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RESEARCH ARTICLE

Nutrient intake and dietary practice among adolescent girls in urban and rural areas of Kano State, Nigeria

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Objective: This study aimed to assess the nutrient intake and dietary practices of adolescent girls in rural and urban areas of Kano State, Nigeria, and to identify potential disparities between these settings.
Design: Cross-sectional study.
Setting: Urban and rural schools in Kano State, Nigeria.
Subject: Adolescent schoolgirls ($n = 424$) aged 15–19 years.
Outcome measure: Dietary intake (using a three-day 24-hour recall), eating behaviour, and physical activity were assessed using a structured questionnaire. Nutrient intake was analysed and compared with Estimated Average Requirements (EAR). Independent t-tests and chi-square tests were performed to assess urban–rural differences.
Results: Inadequate micronutrient intake was prevalent, with 100% of participants having inadequate calcium and vitamin D intake below the EAR. Significant level of inadequacy was also observed for vitamin B12 (90.8%), vitamin A (76.7%), zinc (76.2%), folate (65.1%), riboflavin (43.6%), and niacin (39.9%) among all the participants, with rural girls having significantly lower intakes ($p < 0.05$). Meal skipping, particularly lunch and breakfast, and low consumption of fruits and vegetables were common, especially in rural areas ($p < 0.05$). Food preparation practices such as cutting vegetables before washing and removing bran from grains and legumes were widespread. Food choices were influenced by taste and cost.
Conclusion: This study highlights inadequate intake of micronutrients and suboptimal dietary practices among adolescent girls in Kano State, with pronounced disparities between urban and rural areas. There is a need for targeted interventions, including culturally appropriate nutrition education, to improve fruit and vegetable intake and discourage nutrient-depleting food preparation practices of both urban and rural adolescent girls to promote healthy dietary behaviours.

Keywords adolescents, dietary practices, Kano, micronutrient intake, Nigeria

Introduction

Adolescence represents a pivotal stage of human development, characterised by accelerated growth, sexual maturation, and increased physical activity, all of which drive greater nutritional demands. Ensuring adequate nutrition during this period is vital for promoting healthy development and establishing lifelong health habits. In contrast, inadequate nutrition can lead to both immediate and long-term health consequences, including stunted growth, poor academic performance, and an elevated risk of chronic diseases in adulthood.[1,2] Globally, adolescents, particularly in low- and middle-income countries, face substantial nutritional challenges.[3] It is estimated that malnutrition affects approximately 8% of adolescent girls, representing around 49 million individuals, and 10% of women, totalling approximately 154 million, worldwide.[4]

In Africa, adolescents commonly experience a dual burden of malnutrition, where undernutrition and micronutrient deficiencies coexist alongside a growing prevalence of overweight and obesity.[5] In Nigeria, these nutritional inequalities are especially pronounced, with the Northern regions, including Kano State, reporting higher rates of undernutrition compared with the South.[6] Data from the Nigeria Demographic and Health Survey reveal that among adolescent girls aged 15–19 years, 12% are underweight, 28% are overweight or obese, and over half suffer from anaemia, exacerbating the existing public health burden.[7]

Several factors contribute to the poor nutritional status observed among Nigerian adolescents, including economic hardship, cultural norms, and limited access to diverse and nutrient-rich foods.[8] Furthermore, low levels of nutrition knowledge and unhealthy dietary practices intensify these problems, leading to reduced intake of essential food groups such as whole grains, fruits, and vegetables.[9] Understanding these factors is critical for developing effective public health strategies to address adolescent nutrition.

Despite the recognised challenges, research exploring adolescent nutrition in Northern Nigeria remains limited, particularly regarding comparisons between urban and rural settings. Urban–rural differences in education, healthcare access, and food availability may lead to significant disparities in dietary practices and nutrient intake among adolescents.[10] However, these disparities are not yet fully understood within the Nigerian context. Therefore, this study aims to evaluate and compare the dietary practices and nutrient intake of adolescent girls in urban and rural areas of Kano State. The findings are intended to provide evidence to guide targeted nutritional interventions for this vulnerable group.

Methods

Study location

Kano State was the study location, which is in the northwest region and the most populous state in Nigeria. It spans an area of 21,276.87 km^2 and comprises 44 local government areas (LGAs), classified as urban or rural. This study focused on one urban and one rural LGA selected using simple random sampling to ensure representation of the diverse adolescent experiences.

Study design and participants

A school-based cross-sectional design was employed to assess the nutrient intake and dietary practices of adolescent girls aged 15–19 years. Data collection occurred in October 2024 across four secondary schools (two from the urban LGA and two from the rural LGA) using a multistage sampling technique. A sample size of 384 was determined using a standard formula for prevalence studies based on population size estimates[11] adjusted to 424 to account for a 10% non-response rate.

Ethical approval and consent

Ethical approval was obtained from the Universiti Kebangsaan Malaysia Research Ethics Committee (JEP-2024-232), and permission to conduct the research was granted by the Kano State Senior Secondary School Management Board. Written informed consent was obtained from all participants, with parental or guardian consent and adolescent assent obtained for those under 18 years of age.

Sampling procedure

A multistage random sampling technique was utilised. Initially, one urban and one rural LGA were selected from the 44 LGAs in Kano State using a random number generator (simple random sampling). Subsequently, two secondary schools were randomly chosen from each selected LGA using simple random sampling from a list of all secondary schools in each LGA. In the final stage, eligible students within the selected schools were identified, and 106 participants were recruited from each school using systematic random sampling from the attendance registers to ensure a representative sample.

Data collection tools and procedures

Data were collected using a structured questionnaire that was developed and validated, covering sociodemographic information (e.g. age, household structure, parental education, and employment), general eating behaviour (e.g. self-reported habitual pattern of meal frequency, snacking, skipping meals, fruit and vegetable intake, bran removal practices, food choice determinants), and physical activity (frequency and duration of moderate and vigorous activities). A meal in this study was defined as any main eating occasion, including breakfast, lunch, or dinner. Content and face validity were confirmed, with the Scale-level Content Validity Index (S-CVI) at 0.98 and the Scale-level Content Validity Index based on Universal Agreement (S-CVI/UA) at 0.88, as well as the Scale-level Face Validity Index (S-FVI) at 0.991 and Scale-level Face Validity Index based on Universal Agreement (S-FVI/UA) at 0.9. A pilot test among 42 adolescents demonstrated good internal consistency (Cronbach's alpha = 0.77). Six trained enumerators administered the questionnaires and conducted the dietary recalls through face-to-face interviews. Standard household measurements and food photo aids were used to assist participants in accurately estimating portion sizes.

Dietary intake

Dietary intake was assessed using a three-day 24-hour dietary recall, conducted on non-consecutive days, covering two weekdays and one weekend day to account for day-to-day variability. The recall was administered using the multiple pass method, which includes information on all foods and beverages consumed, including portion sizes, cooking methods, and brand names to improve accuracy. Standard household measurements and food photo aids were used to aid participants in estimating portion sizes accurately. The dietary data were entered and analysed using Nutritionist Pro™ software (Axxya Systems LLC, Redmond, WA, USA) to estimate daily energy and nutrient intakes. The average intake across the three days was calculated for each participant. Nutrient intakes were compared with the Estimated Average Requirement (EAR) for adolescent girls based on age-specific nutritional requirements outlined by Otten et al.[12] and EAR for calcium and vitamin D.[13] The adequacy of intake for energy and selected macro- and micronutrients was then assessed accordingly.

Data analysis

Data were analysed using IBM SPSS Statistics for Windows, version 25 (IBM Corp, Armonk, NY, USA). Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarise the participants' demographic characteristics, nutrient intake, and dietary practices. Dietary intake data from the 24-hour recalls were analysed using Nutritionist Pro software (https://nutritionistpro.com/) to estimate mean nutrient intakes. Independent t-tests were conducted to compare mean differences in continuous variables, while chi-square tests were used to assess differences in proportions between categorical variables. Adjusted residuals were examined to identify specific frequency categories contributing to significant differences, for categories with more than two levels. A significance level of $p < 0.05$ was used for all statistical tests.

Results

Sociodemographic characteristics of participants

Table 1 presents the sociodemographic information on the participants, with an equal distribution between urban and rural schools (50% each). All participants were Muslim and belonged to the Hausa ethnicity. The majority (76.4%) came from monogamous households, while 23.6% were from polygamous households. The average household size was 10.25 ± 3.94, ranging from 3 to 32 members. Most households were headed by the father (96.7%), while a small proportion were headed by the mother (1.4%) or relatives (1.9%).

Significant urban–rural differences were observed in age (0.013), household size ($p = 0.008$), and household headship by father ($p = 0.001$). Differences in mothers' education and parental occupational status were also statistically significant (Table 1). A higher proportion of urban mothers attained tertiary education (19.8%) compared with none in rural areas ($p < 0.001$, adjusted residual = 6.8), while rural mothers were more likely to have only primary education (24.1% vs. 4.2%, adjusted residual = 5.9). Fathers' education did not differ significantly ($p = 0.128$).

Nutrient intake

While most participants met the recommended energy intake equal to or above the Acceptable Macronutrient Distribution Range (AMDR) for carbohydrates (100%) and fat (60.6%), nearly half (49.8%) had protein intake below the recommended level (Table 2).

Micronutrient intake analysis revealed widespread inadequacy, with all participants having calcium and vitamin D intakes

Table 1: Sociodemographic characteristics of participants ($n = 424$)

Variable	Total ($n = 424$)	Urban ($n = 212$)	Rural ($n = 212$)	p-value
Age (years)	16.13 ± 0.91	16.24 ± 1.03	16.02 ± 0.75	**0.013**[a]
Household size	10.25 ± 3.94	9.75 ± 4.93	10.76 ± 2.53	**0.008**[a]
Family type				
Monogamy	324 (76.4%)	162 (76.4%)	162 (76.4%)	1.000[b]
Polygamy	100 (23.6%)	50 (23.6%)	50 (23.6%)	
Head of household				
Father	410 (96.7%)	198 (93.4%)	212 (100%)	**0.001**[b]
Mother	6 (1.4%)	6 (2.8%)	0	
Relative	8 (1.9%)	8 (3.8%)	0	
Father's education				
Islamic school	93 (21.9)	55 (25.9%)	38 (17.9%)	0.128[b]
Primary school cert.	166 (39.2)	7 (3.3%)	8 (3.8%)	
Secondary	15 (3.5)	73 (34.4%)	93 (43.9%)	
Tertiary	150 (35.4)	77 (36.3%)	73 (34.4%)	
Father's working status				
Government	203 (47.9)	95 (44.8%)	108 (50.9%)	0.012[b]
Private	48 (11.3)	34 (16.0%)	14 (6.6%)	
Self-employed	153 (36.1)	76 (35.8%)	77 (36.3%)	
Unemployed	20 (4.7)	7 (3.3%)	13 (6.1%)	
Mother's education				
Islamic school	148 (34.9)	73 (34.4%)	75 (35.4%)	< 0.001[b]
Primary school cert.	60 (14.2)	9 (4.2%)	51 (24.1%)	
Secondary	174 (41.0)	88 (41.5%)	86 (40.6%)	
Tertiary	42 (9.9)	42 (19.8%)	0	
Mother's working status				
Government	41 (9.7)	20 (9.4%)	21 (9.9%)	< 0.001[b]
Private	65 (15.3)	54 (25.5%)	11 (5.2%)	
Self-employed	275 (64.9)	104 (49.1%)	171 (80.7%)	
Unemployed	43 (10.1)	34 (16.0%)	9 (4.2%)	

[a] = Independent t-test, significance level at $p < 0.05$.
[b] = Chi-square test, significance level at $p < 0.05$.

below the EAR. High levels of inadequate intakes were also observed for vitamin B12 (90.8%), vitamin A (76.7%), zinc (76.2%), folate (65.1%), riboflavin (43.6%), and niacin (39.9%). In contrast, most participants had intake equal to or greater than the EAR for iron (97.6%), thiamine (92.9%), vitamin C (73.3%), and niacin (60.1%) (Table 2).

As shown in Table 3, urban participants had significantly higher mean intakes of several micronutrients, including iron, zinc, calcium, vitamin A, vitamin D, thiamine, riboflavin, niacin, and folate ($p < 0.05$) compared with the rural participants. Protein and fat intakes were also higher among urban girls ($p < 0.05$) (Table 3).

Eating behaviours and physical activity of the participants

Table 4 summarises participants' eating behaviours and physical activity levels. Self-reported habitual pattern of meal skipping shows that breakfast skipping was reported by 46.7% of the participants, followed by lunch (35.8%) and dinner (17.5%). Reported reasons for skipping meals included busy schedule (32.3%), being late (29.7%), not feeling hungry (29.5%), and lack of food availability (8.5%). Snack consumption was moderate, with 46.7% of the participants snacking on 1–2 days a week, and 12.5% snacking daily.

In Figure 1, vegetable consumption was generally low. Only 7.3% of the participants reported daily intake, while the majority (74.3%) consumed vegetables 2–3 times per week. Fruit consumption followed a similar pattern, with just 8% consuming fruits daily (Figure 1).

Most participants reported removing the bran from grains (84%) and legumes (89.6%) before cooking, mainly for cultural, taste, and cleanliness reasons. Cost (41.3%) and taste (34.9%) were the primary factors influencing food choices.

Meal skipping and food preparation practices differed significantly between urban and rural participants ($p < 0.05$). Rural participants most frequently skipped lunch (46%, adjusted residual = + 4.5), while urban participants skipped dinner more often (27.4%, adjusted residual = + 5.4). Rural girls were more likely to cut leafy vegetables first, then wash them, while a higher percentage of urban girls washed first, then cut ($p < 0.001$) (Table 4).

On the other hand, the frequency of daily consumption of vegetables, fruits, and soft drinks was significantly higher among urban participants compared with their rural counterparts ($p < 0.001$), suggesting greater access to diverse food options and sugar-sweetened beverages (Figure 2). The frequency of

Table 2: Proportion of participants' nutrient intake below or above EAR (for micronutrients) and AMDR (for macronutrients)

Nutrient	< EAR/ AMDR *n* (%)	≥ EAR/ AMDR *n* (%)	EAR/ AMDR
% energy intake from carbohydrate	0 (0%)	424 (100%)	45–65%[a]
% energy intake from protein	211 (49.8%)	213 (50.2%)	10–30%[a]
% energy intake from fat	167 (39.4%)	257 (60.6%)	25–35%[a]
Iron (mg/day)	10 (2.4%)	414 (97.6%)	7.9 mg
Zinc (mg/day)	323 (76.2%)	101 (23.8%)	7.3 mg
Calcium (mg/day)	424 (100%)	0 (0%)	1 100 mg[b]
Vitamin A (µg/day)	325 (76.7%)	99 (23.3%)	485 µg
Vitamin C (mg/day)	113 (26.7%)	311 (73.3%)	56 mg
Vitamin D (µg/day)	424 (100%)	0 (0%)	10 µg[b]
Thiamine (mg/day)	30 (7.1%)	394 (92.9%)	0.9 mg
Riboflavin (mg/day)	185 (43.6%)	239 (56.4%)	0.9 mg
Niacin (mg/day)	169 (39.9%)	255 (60.1%)	11 mg
Vitamin B12 (µg/day)	385 (90.8%)	39 (9.2%)	2.0 µg
Folate (µg/day)	276 (65.1%)	148 (34.9%)	330 µg

EAR = Estimated Average Requirement (Otten et al.[12]).
[a] = AMDR: Acceptable Macronutrient Distribution Range (% energy intake) (Otten et al.[12]).
[b]EAR for calcium and Vitamin D (Institute of Medicine[13]).

daily consumption of vegetables, fruits, and soft drinks was significantly higher among urban participants compared to rural participants ($p < 0.001$ for all; Figure 2). Post-hoc analysis using adjusted residuals indicated that urban girls were more likely to consume vegetables daily (+5.8), fruits daily (+6.1), and soft drinks daily (+6.9) compared with rural girls, who tended to consume vegetables 2–3 times per week (+3.9), rarely consumed fruits (+4.3), and drank soft drinks 2–3 times per week (+5.2).

Regarding physical activity, 90.1% of the participants engaged in at least 60 minutes of moderate-to-vigorous intensity activities daily, while 62.5% limited screen time. However, rural girls were more active and more likely to limit screen time compared with their urban counterparts ($p < 0.001$) (Table 4).

Discussion

This study provides an assessment of the nutrient intake and dietary practices of adolescent girls in Kano State, with a particular emphasis on urban–rural disparities. The findings reveal significant differences between urban and rural participants, highlighting the influence of geographical location and socioeconomic context on adolescent health outcomes.

Micronutrient intake among the study population was alarmingly below the Estimated Average Requirement (EAR) for several essential nutrients. The EAR represents the average daily nutrient intake level estimated to meet the requirements of 50% of healthy individuals in a specific age and gender group and is therefore appropriate for assessing the adequacy of nutrient intake at the population level.[12] In this study, the inadequacies were most pronounced for calcium and vitamin D, followed by vitamin B12, vitamin A, zinc, folate, riboflavin and niacin, with rural participants consistently demonstrating lower intakes across these nutrients. These findings align with those of Georgina et al.,[14] who reported widespread inadequate micronutrient intake among female adolescents in Ogun State, including vitamin A (84.4%), vitamin B2 (64%), folate (52%), calcium (98%), and vitamin C (55.2%). Similarly, Balogun et al.[15] observed inadequate intakes of calcium, zinc, folate, niacin, and riboflavin among secondary school adolescent girls in Ibadan, attributing these to socioenvironmental determinants such as household size and place of residence. While the present study assessed the place of residence, the influence of household size on nutrient intake was not analysed and remains an area for future investigation.

Although carbohydrate and fat intake met recommended levels, protein intake was inadequate in nearly half of the participants, with urban girls recording significantly higher

Table 3: Nutrient intakes of the participants and urban – rural comparison

Nutrient	Total (Mean ± SD)	Urban (Mean ± SD)	Rural (Mean ± SD)	**p*-value
Energy (kcal/day)	1719 ± 297	1811 ± 269	1628 ± 297	< 0.001
Carbohydrate (g/day)	268.98 ± 47.58	271.25 ± 45.71	266.71 ± 49.39	0.327
Protein (g/day)	43.01 ± 9.16	48.30 ± 7.95	37.73 ± 6.99	< 0.001
Fat (g/day)	52.40 ± 16.38	59.19 ± 14.70	45.60 ± 15.13	< 0.001
% energy intake from carbohydrate	62.83 ± 6.11	59.99 ± 5.50	65.66 ± 5.34	< 0.001
% energy intake from protein	10.12 ± 1.96	10.78 ± 1.74	9.46 ± 1.96	< 0.001
% energy intake from fat	27.06 ± 5.56	29.23 ± 5.16	24.88 ± 5.10	< 0.001
Iron (mg/day)	14.13 ± 2.75	14.90 ± 2.48	13.36 ± 2.80	< 0.001
Zinc (mg/day)	6.02 ± 1.80	6.62 ± 1.62	5.42 ± 1.78	< 0.001
Calcium (mg/day)	454.88 ± 158.77	468.31 ± 155.21	441.45 ± 161.51	0.082
Vitamin A (µg/day)	311.88 ± 182.46	347.37 ± 283.51	276.38 ± 277.55	0.010
Vitamin C (mg/day)	84.13 ± 38.79	78.55 ± 30.36	89.72 ± 45.09	0.003
Vitamin D (µg/day)	0.1 ± 0.19	0.15 ± 0.18	0.046 ± 0.19	< 0.001
Thiamine (mg/day)	1.34 ± 0.32	1.43 ± 0.29	1.25 ± 0.31	< 0.001
Riboflavin (mg/day)	0.99 ± 0.29	1.06 ± 0.25	0.93 ± 0.31	< 0.001
Niacin (mg/day)	13.39 ± 5.6	15.09 ± 6.61	11.70 ± 3.65	< 0.001
Vitamin B12 (µg/day)	0.84 ± 0.75	1.13 ± 0.75	0.55 ± 0.63	< 0.001
Folate (µg/day)	300.40 ± 89.59	317.72 ± 94.59	283.07 ± 80.87	< 0.001

* = Independent *t*-test, *p*-value < 0.05 is significant.

Table 4: Dietary practices and physical activity of participants ($n = 424$)

Variable	Total ($n = 424$) n (%)	Urban girls ($n = 212$) n (%)	Rural girls ($n = 212$) n (%)	*p-value
Meal frequency				
Two times/day	27 (6.4)	3 (1.4)	24 (11.3)	< 0.001
Three times/day	397 (93.6)	209 (98.6)	188 (88.7)	
Most frequently skipped meal				
Breakfast	198 (46.7)	100 (47.2)	98 (46.2)	< 0.001
Lunch	152 (35.8)	54 (25.5)	98 (46.2)	
Dinner	74 (17.5)	58 (27.4)	16 (7.5)	
Reason for skipping meals				
Late	126 (29.7)	49 (23.1)	77 (36.3)	< 0.001
Busy schedule	137 (32.3)	53 (25.0)	84 (39.6)	
Not hungry	125 (29.5)	83 (39.2)	42 (19.8)	
No food available	36 (8.5)	27 (12.7)	9 (4.2)	
Snack consumption				
Every day	53 (12.5)	53 (25.0)	0 (0.0)	< 0.001
3–5 days/week	127 (30.0)	60 (28.3)	67 (31.6)	
1–2 days/week	198 (46.7)	73 (34.4)	125 (59.0)	
Never	46 (10.8)	26 (12.3)	20 (9.4)	
Washing leafy vegetables				
Cut, then wash	290 (68.4)	109 (51.4)	181 (85.4)	< 0.001
Wash first, then cut	134 (31.6)	103 (48.6)	31 (14.6)	
Removal of bran from grains				
Yes	356 (84.0)	181 (85.4)	175 (82.5)	0.427
No	68 (16.0)	31 (14.6)	37 (17.5)	
Removal of bran from legumes				
Yes	380 (89.6)	190 (89.6)	190 (89.6)	1.000
No	44 (10.4)	22 (10.4)	22 (10.4)	
Main factor determining food choice				
Food taste	148 (34.9)	78 (36.8)	70 (33)	< 0.001
Cost	175 (41.3)	43 (20.3)	132 (62.3)	
Nutritional value	101 (23.8)	91 (42.9)	10 (4.7)	
≥ 60 minutes' moderate-to-vigorous physical activity/day				
Yes	382 (90.1)	174 (82.1)	208 (98.1)	< 0.001
No	42 (9.9)	38 (17.9)	4 (1.9)	
Engaged in vigorous-intensity and bone-strengthening activity				
Yes	354 (83.5)	187 (88.2)	167 (78.8)	0.009
No	70 (16.5)	25 (11.8)	45 (21.2)	
Limit sedentary/recreational screen time				
Yes	265 (62.5)	82 (38.7)	183 (86.3)	< 0.001
No	159 (37.5)	130 (61.3)	29 (13.7)	

* = Chi-square-test, p-value < 0.05 is significant.

intakes (48.30 ± 7.95 g/d) compared with their rural counterparts (37.73 ± 6.99 g/d) ($p < 0.001$). Adequate intake of protein is critical during adolescence to support growth, immune function, and cognitive development.[1] Similar trends were reported among women of reproductive age in Kano State, where micronutrient deficiencies were significantly more pronounced in rural areas ($p < 0.05$).[16] The persistent micronutrient gaps, particularly in rural settings, elevate the risk of anaemia, impaired immunity, and suboptimal physical and cognitive development during adolescence.[17] Although inadequate intakes of calcium and vitamin D were universal, urban girls exhibited relatively better overall micronutrient intake profiles, likely due to more diversified diets and increased access to fortified foods.

Meal skipping and low intake of fruits and vegetables were common across all participants, with rural adolescents exhibiting particularly poor dietary behaviours. Omitting lunch and breakfast was notably higher among rural girls in this study, with the most common reasons reported as busy schedules, being late, and not feeling hungry, while food unavailability was less commonly cited. These patterns differ from a previous study by Balogun et al.,[15] which found lunch was most often skipped due to food unavailability among female adolescents in Oyo State. Similarly, Sosanya et al.[18] observed that meal skipping in rural settings is frequently driven by socioeconomic limitations and cultural factors.

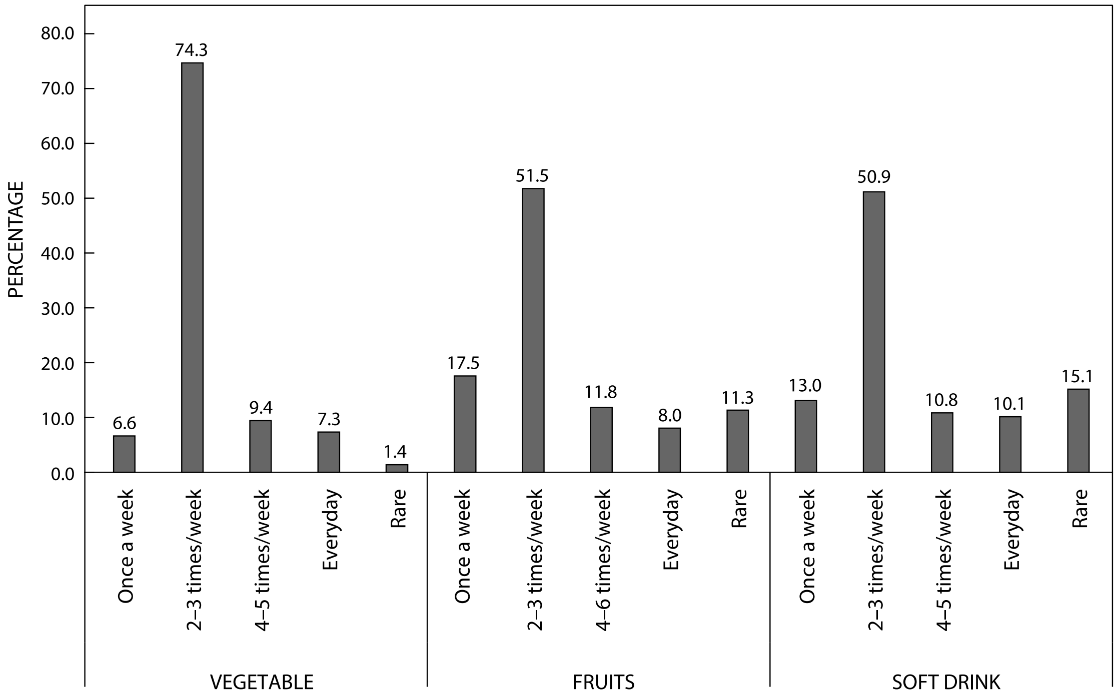

Figure 1: Frequency of vegetable, fruit, and soft drink consumption among all the participants ($n = 424$). * = Chi-square test.

The implications of meal skipping extend beyond immediate hunger to increase the risk of widespread inadequate micronutrient intake and irregular eating patterns.[19] In the present study, widespread nutrient inadequacies were observed alongside frequent meal skipping, highlighting the potential impact of irregular meal patterns on micronutrient intake. Poor food-handling practices, such as washing leafy vegetables after cutting, may exacerbate nutrient losses, particularly water-soluble vitamins like B vitamins, due to leaching into wash water.[20] In addition, while fibre intake was not directly assessed in this study, the widespread practice of removing bran from grains and legumes among participants likely reduces their intake of dietary fibre, B vitamins, and minerals, thereby compounding the risk of micronutrient deficiencies.[21] In addition, the present study revealed a low frequency of fruit and vegetable consumption across both urban and rural participants. This aligns with previous studies in Nigeria reporting inadequate intake. While Darling et al.[22] found that only 4.9% adolescents met the recommended intake of five or more servings of fruits and vegetables daily, the present study assessed using frequency of consumption rather than actual serving, limiting direct comparability. Low fruit and vegetable consumption

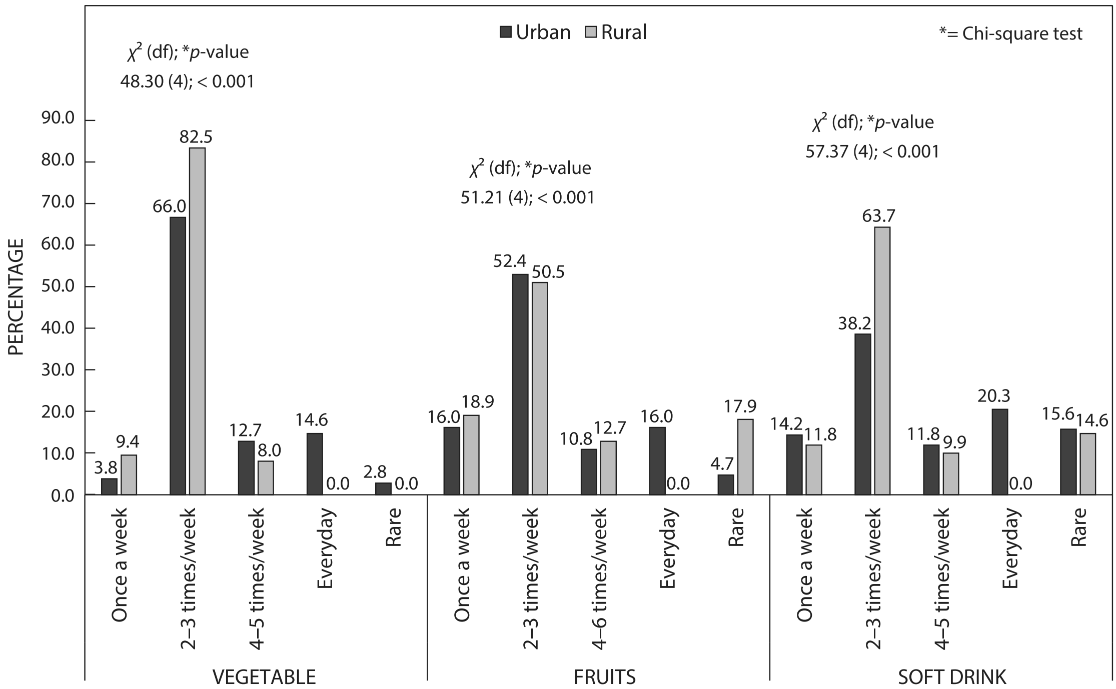

Figure 2: Urban–rural differences in the frequency of vegetable, fruit, and soft drink consumption. * = Chi-square test.

likely contributed to the observed inadequate intakes of micronutrients such as vitamin A and folate, which are abundant in these food groups. Urban participants reported higher consumption of snacks (high in fat, sugar, or salt) and sugar-sweetened beverages, reflecting a nutrition transition in the community, where traditional diets are displaced by energy-dense, nutrient-poor processed foods.[23] This dietary shift increases the risks of non-communicable diseases.

Despite concerning dietary behaviours, physical activity levels were generally high, especially among rural participants. About 90.1% of participants met the World Health Organization's recommendation for moderate-to-vigorous physical activity (MVPA). This is comparable to findings from Southern Nigeria, where 82.8% of adolescents met the recommended physical activity levels,[24] but higher than those in Maiduguri, Northern Nigeria, where only 37% engaged in MVPA.[25] Urban adolescents exhibited more sedentary behaviour, consistent with a systematic review by Adeloye et al.,[26] which found a higher rate of physical inactivity among urban residents (56.8%) compared with rural dwellers (18.9%). Rural lifestyles, characterised by active commuting and manual chores, may account for the higher physical activity level observed. Urban adolescents, although relatively better nourished, face emerging risks associated with modernisation, such as unhealthy dietary habits and increased screen time.[27]

The disparities observed between urban and rural female adolescents are likely rooted in interconnected socioeconomic, educational, and environmental factors. Urban girls benefit from greater access to health information, economic resources, and a more diverse diet.[10,28] In contrast, rural adolescents face food insecurity, limited dietary diversity, and entrenched traditional beliefs,[18] which exacerbate undernutrition.

While this study assessed nutrient intake and dietary behaviours, future research should examine how these practices interact, such as whether low nutrient intake co-occurs with poor food handling or frequent meal skipping. Investigating how factors like household structure and parental education influence these behaviours could also inform targeted interventions. The findings of the present study may not be fully generalisable to all adolescents across Kano State, as the study was conducted in only one urban and one rural LGA out of 44 LGAs in the state.

Conclusion

This study provides compelling evidence of widespread inadequate intake of micronutrients and suboptimal dietary practices among adolescent girls in Kano State, Nigeria, with significant differences observed between urban and rural settings. The alarmingly low intakes of essential micronutrients, particularly zinc, calcium, vitamin D, vitamin B12, vitamin A, and folate, pose a serious threat to the health and development of these young women. Rural adolescents appear to be more vulnerable, exhibiting lower intakes across nutrients and poorer dietary behaviours, including meal skipping and lower consumption of fruits and vegetables, while urban adolescents demonstrated higher consumption of snacks and sugar-sweetened beverages, coupled with lower physical activity levels.

Implications for public health

The findings of this study underscore the urgent need for targeted and context-specific interventions to improve the nutrient intake and dietary practices of adolescent girls in Kano State. Nutrition education programmes are crucial to address poor food-handling practices and promote the consumption of nutrient-dense foods, such as fruits and vegetables and whole plant foods. Empowering adolescent girls with nutrition knowledge and promoting healthy behaviours is vital for their present well-being and for breaking the intergenerational cycle of malnutrition, given their future roles as mothers and influencers of family health. Future research should focus on designing and evaluating effective, culturally appropriate intervention strategies to improve adolescent nutrition in this setting.

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