650 million people (13%) are obese. The prevalence of overweight and obesity among children and adolescents between the ages of 5 and 19 increased drastically from 4% in 1975 to 18% in 2016 (39). Overweight and obesity are the fifth biggest contributing factors to deaths worldwide, accounting for almost 3.4 billion deaths each year (33).

According to (26), 17% of adolescents in Greater Accra were not physically active, with 11.7% being obese. Female students were 15.6% more prone to be diagnosed with obesity compared to their male counterparts (4.5%). Adolescents who took part in greater levels of exercise had a lower risk of obesity compared to those who indulged in less physical activity.

The results of (25) showed that 32.2% of adolescents in the Tamale Metropolis were physically inactive. This was supported by (9), who found that the prevalence of obesity in adolescent girls in the Tamale Metropolis was 6%. Obesity and physical inactivity were shown to be more common in adolescent girls than in boys, according to their research.

Several factors serve as predictors of overweight: eating habits, dietary intake, and physical activity. Obesity is caused by an imbalance between calories taken and energy spent, consuming calorie-dense foods and drinks (rich in sugar as well as fat), and engaging in insufficient physical activity. The transition from communicable to non-infectious illnesses is caused by growth in the economy, which includes increasing the availability of food, the number of snacks sold by street vendors, and a lack of physical activity (32).

In general, adolescents like consuming snacks compared to home-cooked meals. Changes in dietary intake and physical activity result in an increase in nutritional disorders (30). Physical activity level declines in homes as well as schools, and poor food habits, excessive snacking, and diverse types of eating have proliferated. Nutrition, fast food intake, education level, gender, offspring, and levels of exercise all contribute to obesity in children (12, 16). Excessive consumption of oil and fried foods elevates the risk of obesity (36, 5, 29). Fats and oils supply the most calories compared to other nutrients. Oil consumption of more than 30 ml per day is associated with obesity in adults in urban areas (38).

Engaging in physical activity will increase the amount of energy expended as a result of consuming patterns. According to several studies, physical activity is a preventive mechanism for obesity. Obesity risks are heightened by a lack of physical activity (6, 38). Sedentary behavior is defined as laziness or lack of mobility (8). Sedentary behavior involves watching television. Obesity risk increases with prolonged watching of television (31,14,7). The risk of obesity is increased when adolescents watch television for more than two hours per day. Adolescents who viewed 1.0 hours of television every day had a higher incidence of obesity (129%) and central obesity (78%) than those who did not (42).

Furthermore, there has been a surge in the number of obese adolescents being diagnosed with typical adult diseases that include type 2 diabetes and high blood pressure. Obese youth are additionally more likely to develop significant health problems later in life, such as heart disease, stroke, diabetes, asthma, and several malignancies. Overweight and obesity in young people and adolescents have been linked to adult morbidity and mortality (21, 22).

More diet-related issues among children and adolescents can lead to an increase in the prevalence of type 2 diabetes mellitus (DM). Obesity in adults is also dangerous since it can lead to problems with glucose metabolism and chronic illnesses like as coronary artery disease, and artery blockage, among others (28, 37, 41). Although the influence of dietary patterns on achieving good nutrition and decreasing malnutrition among adolescents is well understood, little research has examined the impact of dietary patterns and physical activity on the achievement of good nutrition and reducing malnutrition. As a result, determining the impact of food choices and physical activity on nutritional status in adolescent girls is critical.

## Materials and Methods

### Study Design and Participants

This study employed a descriptive cross-sectional design. The study included 397 adolescent girls aged 13 to 19, who lived in and attended Junior High Schools. The study was approved by the University for Development Studies, Tamale, Department of Nutritional Sciences, School of Allied Health Sciences.

The necessary permissions were sought and successfully acquired from both the school authorities and the regional and municipal offices of the Ghana Education Service. Written letters were utilized to obtain informed consent from the student's parents or guardians. Before commencing the data collection process, all prescribed procedures were explained to the parents during the Parents

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Teachers Association Meeting. Using the Cochran formula, a sample size of 384 was determined with a 50% response rate, a 95 percent confidence interval, and a 5 percent margin of error. A total of 5 Junior High Schools were chosen randomly from the list of all the basic schools in the Sagnarigu Municipal. Although the initial plan was to recruit 79 schoolgirls aged 13 to 19 from each of the 5 schools, the actual enrolment varied due to the number of eligible girls at each school. Ultimately, the final sample size of the study was 397, based on the availability of the recruited adolescent girls in the school on the day of enrolment and the fact that some schools had less than 79 adolescent girls between the ages of 13-19, and some had more than that. The study only included adolescent girls of school age who volunteered to participate and appeared to be in good health. Adolescent girls with any physical disabilities, as well as those above aged 19 and under 13, were excluded from the study.

**Data Collection**

The data collection was done by researchers and trained field assistants between July 2021 and September 2021. The data on dietary intake were collected using the standardized, updated Food and Agriculture Organization (10) questionnaire. The physical activity data were collected using the physical activity questionnaire developed by the University of Canada (18). A semi-structured questionnaire specially designed on software known as Kobocollect was formulated to capture the many individual variables of the study.

This questionnaire was structured into four main sections. Section A focused on sociodemographic characteristics, Section B covered anthropometric measures, Section C delved into dietary intake, and Section D captured details about physical activity and its duration.

To ensure the questionnaire's accuracy and effectiveness, a pre-test was conducted at a Junior High School in the same vicinity as the target schools, under similar conditions. This pre-test aimed to identify and rectify any issues related to factors such as time management and question comprehension. Based on the pre-test results, the questionnaire underwent modifications.

The actual data collection process took place in five schools over the course of a month. Before the data collection, research assistants received comprehensive training on the study's objectives and data collection techniques. Throughout the data collection period, the principal researcher and three research assistants supervised the process. Daily checks were performed on the questions to ensure they were complete, consistent, and easily understandable.

**Anthropometric measures**

Anthropometric measurements of weight and height were measured without shoes and with light clothing by trained personnel. Weight was measured to the nearest 0.1kg using a UNICEF electronic scale manufactured by Seca. Height was measured using a wall-mounted microtoise and recorded to the nearest 0.5cm. Two measurements were taken at 0.1kg intervals, and the average was used to calculate the adolescent's actual weight. The BMI was calculated by dividing weight by height squared. The participants' BMI-for-age z scores were calculated using the WHO AnthroPlus (WHO, 2006) software designed to calculate z scores.

**Dietary intake: 24-hour recall and FFQ**

A dietary assessment was conducted to establish the nutritional status of adolescent girls. This allowed their food consumption pattern and food variety to be assessed via a 24-hour recall and Food Frequency Questionnaire (FFQ) because the measurement tools are the most effective indicators of dietary intake.

A structured 24-hour recall template was used. Food patterns and composition could be assessed by employing a 24-hour recall, which requires participants to describe in detail what food was consumed over 24 hours; the time frame, and where the food was eaten. The girls were asked to recall everything, including beverages and snacks.

A food frequency questionnaire (FFQ) was designed to assess the dietary habits of the participants. The study adopted the (10) FFQ questionnaire, which provides nine nutrient-based food categories. Participants were asked to report how often they consumed each listed food item on a weekly basis. The foods were categorized into seven groups: cereals, roots, and tubers (such as rice, maize, yam, cocoyam, and plantain), dairy products (including yogurt, ice cream, evaporated milk, condensed milk, and cheese), legumes and nuts (like beans and soybeans), vitamin A-rich fruits and vegetables (such as mangoes, oranges, pawpaw, carrots, lettuce, and bananas), flesh foods (including sardines, sausages, beef, pork, chicken, and goat meat), egg products, and fats and oils (like palm oil, margarine, butter, and chocolate). Participants indicated how often they consumed each food item per week.

Due to the absence of standardized portion sizes in Ghana, the quantities of food consumed were not included in the analysis. Instead, scores reflecting the frequency of consumption were calculated for each food item within a group. These scores were then used to determine the average weekly frequency of consumption for each food group. A consumption frequency of 6-10 times per week was considered high, while 1-5 times per week was considered low intake.

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### Physical Activity Level

The physical activity levels of the respondents were assessed using the physical activity questionnaire for adolescents developed by the University of Canada (18). The physical activity questionnaire is used to identify what physical activities are done by school-going adolescents and how much time is dedicated to the activities. The selected physical activity was presented on a 4-point Likert scale, allowing for the creation of a composite score that was used as a measure of activity.

The physical activities were categorized into two groups: low activities and high activities. The frequency of activity was divided into four ranges: 1-2 times, 3-4 times, 5-6 times, and 7 or more times per week. The duration of physical activity was classified as ≤ 40 minutes, 60-120 minutes, 180-240 minutes, and ≤ 300-360 minutes per day.

A participant was considered highly active if they fell into any of the following categories: engaging in vigorous-intensity activity for at least 3 days, accumulating a minimum of 90 minutes, or participating in walking, moderate, or vigorous activities for a total of at least 330 minutes over 7 or more days per week.

On the other hand, a participant was categorized as lowly active if their reported activity level was below the thresholds mentioned above or if they reported no physical activity at all.

### Data Analysis

The Statistical Package for Social Sciences (SPSS) software (IBM Inc.) version 21 was used to analyze the data. Information for categorical data was expressed as n(number) and percentage. The chi-square tabulation method was used to examine the relationship between Dietary intake, Physical activity, and participants' BMI for age. All statistical analyses were two-tailed and had statistically significant p-values of 0.05.

## Results

### Socio-demographic characteristics of the sample

Table 1 presents the sociodemographic characteristics of the participants, with Choggu Yapalsi Junior High School contributing the highest proportion of participants (38.5%). The majority of adolescent girls (84.4%) fell within the age range of 15 to 17 years, while the smallest age group (7.3%) was adolescent girls aged 18 to 19 years.

### Dietary Intake of Adolescent Girls

Table 2 describes the Meals eaten by In-School Adolescent Girls. The study found that a significant portion of the girls (44.2%, n=176) didn't have three square meals per day, often skipping one or two meals. However, the majority (55.5% n=221) of the girls had three meals per day. Most of these adolescent girls (78.6%, n=312) consumed their meals at home, while a smaller percentage (19.1% n=76) ate at school. Places outside the school and home showed the least of where food was eaten by the adolescent girls. The study also noted that all the girls who attended school bought food at least once a week, with more than half (52.4%, n=208) buying food daily. Supper was the most frequently eaten meal (93.2%, n=370), followed by breakfast (80.9%, n=321). Snacks were the least consumed meal, making up 35% (n=139) of eating occasions. In the study, snacks were the most frequently skipped meal (65%, n=258), followed by lunch (21.8%, n=108) and breakfast (19.1%, n=79), which is considered the most crucial meal of the day.

**Table 1.** Socio-demographic characteristics of school-aged adolescent girls

| Sociodemographic, n=397 | Frequency (n=397) | Percent (%) |
|---|---|---|
| **Age in years** | | |
| 13 – 14 | 33 | 8.5 |
| 15 – 17 | 335 | 84.4 |
| 18 – 19 | 29 | 7.3 |
| **Schools (n= 5)** | | |
| Bagabaga Demonstration JHS | 61 | 15.4 |
| Bishop R/C JHS | 51 | 12.8 |
| Choggu Demonstration JHS | 103 | 25.9 |
| Choggu Yapalsi JHS | 153 | 38.5 |
| Ridge JHS | 29 | 7.3 |

**Table 2.** Description of Meals Intake by In-School Adolescent Girls

| **Indicators** | Frequency (n=397) | Percentage (%) |
|---|---|---|
| **Place of meal consumption** | | |
| Home | 312 | 78.6 |
| Friends | 9 | 2.3 |
| School | 76 | 19.1 |
| **Food bought in a week** | | |
| Everyday | 208 | 52.4 |
| Once a week | 50 | 12.6 |
| Twice a week | 64 | 16.1 |
| Thrice a week | 48 | 12.1 |
| Four times a week | 27 | 6.8 |
| **Number of meals consumed per day** | | |
| Once a day | 19 | 4.8 |
| 2 times a day | 157 | 39.4 |
| 3 times a day | 221 | 55.5 |
| **Breakfast** | | |
| Intakers | 321 | 80.9 |
| Skippers | 76 | 19.1 |
| **Lunch** | | |
| Intakers | 289 | 78.2 |
| Skippers | 108 | 21.8 |
| **Supper** | | |
| Intakers | 370 | 93.2 |
| Skippers | 27 | 6.8 |
| **Snacks** | | |
| Intakers | 139 | 35.0 |
| Skippers | 258 | 65.0 |

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**Dietary diversity and frequency of consuming specific foods**

Table 3 summarizes the Dietary Diversity Scores (DDS) and food consumption frequency. The individual dietary diversity score reflects diet quality based on nutrient intake. The mean DDS for the studied population from 10 food groups was 6.2 ± 1.4. Among 397 adolescent girls, 29.4% didn't meet daily DDS requirements, while over half scored ≥6, indicating diverse diets. All food groups, except fruits, were well-consumed. Eggs and fruits were poorly consumed, with only 10.5% consuming eggs in the past week. Starchy staple foods were highly consumed (99.5%).

**Nutritional status of adolescent girls**

Table 4 indicates the Nutritional status of the adolescent Girls. Anthropometric data involves measuring weight and height to calculate Body Mass Index (BMI) and assess health conditions like stunting, overweight, and obesity. In the study, 1.0% of adolescent girls were stunted, and 98.7% were within the normal height range. One girl was severely stunted. Regarding BMI for age, 99% of girls had a normal BMI, 0.8% were overweight, and 0.3% were obese. None were recorded as wasted. The average BMI was 22.5 with a standard deviation of 9.63. A majority (70%) of the girls had a normal BMI, followed by 13.4% in the underweight category, 12.1% were overweight, and 4.5% were obese.

**Table 3.** Food groups consumed in the past week

| Serial No. | Food groups (variable) | Frequency (n=397) | Percent (%) |
|---|---|---|---|
| 1 | All starchy staple foods (Cereals, roots & tubers | 395 | 99.5 |
| 2 | Legumes and Nuts | 250 | 63 |
| 3 | Fats and Oils | 383 | 96.5 |
| 4 | Dairy Products | 289 | 72.8 |
| 5 | Flesh food (beef, Lamb, fish, poultry, etc.) | 262 | 66 |
| 6 | Egg | 197 | 49.6 |
| 7 | Vitamin A-rich fruits and vegetables | 157 | 39.5 |
| 8 | Other fruits | 18 | 4.5 |
| 9 | Sub-Tropical Fruits | 132 | 33.2 |
| 10 | Other Vegetables | 376 | 94.7 |
| **Serial No.** | **DDS Status** | **Frequency** | **Percent (%)** |
| 1 | Low (1-5) | 117 | 29.4 |
| 2 | High (6-10) | 280 | 70.5 |
| | **Total** | **397** | **100** |

**Table 4.** Nutritional status of adolescent Girls

| Growth Indicators | Classification | Girls (n) | Girls (%) |
|---|---|---|---|
| **Stunting (Height-for-Age) (n=397)** | | | |
| <-3SD | Severe stunting | 1 | 0.3 |
| <-2SD | Stunting | 4 | 1.0 |
| ≥-2SD to <+3SD | Normal | 392 | 98.7 |
| **Wasting/Thinness (Weight-for Height) (n=397)** | | | |
| <-3SD | Severely Wasted | 0 | 0.0 |
| <-2SD to -3SD | Wasted | 0 | 0.0 |
| **Underweight (Weight-for-Age)** | | | |
| <-2SD | Underweight | 0 | 0.0 |
| -2SD to +1SD | Normal | 393 | 99.0 |
| >+1SD to +2SD | Overweight | 3 | 0.8 |
| >+2 | Obese | 1 | 0.3 |
| **BMI-For-Age** | | | |
| 18.5 | Underweight | 53 | 13.4 |
| 18.5-24.99 | Normal | 278 | 70.0 |
| 25-29.99 | Overweight | 48 | 12.1 |
| 30 | Obese | 18 | 4.5 |

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**Physical activities done per week by the adolescent girls**

Table 5. shows the many varieties of sporting activities that the girls participated in. The most popular activity amongst the girls (n=348) is walking, with more than half of the girls taking part in the activity at least one to seven or more times per week. This is closely followed by fetching water for exercise, with more than half of the girls (n=330) participating once to twice a week. The sports participated in more than seven times a week, in order of popularity, are fetching of water,

**Activities Done on Each Week Day**

The table (Table 6) presents the breakdown of physical activity minutes for girls across each day of the week. On Sunday, 41.8% (n=166) of adolescent girls were categorized as "none" (>40 mins) for being less active, while Friday had the highest number of active girls, with only 29.2% (n=116) being inactive. Few girls (less than 5) were consistently highly active (>300-360 mins), while the majority showed consistent a little bit active (60-120 mins) throughout the week.

**Physical activity levels**

Table 7 presents data on the physical activity levels of adolescent girls, indicating the number who were Lowly Active and highly active. The study found that 50.6% (n=201) of the girls were categorized as lowly active throughout the entire week, while 49.9% (n=196) were considered highly active. The classification was based on the average minutes of physical activity during break times or leisure periods at school and home.

**Relationship between Dietary Intake, Physical Activity, and Nutritional Status**

Table 8 shows the Relationship between Dietary Intake, Physical Activity, and Nutritional Status of Adolescent Girls. A Chi-Square test was done among some dependent and independent variables to ascertain the degree of relationship or association among the variables. Some of the key variables with which chi-square analysis was done were Physical activity level, Dietary Diversity Score, number of meal intakes and skips, and the Nutritional Status (BMI and Stunting status) of the adolescent girls.

**Table 5.** The percentage of girls performing specific activities at different frequencies within a week (n=397).

| Variables | Frequency per week (%) | | | |
|---|---|---|---|---|
| | **1-2** | **3-4** | **5-6** | **7 or more** |
| Skipping n= (53) | 60.4 | 32.1 | 5.7 | 1.9 |
| Walking (brisk) n= (348) | 52.0 | 41.1 | 5.5 | 1.4 |
| Running n= (142) | 82.4 | 14.1 | 2.1 | 1.4 |
| Bicycling n= (108) | 52.8 | 23.1 | 10.2 | 13.9 |
| Jogging n = (14) | 57.1 | 28.6 | 17.1 | 7.1 |
| Aerobics n= (19) | 68.4 | 10.5 | 10.5 | 10.5 |
| Swimming n= (8) | 87.5 | 12.5 | 0.0 | 0.0 |
| Dancing n= (69) | 59.4 | 30.4 | 4.5 | 5.8 |
| Football n= (11) | 90.9 | 9.1 | 0.0 | 0.0 |
| Volleyball n= (4) | 75 | 25 | 0.0 | 0.0 |
| Basketball n= (5) | 80 | 20 | 0.0 | 0.0 |
| Fetching of water n= (330) | 36.1 | 43.9 | 7.0 | 13.0 |
| Jumping n = (16) | 87.5 | 6.3 | 6.3 | 0.0 |

**Table 6.** Frequency of exercise done on each weekday (n=397)

| Weekday | Frequency | | | |
|---|---|---|---|---|
| | Very low (0-40mins) | A little bit low (60-120mins) | Medium (180-240mins) | Often (300-360mins) |
| Monday | 41.6 (n=165) | 44.6 (n=177) | 13.4 (n=53) | 0.5 (n=2) |
| Tuesday | 33.8 (n=134) | 51.1 (n=203) | 14.9 (n= 59) | 0.3 (n=1) |
| Wednesday | 36.3 (n=144) | 47.9 (n=190) | 15.1 (n=60) | 0.8 (n=3) |
| Thursday | 31.7 (n=126) | 52.6 (n=209) | 14.9 (n=59) | 0.8 (n=3) |
| Friday | 29.2 (n=116) | 50.6 (n=201) | 19.4 (n=77) | 0.8 (n=3) |
| Saturday | 31.0 (n=123) | 52.4 (n=208) | 15.6 (n=62) | 1.0 (n=4) |
| Sunday | 41.8 (n=166) | 45.3 (n=180) | 12.1 (n=48) | 0.8 (n=3) |

Min = Minutes

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**Table 7.** Physical activity levels

| Indicators | Frequency (n=397) | Percent (100%) |
|---|---|---|
| Lowly active (≤40 - 89mins/week) | 201 | 50.6 |
| Highly Active (90-330mins/week) | 196 | 49.4 |

**Table 8.** Associations between dietary intake, physical activity, and BMI-for age

| | Chi-square test | | |
|---|---|---|---|
| **Variables** | Chi-Square Value ($\chi 2$) | Degree of freedom (df) | Significance (p-value) |
| **Meal (intakes and skips) and BMI-for age** | **20.156** | 6 | **0.003** |
| DDS Status and BMI-for age | 10.726 | 6 | 0.097 |
| **Physical Activity Levels and BMI-for age** | **24.865** | 9 | **0.003** |
| Meal (intakes and skips) and Stunting status | **1.866** | 4 | 0.760 |
| DDS Status and stunting status | 7.115 | 4 | 0.130 |

From the study, it was observed that a significant relationship exists between Physical Activity Level and Nutritional status (BMI) of the adolescent girls ($\chi 2$ = 24.869, p = 0.003), BMI, and Meal times ($\chi 2$=20.156, p=0.003), and stunting status and physical activity level ($\chi 2$=16.665, p=0.011). However, the study could not establish a significant association with the rest of the variables shown in Table 6.

We utilized BMI- for age categories such as wasting, overweight, and obesity. We compare the association between Meal (intakes and skips) and BMI-for age (wasted, overweight, and obesity), the association between Physical Activity Levels and BMI-for age (wasted, overweight, and obesity), and DDS Status and BMI-for age (wasted, overweight, and obesity). However, the BMI-age (wasted, overweight, and obesity) was put in one and compared with meal intake (intakers and skippers), physical activity levels, and DDS to ascertain the degree of relationship between the Nutritional status and the independent variables.

## Discussion

The overall mean age of the participants was 15.28 ± 1.33 years, which ranged from 13 to 19 years. Most of the participants (84.4 %) were between the ages of 15 – 17 years (mid-adolescence), and a few of them (7.3%) were in their late adolescence (18–19 years).

The present study aimed to investigate the relationship between dietary intake, physical activity, and nutritional status of adolescent girls. Generally, the prevalence of physical inactivity stands at 50.6% among adolescent girls in the Sagnarigu Municipality, which is lower than the national prevalence of 87.9% (Global Status Report on NCDs, 2014). The possible reason for the disparities in the two studies could be due to largely geographical factors, a high physical activity-demanding lifestyle in the current study area. However, this current study largely corroborates (2), who reported a prevalence of low physical activity of 48.4% among adolescents in both the Kumbungu district and the Tamale metropolis.

Out of the 397 adolescent girls assessed, only 29.4% did not meet the DDS daily requirement. This implies that the majority (70.6%) of the adolescent girls assessed met the minimum score (≥6), thus most of the adolescent girls ate varied diets.

The majority (70%) of the girls had a normal BMI (18.5-24.99), and a smaller portion of the adolescent girls were underweight (13.4%), overweight (12.1%), and Obese (4.5%). A different study conducted in Ghana by (35) also realized that the majority of adolescent girls had normal BMIs, with a few of them being underweight, overweight, and obese.

Also, the prevalence of obesity, 4.5% among the adolescent girls in this study, is consistent with that of (25) but higher than that of (19), who reported a prevalence of 0.8% for obesity. A higher prevalence of obesity in this study may be a result of rapid urbanization over the period during which the two studies were conducted. The increased prevalence of obesity and overweight is attributable to urbanization, with associated acculturation plagued by changes in diet and physical activity (4).

On the other hand, the prevalence of underweight in this study was found to be 13.4%, comparable to that of **(**24) in similar Burkina Faso, Ethiopia, Sudan, and Tanzania populations, but higher than that reported by (40).

More than 50% of the adolescent girls reported eating 3 times during a typical day. According to (1), school children and adolescents' daily meals should be composed of 3 meals and some snacks. This result is consistent with the findings of (17) found in their study on determining the dietary pattern of school-going adolescents in urban Baroda, that the majority (55%) of adolescents consumed three meals daily. However, the (13) study on the dietary behaviors of adolescents, from urban and rural areas in the

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district of Szamotuly, Poland, revealed that 39.7% of adolescents ate 3 times daily.

The results also revealed that the most skipped meal was a Snack (65%), followed by lunch (21.8%), and breakfast (19.1%), and the least skipped meal was supper. A similar finding was made by (27), which showed that some adolescents did not take snacks frequently. They further went on to add that snack consumption, in addition to 3 regular meals in a day, is expected to improve adolescent growth and meet their developmental requirement.

According to the study, the consumption of fruits was poor. The findings in this study greatly correspond with those of (2), who reported that only a few adolescents consumed fruits and vegetables. The findings of this study suggested that parents may not be providing fruits and vegetables often at home.

Purchased meals (out-of-home eating) were part of the measures of the dietary habits of the adolescents. The majority of the adolescents indicated they eat at home, mostly supper and lunch. During the afternoons, adolescents are mostly found in school or left behind at home by their parents. As a result, adolescents mostly eat foods outside their homes. The type and quantity of food eaten by an individual affects his/her well-being; hence, eating properly at meal times at this stage of life is vital in achieving optimum growth (34).

Generally, the findings of the study revealed significant associations between dietary intake, physical activity levels, and nutritional status in this population. This is consistent with previous research conducted by (20), who reported that there are significant associations between dietary patterns, physical activity levels, and weight status.

From our study, it was observed that a significant association exists between skipping meals and BMI-for-age in adolescent girls ($\chi2 = 20.156$, $p=0.003$) because some important meal moments being skipped have a long-term effect on their nutritional status. A similar study carried out by (3) stated that poor dietary practices as established as meal skipping or irregular meal patterns, were found to be positively associated with BMI (overweight conditions among adolescent girls).

On the contrary, the study could not establish a significant association between dietary diversity score and BMI ($\chi2=10.726$, $p=0.097$) of adolescent girls. A study conducted by (11) comparing DDS and BMI stated that many (57) overweight individuals had low DDS, though there was no significant relationship between DDS and BMI ($r=0.003$, $p=0.969$).

There was also no association between dietary diversity score and stunting ($\chi2= 7115$, $p=0.130$) among adolescent girls according to our study, but a study conducted by (15) said otherwise, which stated that adolescents who had a poor consumption of diversified foods (DDS <4 food) were 2.2 times more likely to be stunted compared to those who had good consumptions. Likewise, no significant association was found between meal skipping and stunting among adolescent girls ($\chi2=1.866$, $p=0.760$). (15) indicated a significant relationship between meal skipping and stunting.

**Conclusion**

While there was a significant relationship between physical activity, dietary intake, and BMI for age (wasted, overweight, obese), the Dietary Diversity Score (DDS) had no significant relationship with BMI for age. This implies that improvements in Dietary Diversity Score (DDS) could have a positive impact on BMI for age. Intervention research aimed at improving school-aged adolescent girls' nutritional status should also be implemented; policies to improve the school environment and encourage students to make healthy food choices should be enforced.

**Ethics approval and consent to participate**

Ethics approval for this study was obtained from the ethical review board of the University for Development Studies Research Council. A verbal agreement was reached between the Heads of the Ghana Education Services and Ghana Health Services under the Sagnarigu Municipal, allowing for a single written consent letter from either sector instead of acquiring both. Therefore, a written approval was obtained from the Director of Health Services in the Sagnarigu Municipal. Furthermore, written informed consent to participate was obtained from all the respondent parents, and the letter from Ghana Health Services was sent to the school authorities before data collection.

**Consent for publication**

**Not applicable**

**Availability of data and materials**

All data is presented within the paper. The datasets generated and analyzed for this study are available from the corresponding author upon request.

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The authors declare that they have no competing interests.

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**Authors' contributions**

SAA conceived the study, recruited the participants, collected the data, analyzed and interpreted the data, and drafted the manuscript. He was also a major contributor in conceptualizing the research plan, refining methodologies and tools, finalizing the manuscript, and writing the manuscript. PMA assisted with data collection, analysis, and drafting of the manuscript. DKDB aided in data

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collection and coding. All authors read and approved the final manuscript.

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