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Sociocultural Determinants of BMI-for-Age: Effects of Food Taboos, Cultural Beliefs, and Food Fallacies Among Adolescent Girls in Sokoto, Nigeria.

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Abstract

Background: Adolescent girls in Northern Nigeria are highly vulnerable to malnutrition due to increased nutritional demands and sociocultural practices that shape dietary behavior. Food taboos, cultural beliefs, and food fallacies are widely documented, yet their specific relationship with nutritional status as measured by BMI-for-age remains underexplored in Sokoto Metropolis. Objective: To assess the effect of food taboos, cultural beliefs, and food fallacies on the nutritional status (BMI-for-age) of adolescent girls in Sokoto Metropolis, Nigeria. Methods: A descriptive cross-sectional study was conducted among 251 adolescent girls aged 10–19 years in Sokoto North and Sokoto South Local Government Areas. A multistage sampling technique was used. Data were collected using an interviewer-administered structured questionnaire and anthropometric measurements. BMI-for-age z-scores were derived using WHO AnthroPlus (2007 reference). Food taboo, cultural belief, and food fallacy scores were computed, and their association with nutritional status was tested using chi-square, Kruskal-Wallis, Spearman's correlation, and multiple regression analyses. Statistical significance was set at $p < 0.05$. Results: The mean age was 13.8 ± 3.3 years. Food avoidance was common (86.1% avoided at least one food; 39.8% when snails were excluded), mostly for religious reasons (46.6%). Cultural beliefs were strong, with 44.6% of girls having high belief levels. Food fallacies were widespread (41.8% high level), with 61.0% believing skipping breakfast promotes slimness. Nine in ten girls (89.6%) reported beliefs influenced their daily food choices, and 21.5% had stopped eating a nutritious food because of a belief. Nutritional status showed a double burden: 16.7% were thin (8.8% severely thin) and 12.7% were overweight or obese, with both conditions concentrated among girls aged 10–13 years. No significant relationship was found between food taboos ($p = 0.484$), cultural beliefs ($p = 0.779$), or food fallacies ($p = 0.846$) and BMI-for-age z-scores. Only age group ($p < 0.001$) and level of education ($p < 0.001$) were significantly associated with nutritional status. Conclusion: Food taboos, cultural beliefs, and food fallacies were highly prevalent but were not significantly associated with BMI-for-age in this population. The double burden of malnutrition was concentrated in early adolescence. Interventions should target beliefs that affect diet quality, focus on girls aged 10–13 years, and involve family and religious leaders in culturally sensitive nutrition education.

Keywords: *Food taboos, cultural beliefs, food fallacies, nutritional status, BMI-for-age, adolescent girls, Sokoto, Nigeria*

1. Introduction

Adolescence is a period of rapid physical growth and rising nutritional demand (World Health Organization, 2024), and adolescent girls in Northern Nigeria are considered especially vulnerable to malnutrition because sociocultural practices frequently shape what they may and may not eat. Food taboos, cultural beliefs and food fallacies are widely documented across the region, yet the extent to which they are statistically associated with nutritional status, measured objectively as BMI-for-age, remains poorly characterised in Sokoto Metropolis. This study set out to close that gap by simultaneously measuring exposure to these three sociocultural constructs and the BMI-for-age status of a sample of adolescent girls.

Food taboos refer to culturally or religiously rooted prohibitions on specific foods, often based on symbolic meaning rather than nutritional science. Cultural beliefs encompass the shared values and convictions a community holds about the safety or appropriateness of particular foods for particular people or occasions, while food fallacies are unsubstantiated claims about a food's effects that are widely accepted despite lacking scientific support. In many African societies, these three sociocultural forces jointly shape household food allocation, restricting foods such as eggs, fish, meat, milk and certain fruits for adolescent girls on the grounds that they promote promiscuity, infertility or otherwise undesirable traits.

In Northern Nigeria, including Sokoto State, cultural norms and traditional beliefs strongly influence food allocation, preparation and the foods considered acceptable for females. Sokoto Metropolis is predominantly Hausa-Fulani, and Islamic teaching and long-standing tradition together shape what girls are permitted, encouraged or discouraged from eating. While such traditions contribute to cultural identity and cohesion, food-related beliefs and fallacies may inadvertently narrow dietary diversity among adolescent girls at precisely the life stage when their nutritional requirements are highest (Agofure et al., 2021; Ariyo et al., 2023).

Nigerian studies conducted within Sokoto metropolis have documented the prevalence of BMI-for-age abnormalities among school adolescents and identified demographic predictors such as parental education, household size and social class (Jiya et al., 2024; Essien et al., 2014), but none has systematically examined the specific contribution of food taboos, cultural beliefs and food fallacies to BMI-for-age among adolescent girls in the metropolis. Elsewhere in Nigeria, food-taboo research has focused mainly on pregnant and lactating women (Ekwochi et al., 2016;

Ugwa, 2016) rather than on adolescent girls, while studies centred specifically on adolescent girls have been conducted outside Nigeria, principally in Tanzania and Uganda (Lekey et al., 2024). A qualitative study across three Northern Nigerian states found that adolescent girls exercised only "circumscribed agency" over their own food choices, with fathers and husbands largely controlling household food decisions (Conrad et al., 2024). This leaves a clear empirical gap: little is known about the specific taboos, beliefs and fallacies held by adolescent girls in Sokoto metropolis, or about how far adherence to these beliefs is statistically associated with measured nutritional status.

The specific objectives were to assess the prevalence of food taboos, cultural beliefs and food fallacies; to assess the nutritional status (BMI-for-age) of the girls; and to determine the relationship between these three sociocultural constructs, socio-demographic characteristics, and nutritional status.

2. Materials and Methods

This study used a descriptive cross-sectional design, combining a structured, interviewer-administered questionnaire with direct anthropometric measurement, to allow the simultaneous assessment of nutritional status and the sociocultural variables of interest within a single, defined population.

The study was conducted in Sokoto metropolis, Sokoto State, in the North-Western geopolitical zone of Nigeria. The metropolis comprises three Local Government Areas (Sokoto North, Sokoto South and Wamakko), with a combined population of about 858,000 people. It is predominantly Hausa-Fulani and Muslim, a factor that strongly shapes dietary customs and gender-differentiated feeding practices.

The study population comprised adolescent girls aged 10 to 19 years resident in Sokoto metropolis. Because girls in this age range are found across different levels of education in the study area, the sampling frame included girls attending public and private primary, secondary and tertiary institutions, as well as those in non-formal Islamiyya (Qur'anic) education, within the selected Local Government Areas.

A multistage sampling technique was used. Two of the three Local Government Areas were randomly selected by balloting. Schools and learning centres in each selected area were stratified

into public and private categories, and a proportionate number was randomly selected from each stratum. The sample size was allocated proportionately across the selected schools/centres, and individual respondents were then drawn by systematic random sampling from class or enrolment registers. The minimum sample size, calculated with the Cochran formula (Z = 1.96, assumed prevalence of adolescent malnutrition = 20%, margin of error = 5%), was approximately 250 participants; 251 girls were eventually enrolled.

Data were collected with a structured questionnaire covering sociodemographic information, household background, dietary practices, food-frequency, food taboos and restrictions, food fallacies and misconceptions, physical activity, and anthropometric measurements. The questionnaire was face- and content-validated by nutrition and public health experts and pretested among girls outside the study schools (about 5% of the calculated sample size). Weight was measured to the nearest 0.1 kg and height to the nearest 0.1 cm using calibrated instruments, following standard anthropometric procedures. Body Mass Index (BMI) was calculated as weight in kilograms divided by height in metres squared, and BMI-for-age z-scores were derived from age, BMI and the WHO 2007 growth reference for children and adolescents aged 5 to 19 years. Girls were classified as thin/underweight (z-score below -2 SD), normal (-2 SD to +1 SD), overweight (above +1 SD to +2 SD) or obese (above +2 SD); thin girls below -3 SD were further described as severely thin.

The food taboo score was the number of listed foods (of 12) that a respondent avoided. The cultural belief score (10 items) and food fallacy score (12 items) were computed as the sum of responses to Likert-scale statements (1 = strongly disagree to 4 = strongly agree), and respondents were grouped into low, moderate and high levels using the mean item score. Internal consistency was excellent for both scales (Cronbach's alpha = 0.95 for cultural beliefs and 0.96 for food fallacies).

Descriptive statistics (frequencies, percentages, means and standard deviations) summarised the data. The chi-square test (with Monte Carlo simulation where more than 20% of cells had an expected count below 5) tested associations between categorical variables. The Mann-Whitney U and Kruskal-Wallis tests compared BMI-for-age z-scores across groups, and Spearman's rank correlation examined relationships between the sociocultural scores and BMI-for-age. Multiple linear regression (outcome: BMI-for-age z-score) and multiple logistic regression (outcome:

thinness) tested whether associations remained after adjusting for age, religion, household income, food security and mother's education. All analyses were performed in Python (pandas and SciPy), and a p-value below 0.05 was considered statistically significant.

This study was conducted in accordance with the Declaration of Helsinki. Ethical clearance was obtained from the Sokoto State Ministry of Health (Ref. No. SMH/1580/V.IV), and permission was obtained from the Sokoto State Ministry of Education, the body responsible for Islamiyya schools, and the management of the selected schools/centres. Written informed consent was obtained from parents/guardians, with assent from the girls themselves. Participation was voluntary, confidentiality was maintained throughout, and girls found with abnormal BMI-for-age were referred for further evaluation.

3. Results

Socio-demographic characteristics of the respondents

Table 1 shows the socio-demographic characteristics of the 251 girls. Their mean age was 13.8 ± 3.3 years (median 13 years). Just over half (50.2%) were in early adolescence (10 to 13 years), 21.5% were in middle adolescence and 28.3% were in late adolescence. The most common single age was 10 years (Figure 1). By level of education, 44.2% were in primary school, 33.5% in secondary school and 7.2% in tertiary or post-secondary institutions, while 15.1% attended only Islamiyya school. Most of the girls (77.7%) attended integrated schools that combine modern and Islamic education.

Most of the girls were Muslim (84.5%) and Hausa (77.7%), but 15.5% were Christian and 17.5% were Yoruba. Almost all were single (97.2%), and 79.7% lived with their parents. Sokoto South contributed 61.0% of the respondents and Sokoto North 39.0%.

Table 1: Socio-demographic characteristics of the respondents (n = 251)

Characteristic	Frequency (n)	Percentage (%)
Age group		
Early (10–13 years)	126	50.2
Middle (14–16 years)	54	21.5
Late (17–19 years)	71	28.3
Level of education		
Primary	111	44.2

Characteristic	Frequency (n)	Percentage (%)
Secondary (JSS/SSS)	84	33.5
Tertiary/Post-secondary	18	7.2
Islamiyya only (not in formal school)	38	15.1
Type of school attended		
Integrated (modern + Islamic)	195	77.7
Modern/formal only	43	17.1
Islamic (Islamiyya/Qur'anic) only	13	5.2
Religion		
Islam	212	84.5
Christianity	39	15.5
Ethnic group		
Hausa	195	77.7
Yoruba	44	17.5
Igbo	8	3.2
Others (Fulani, Nupe, missing)	4	1.6
Marital status		
Single	244	97.2
Married	7	2.8
Living arrangement		
With parents	200	79.7
With guardian	44	17.5
Alone or with husband	7	2.8
Local Government Area		
Sokoto South	153	61.0
Sokoto North	98	39.0
Community		
Mabera	105	41.8
Runjin Sambo	53	21.1
Unguwan Rogo	49	19.5
Tudun Wada	44	17.5

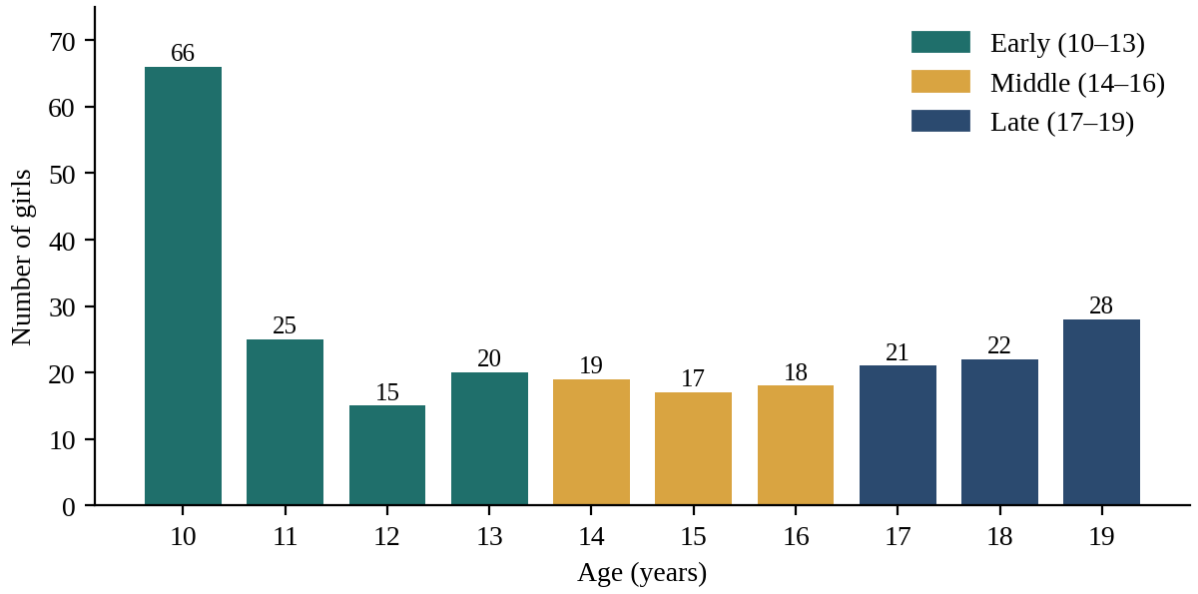

Fig. 1. Age distribution of the respondents.

Household characteristics

Table 2 describes the households of the girls. About 40.6% of fathers or guardians had tertiary education, compared with 10.0% of mothers or guardians. Most mothers had secondary (40.2%) or primary education (23.1%). Trading or business was the main occupation of both fathers (41.8%) and mothers (44.2%), while 25.1% of mothers had no paid occupation. Nearly two-thirds of the girls (62.9%) came from monogamous families. On food security, 45.8% said their household always had enough food, 47.0% said they sometimes went without, and 7.2% often went without. In other words, more than half of the households reported some level of food shortage.

Table 2: Household characteristics of the respondents (n = 251)

Characteristic	Frequency (n)	Percentage (%)
Father's/guardian's education		
No formal or Qur'anic only	71	28.3
Primary	15	6.0
Secondary	63	25.1
Tertiary	102	40.6
Mother's/guardian's education		
No formal or Qur'anic only	67	26.7
Primary	58	23.1
Secondary	101	40.2

Characteristic	Frequency (n)	Percentage (%)
Tertiary	25	10.0
Father's/guardian's occupation		
Trading/Business	105	41.8
Civil servant	101	40.2
Farming	25	10.0
Artisan/Skilled labour	17	6.8
Others/unemployed	3	1.2
Mother's/guardian's occupation		
Trading/Business	111	44.2
Unemployed	63	25.1
Civil servant	34	13.5
Artisan/Skilled labour	24	9.6
Farming	14	5.6
Others	5	2.0
Family type		
Monogamous	158	62.9
Polygamous	93	37.1
Monthly household income (₦)		
≤60,000	74	29.5
61,000–100,000	99	39.4
>100,000	78	31.1
Household food security		
Always have enough food	115	45.8
Sometimes go without	118	47.0
Often go without	18	7.2

Prevalence of food taboos

Table 3 and Figure 2 show how many girls avoid each of the 12 listed foods. Overall, 216 girls (86.1%; 95% CI 81.2–89.8) avoided at least one of the listed foods. This figure is high mainly because of snails, which were avoided by 176 girls (70.1%). Snail avoidance was reported by 81.6% of Muslim girls but only 7.7% of Christian girls, which points to a religious rather than a purely cultural reason. When snails are left out, 100 girls (39.8%; 95% CI 34.0–46.0) still avoided at least one food.

After snails, the foods most often avoided were groundnuts (17.9%), fish (10.8%) and bone marrow or bones (8.8%). Avoidance of eggs, milk, red meat, fruits, vegetables and cereals was

low, each below 4%. On average, a girl avoided 1.3 ± 1.1 of the 12 foods, and 0.6 ± 1.1 foods when snails were excluded. By taboo exposure level, 77.7% of girls avoided 1 to 2 foods, 8.4% avoided three or more foods, and 13.9% avoided none. In addition, 46 girls (18.3%) wrote pork as another food avoided in their household, mostly because it is haram.

Table 3: Foods avoided by the respondents (n = 251)

Food	Avoiding (n)	Percentage (%)	95% CI (%)
Snails	176	70.1	64.2–75.4
Groundnuts	45	17.9	13.7–23.1
Fish	27	10.8	7.5–15.2
Bone marrow/bones	22	8.8	5.9–12.9
Honey	11	4.4	2.5–7.7
Liver/organ meats	10	4.0	2.2–7.2
Milk & dairy	9	3.6	1.9–6.7
Red meat	8	3.2	1.6–6.2
Fruits	8	3.2	1.6–6.2
Egg	7	2.8	1.4–5.6
Certain cereals	7	2.8	1.4–5.6
Vegetables	2	0.8	0.2–2.9

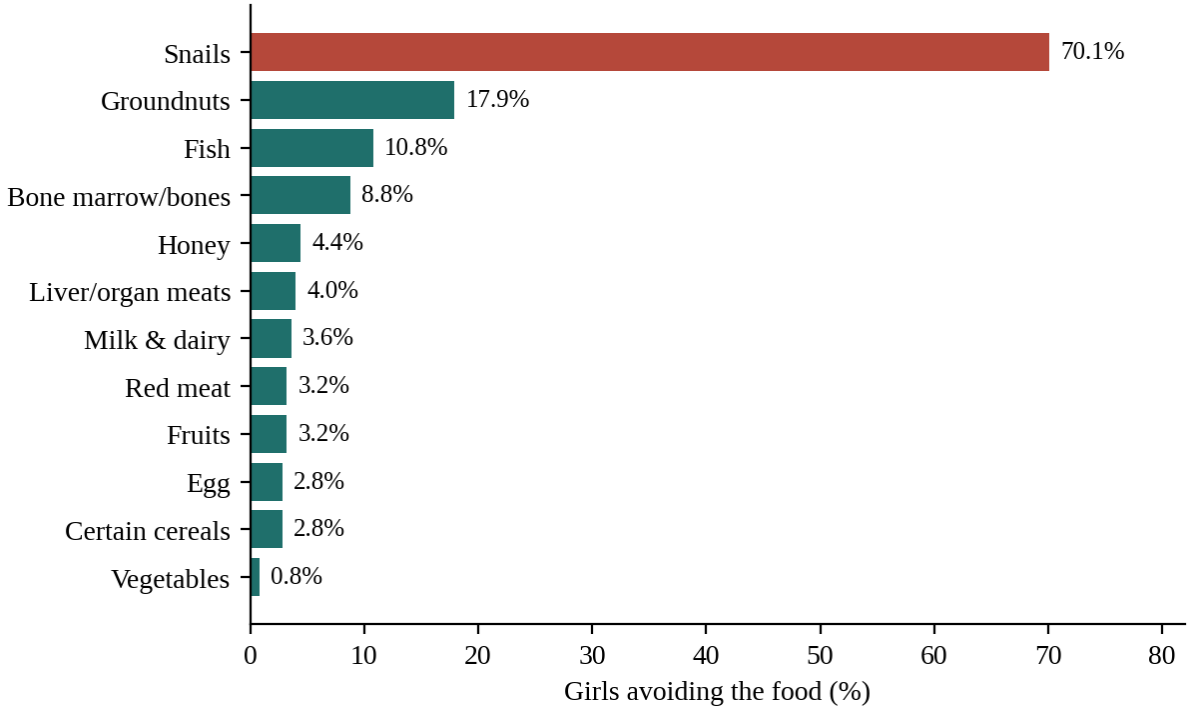

Fig. 2. Percentage of girls avoiding each food.

Among the 189 girls who gave a reason for avoiding food, the most common reason was religious prohibition (46.6%), followed by health reasons or allergy such as skin rash and eczema (31.2%) and culture, tradition or belief (15.3%) (Table 4). Some girls gave more than one reason, so the percentages add up to more than 100. This means that not every avoidance is a true taboo. Some girls avoid a food for a personal health reason such as an allergy.

Table 4: Reasons given for avoiding foods (n = 189 girls who gave a reason)

Reason	n	Percentage (%)
Religious prohibition (haram)	88	46.6
Health reasons or allergy	59	31.2
Culture, tradition or belief	29	15.3
Other	23	12.2
Personal dislike/preference	9	4.8

Multiple reasons were possible, so percentages add up to more than 100.

On who taught the girls to avoid a food, fathers were named most often (30.5%), followed by grandmothers (20.3%) and mothers (16.9%) (Figure 3a). When asked who most influences the food restrictions they follow, 47.4% named the father, 36.3% the mother, 31.1% grandmothers or elderly female relatives and 26.7% religious leaders or teachers (Figure 3b). Peers and traditional birth attendants or herbalists were named far less often.

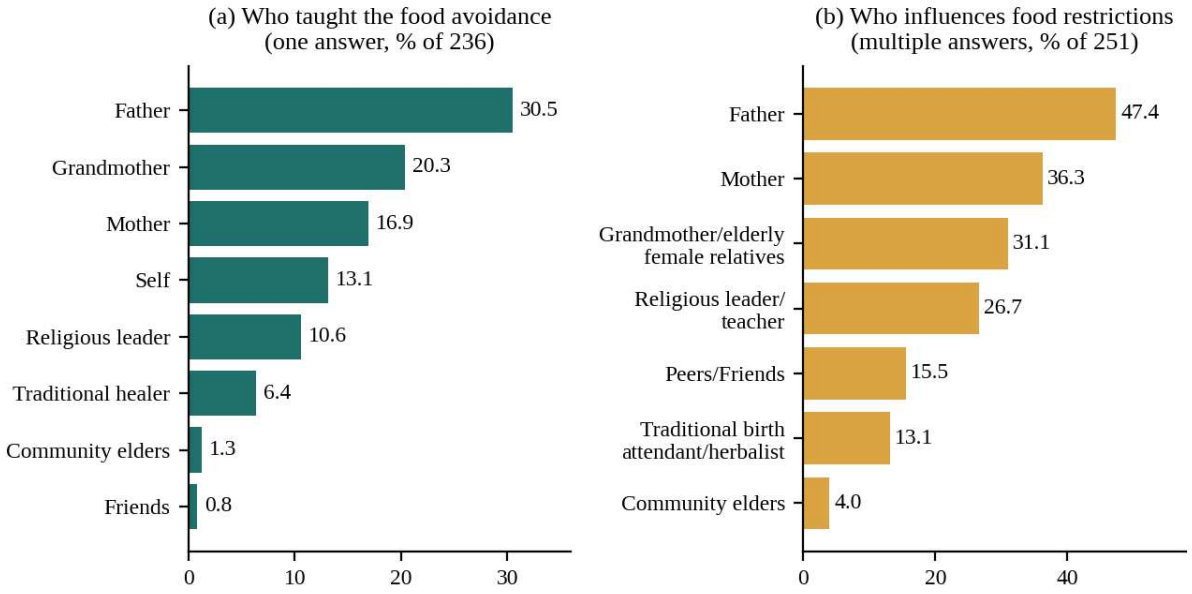

Fig. 3. Sources of food avoidance and influence on food restrictions.

Cultural beliefs influencing food choices

Table 5 and Figure 4 show the responses to the 10 cultural belief statements. For every statement, more than half of the girls agreed or strongly agreed, with agreement ranging from 56.6% to 63.7%. The statements with the highest agreement were that certain foods are restricted during menstruation (63.7%), that elders' advice on food restriction is followed even without understanding the reason (62.9%), and that religious teachings decide which foods are suitable for girls (61.8%). More than half also agreed that some foods can cause infertility in girls (56.6%), that some foods are kept for adults or men (56.6%), and that food can affect a girl's chances of marriage (57.4%).

Table 5: Responses to cultural belief statements (n = 251)

Statement	SD (%)	D (%)	A (%)	SA (%)	Agree (A+SA, %)	Mean ± SD
Certain foods cause infertility/reproductive problems in girls if eaten often	25.5	17.9	35.9	20.7	56.6	2.52 ± 1.09
Some foods are reserved for adults/men and are inappropriate for girls	9.2	34.3	47.4	9.2	56.6	2.57 ± 0.78
Some foods are "too strong" or "hot" for a girl's body	24.3	19.1	35.5	21.1	56.6	2.53 ± 1.08
Eating certain foods can affect a girl's marriage prospects	9.6	33.1	43.0	14.3	57.4	2.62 ± 0.85
Certain foods are restricted during menstruation	23.5	12.7	40.6	23.1	63.7	2.63 ± 1.08
Religious teachings influence which foods are permissible/appropriate for girls	6.4	31.9	43.4	18.3	61.8	2.74 ± 0.83
Eating certain animal foods makes a girl behave like that animal	23.1	16.7	42.6	17.5	60.2	2.55 ± 1.03
Elders' advice on food restriction is followed without understanding the reason	6.4	30.7	44.2	18.7	62.9	2.75 ± 0.83
Some foods cause early puberty or excessive body growth	21.9	17.1	46.6	14.3	61.0	2.53 ± 0.99
Breaking a food taboo brings misfortune or illness to the person or family	5.6	33.1	43.4	17.9	61.4	2.74 ± 0.82

SD = strongly disagree, D = disagree, A = agree, SA = strongly agree. Mean score is out of 4 (higher = stronger agreement).

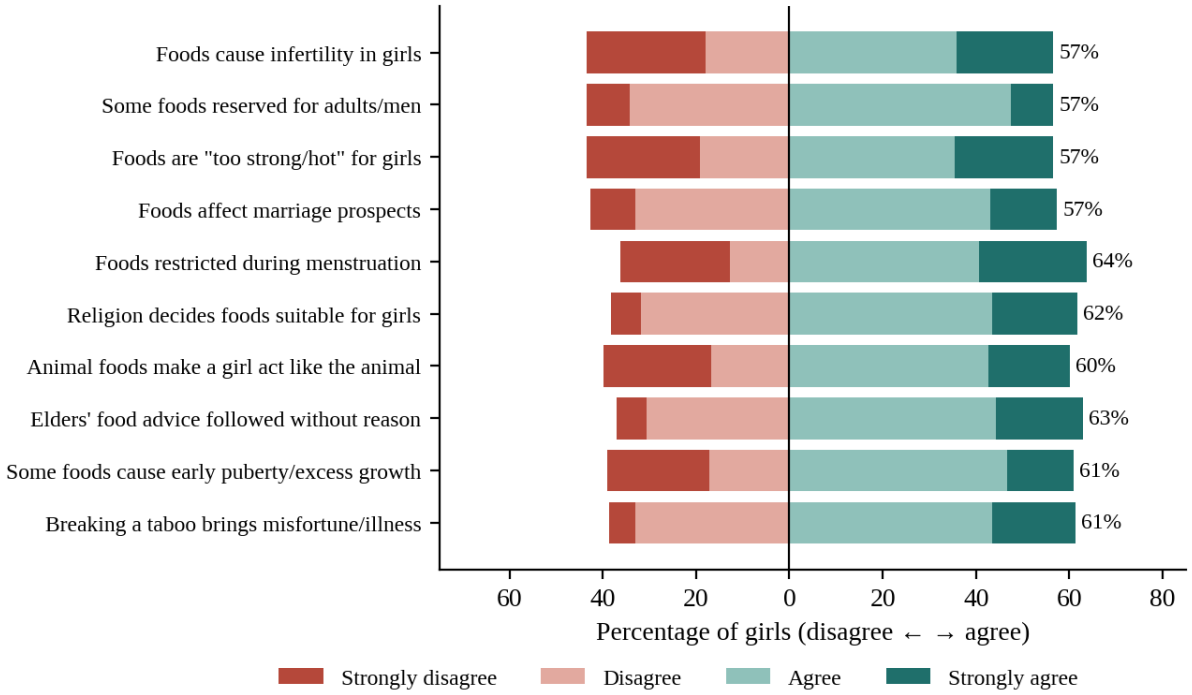

Fig. 4. Agreement with the cultural belief statements (n = 251).

The mean cultural belief score was 26.2 ± 7.8 out of 40 (mean item score 2.62 out of 4). By level, 44.6% of the girls had a high level of cultural belief, 25.5% a moderate level and 29.9% a low level (Table 7).

Prevalence of food fallacies

Table 6 and Figure 5 show the responses to the 12 food fallacy statements. Belief in the fallacies was common. Agreement with each false statement ranged from 55.0% to 63.3%. The most widely held fallacies were that sugar and sweet foods are the main cause of all illnesses in adolescents (63.3%), that vitamin supplements are not needed if a girl eats any food at all (62.5%), and that skipping breakfast helps a girl stay slim and attractive (61.0%). Other common fallacies were that groundnuts cause appendicitis (59.0%), that fish causes worms (57.4%), that a fuller body shape means better health than a slim one (57.8%) and that vegetables have little value compared with meat (58.2%).

Table 6: Responses to food fallacy statements (n = 251)

Statement	SD (%)	D (%)	A (%)	SA (%)	Agree (A+SA, %)	Mean ± SD

Statement	SD (%)	D (%)	A (%)	SA (%)	Agree (A+SA, %)	Mean ± SD
Eating too many eggs makes a girl promiscuous	26.7	16.7	37.5	19.1	56.6	2.49 ± 1.08
Eating fish causes worms in the stomach	4.0	38.6	50.2	7.2	57.4	2.61 ± 0.68
Drinking cold water with meals makes the body fat unnecessarily	24.3	20.7	37.5	17.5	55.0	2.48 ± 1.04
Eating fruit at night is harmful to health	9.2	35.9	36.7	18.3	55.0	2.64 ± 0.88
Skipping breakfast helps a girl stay slim and attractive	22.7	16.3	43.0	17.9	61.0	2.56 ± 1.03
Eating groundnuts causes appendicitis	8.0	33.1	46.2	12.7	59.0	2.64 ± 0.81
Eating outside the home is more nutritious than home-cooked food	23.9	19.5	41.8	14.7	56.6	2.47 ± 1.01
Too much water with food dilutes the blood and weakens the body	8.8	35.9	37.8	17.5	55.4	2.64 ± 0.87
Sugar and sweet foods are the main cause of all illnesses in adolescents	21.1	15.5	47.4	15.9	63.3	2.58 ± 0.99
A fuller body shape is a sign of better health than a slim body	10.8	31.5	43.4	14.3	57.8	2.61 ± 0.86
Vegetables have little or no nutritional value compared to meat	22.7	19.1	42.2	15.9	58.2	2.51 ± 1.01
Vitamin supplements are unnecessary if a girl eats any food at all	8.8	28.7	47.4	15.1	62.5	2.69 ± 0.83

SD = strongly disagree, D = disagree, A = agree, SA = strongly agree. Agreeing with a statement means believing the fallacy.

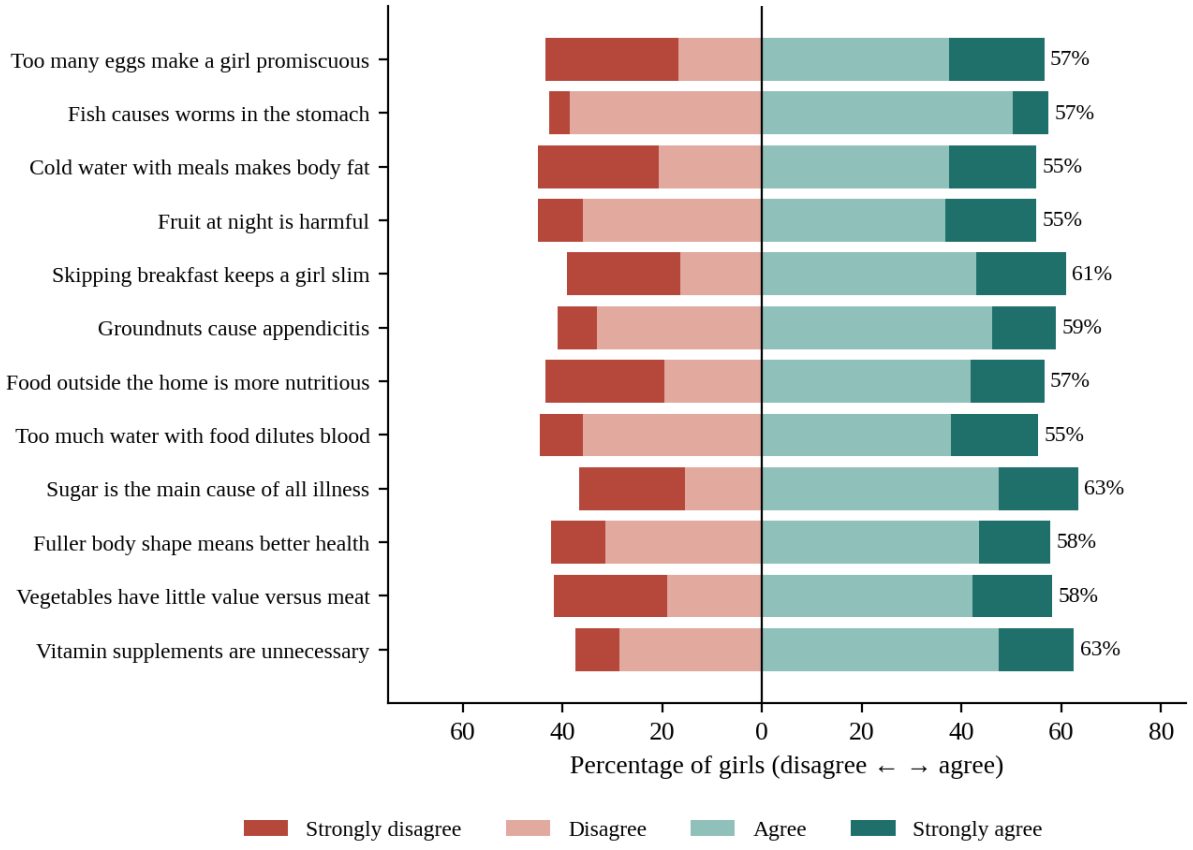

Fig. 5. Agreement with the food fallacy statements (n = 251).

The mean food fallacy score was 30.9 ± 9.4 out of 48 (mean item score 2.58 out of 4). By level, 41.8% of the girls had a high level of belief in food fallacies, 30.7% a moderate level and 27.5% a low level (Table 7). The cultural belief score and the food fallacy score were strongly related (Spearman's rho = 0.89, $p < 0.001$), meaning that girls who agreed with the cultural beliefs also tended to agree with the fallacies.

Table 7: Levels of food taboo exposure, cultural beliefs and food fallacies (n = 251)

Level	Frequency (n)	Percentage (%)
Food taboo exposure (foods avoided)		
None (0 foods)	35	13.9
Low (1–2 foods)	195	77.7
High (3 or more foods)	21	8.4
Cultural belief level		
Low	75	29.9
Moderate	64	25.5
High	112	44.6
Food fallacy level		

Level	Frequency (n)	Percentage (%)
Low	69	27.5
Moderate	77	30.7
High	105	41.8

The girls were also asked how these beliefs affect their eating. Most said the beliefs affect what they eat every day, with 27.1% saying "strongly" and 62.5% saying "somewhat". Only 10.4% said the beliefs had no influence. About one in five girls (21.5%) had stopped eating a nutritious food because of a belief, and a further 2.8% said "maybe" (Table 8). The beliefs were mostly learnt at home (56.6%), followed by school (15.9%), religious gatherings (13.9%) and friends (10.8%). Social media and the internet were named by only 2.4% of the girls.

Table 8: Influence of beliefs on food choice and where the beliefs were learnt (n = 251)

Item	Frequency (n)	Percentage (%)
Do the beliefs influence what you eat daily?		
Yes, strongly	68	27.1
Yes, somewhat	157	62.5
No, not at all	26	10.4
Ever stopped eating a nutritious food because of a belief?		
Yes	54	21.5
Maybe	7	2.8
No	190	75.7
Where the beliefs were first learnt		
Family or home	142	56.6
School	40	15.9
Religious gathering	35	13.9
Friends or peers	27	10.8
Social media or internet	6	2.4
Television or radio	1	0.4

Dietary practices of the respondents

Table 9 shows the meal pattern of the girls. About three-quarters (74.1%) ate three main meals a day and 24.3% ate only one or two. Most girls (74.4% of those who reported) ate two or three snacks a day. On meal skipping, 66 girls (26.4%) said they skip meals often or sometimes.

Table 9: Meal pattern of the respondents

Practice	Frequency (n)	Percentage (%)
Main meals per day (n = 251)		
One or two	61	24.3
Three	186	74.1
More than three	4	1.6
Snacks per day (n = 250)		
One	30	12.0
Two	104	41.6
Three	82	32.8
More than three	34	13.6
Skipping meals (n = 250)		
Never	34	13.6
Rarely	150	60.0
Sometimes	21	8.4
Often	45	18.0

The food frequency results are in Table 10. Animal-source protein foods were eaten daily by only 8.4% of the girls, and 53.0% ate them at least three times a week. Fruits were eaten at least three times a week by 49.0% and dark green leafy vegetables by 55.4%. Sugary foods and drinks and fried or fast foods were eaten at least three times a week by 50.0% and 54.2% of the girls respectively.

Table 10: Food frequency of the respondents (%)

Food group	Daily	3–6 times/week	1–2 times/week	Rarely	Never	Daily or 3–6/wk
Animal-source protein	8.4	44.6	37.5	9.2	0.4	53.0
Milk & dairy	15.9	29.9	43.8	9.2	1.2	45.8
Legumes & nuts	13.5	41.0	32.3	12.4	0.8	54.6
Dark green leafy veg	15.5	39.8	35.5	8.0	1.2	55.4
Other vegetables	13.5	43.0	37.1	6.0	0.4	56.6
Fruits	11.6	37.5	43.4	6.8	0.8	49.0
Fortified/whole grains	18.7	40.6	32.3	6.0	2.4	59.4
Sugary foods/drinks	14.8	35.2	36.8	11.2	2.0	50.0
Fried/fast foods	12.0	42.2	32.7	10.4	2.8	54.2

Percentages are row percentages (one girl did not answer the sugary foods question).

Nutritional status (BMI-for-age) of the respondents

Table 11 gives the body measurements of the girls. The mean weight was 41.2 ± 11.5 kg, the mean height was 148.0 ± 11.1 cm and the mean BMI was 18.5 ± 3.4 kg/m². The mean BMI-for-age z-score was −0.55 ± 1.56, which is slightly below the WHO reference median of zero. The spread of z-scores was much wider in early adolescence (SD = 1.96) than in middle (SD = 1.00) or late adolescence (SD = 1.00) (Figure 7).

Table 11: Anthropometric characteristics of the respondents (mean ± SD)

Measurement	All (n = 251)	Early (n = 126)	Middle (n = 54)	Late (n = 71)
Weight (kg)	41.2 ± 11.5	32.7 ± 7.2	46.5 ± 7.6	52.1 ± 7.8
Height (cm)	148.0 ± 11.1	139.1 ± 5.4	153.2 ± 7.7	159.7 ± 6.2
BMI (kg/m²)	18.5 ± 3.4	16.9 ± 3.5	19.7 ± 2.5	20.4 ± 2.5
BMI-for-age z-score	−0.55 ± 1.56	−0.73 ± 1.96	−0.31 ± 1.00	−0.43 ± 1.00
Waist circumference (cm)	59.4 ± 6.5	56.6 ± 5.0	61.4 ± 6.3	62.8 ± 6.7
Hip circumference (cm)	62.6 ± 7.2	59.7 ± 5.2	64.6 ± 7.4	66.1 ± 8.0

Table 12 and Figure 6 show the nutritional status of the girls. Most girls (70.5%) had a normal BMI-for-age. However, 42 girls (16.7%; 95% CI 12.6–21.8) were thin, including 22 (8.8%) who were severely thin. Another 32 girls (12.7%; 95% CI 9.2–17.4) were overweight (9.2%) or obese (3.6%). So both undernutrition and overnutrition were present in the same group of girls.

The problem was concentrated in early adolescence. Among girls aged 10 to 13 years, 27.8% were thin and 22.2% were overweight or obese, so only half (50.0%) had a normal BMI-for-age. Among girls aged 14 to 16 years, 5.6% were thin and 5.6% were overweight or obese. Among girls aged 17 to 19 years, the figures were 5.6% and 1.4%.

Table 12: Nutritional status (BMI-for-age) of the respondents

BMI-for-age category	Frequency (n)	Percentage (%)
All respondents		
Severe thinness (below −3 SD)	22	8.8
Thinness (−3 SD to below −2 SD)	20	8.0
Normal (−2 SD to +1 SD)	177	70.5
Overweight (above +1 SD to +2 SD)	23	9.2
Obese (above +2 SD)	9	3.6
Total thin (below −2 SD)	**42**	**16.7**
Total overweight or obese (above +1 SD)	**32**	**12.7**

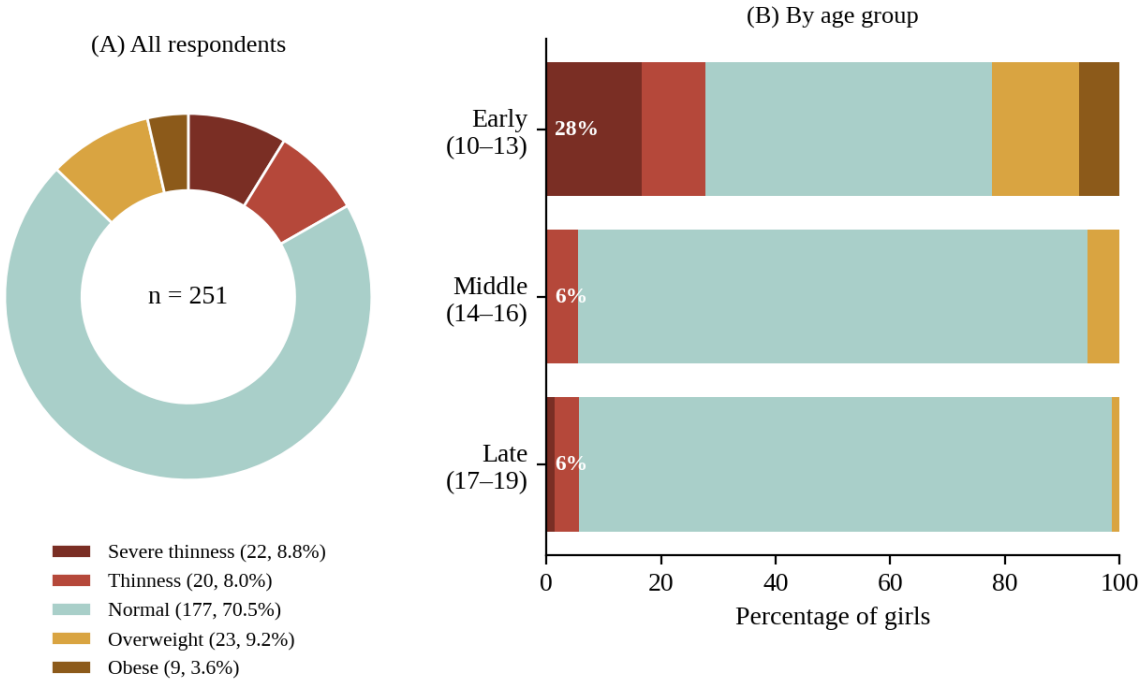

Fig. 6. Nutritional status of the girls, overall and by age group. (A) Nutritional status of all respondents. (B) Nutritional status by age group

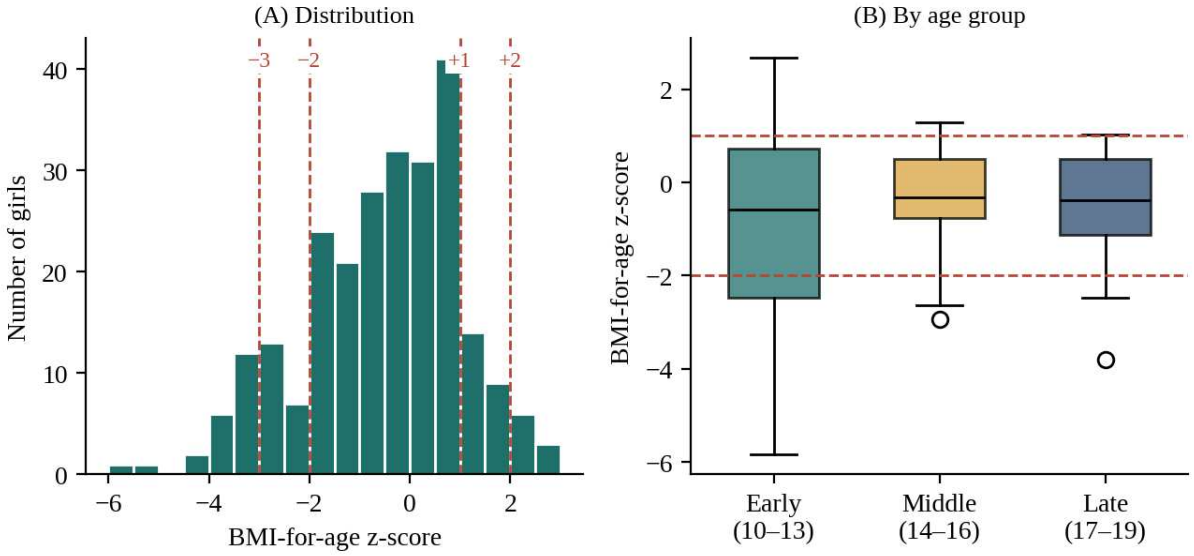

Fig. 7. BMI-for-age z-scores of the girls, with dashed lines marking −3, −2, +1 and +2 SD. (A) Distribution of z-scores for all respondents. (B) Z-scores by age group

Relationship between sociocultural factors and nutritional status

Socio-demographic characteristics and nutritional status

Table 13 compares the nutritional status of the girls across their socio-demographic and household characteristics. Only two characteristics were significantly associated with nutritional status: age group ($\chi^2 = 51.84$, df = 4, $p < 0.001$, Cramér's V = 0.32) and level of education ($\chi^2 = 36.30$, df = 6, $p < 0.001$, V = 0.27). Thinness and overweight were both far more common among the youngest girls, and among girls in primary school, who are mostly the youngest. Religion, ethnic group, Local Government Area, living arrangement, parents' education, family type, household income, food security, number of meals and meal skipping were not significantly associated with nutritional status (all $p > 0.05$).

Table 13: Association between socio-demographic characteristics and nutritional status (n = 251)

Characteristic	Thin n (%)	Normal n (%)	Overweight/ obese n (%)	χ^2 (df)	p-value	Cramér's V
Age group				**51.84 (4)**	**<0.001**	**0.32**
Early (10–13 years)	35 (27.8)	63 (50.0)	28 (22.2)			
Middle (14–16 years)	3 (5.6)	48 (88.9)	3 (5.6)			
Late (17–19 years)	4 (5.6)	66 (93.0)	1 (1.4)			
Level of education				**36.30 (6)**	**<0.001†**	**0.27**
Primary	32 (28.8)	58 (52.3)	21 (18.9)			
Secondary (JSS/SSS)	6 (7.1)	72 (85.7)	6 (7.1)			
Tertiary/Post-secondary	0 (0.0)	18 (100.0)	0 (0.0)			
Islamiyya only	4 (10.5)	29 (76.3)	5 (13.2)			
Religion				**3.35 (2)**	**0.187**	**0.12**
Islam	39 (18.4)	145 (68.4)	28 (13.2)			
Christianity	3 (7.7)	32 (82.1)	4 (10.3)			
Ethnic group				**3.03 (6)**	**0.827†**	**0.08**
Hausa	35 (17.9)	133 (68.2)	27 (13.8)			
Yoruba	5 (11.4)	35 (79.5)	4 (9.1)			
Igbo	1 (12.5)	6 (75.0)	1 (12.5)			
Others (Fulani, Nupe, missing)	1 (25.0)	3 (75.0)	0 (0.0)			
Local Government Area				**0.34 (2)**	**0.842**	**0.04**
Sokoto North	16 (16.3)	68 (69.4)	14 (14.3)			
Sokoto South	26 (17.0)	109 (71.2)	18 (11.8)			

Characteristic	Thin n (%)	Normal n (%)	Overweight/ obese n (%)	χ^2 (df)	p-value	Cramér's V
Living arrangement				**3.95 (4)**	**0.403†**	**0.09**
With parents	33 (16.5)	142 (71.0)	25 (12.5)			
With guardian	9 (20.5)	28 (63.6)	7 (15.9)			
Alone or with husband	0 (0.0)	7 (100.0)	0 (0.0)			
Father's/guardian's education				**5.20 (6)**	**0.518**	**0.10**
None/Qur'anic only	12 (16.9)	48 (67.6)	11 (15.5)			
Primary	1 (6.7)	13 (86.7)	1 (6.7)			
Secondary	11 (17.5)	41 (65.1)	11 (17.5)			
Tertiary	18 (17.6)	75 (73.5)	9 (8.8)			
Mother's/guardian's education				**2.74 (6)**	**0.841**	**0.07**
None/Qur'anic only	11 (16.4)	47 (70.1)	9 (13.4)			
Primary	8 (13.8)	42 (72.4)	8 (13.8)			
Secondary	19 (18.8)	68 (67.3)	14 (13.9)			
Tertiary	4 (16.0)	20 (80.0)	1 (4.0)			
Family type				**3.90 (2)**	**0.142**	**0.12**
Monogamous	27 (17.1)	106 (67.1)	25 (15.8)			
Polygamous	15 (16.1)	71 (76.3)	7 (7.5)			
Monthly household income (₦)				**1.48 (4)**	**0.830**	**0.05**
≤60,000	15 (20.3)	49 (66.2)	10 (13.5)			
61,000–100,000	15 (15.2)	73 (73.7)	11 (11.1)			
>100,000	12 (15.4)	55 (70.5)	11 (14.1)			
Household food security				**1.17 (4)**	**0.887†**	**0.05**
Always have enough food	18 (15.7)	81 (70.4)	16 (13.9)			
Sometimes go without	21 (17.8)	82 (69.5)	15 (12.7)			
Often go without	3 (16.7)	14 (77.8)	1 (5.6)			
Main meals per day				**1.78 (4)**	**0.790†**	**0.06**
1–2 meals	10 (16.4)	45 (73.8)	6 (9.8)			
3 meals	32 (17.2)	129 (69.4)	25 (13.4)			
>3 meals	0 (0.0)	3 (75.0)	1 (25.0)			
Meal skipping				**0.22 (2)**	**0.895**	**0.03**
Never/Rarely	29 (15.8)	131 (71.2)	24 (13.0)			
Sometimes/Often	12 (18.2)	46 (69.7)	8 (12.1)			

Percentages are row percentages. † p-value from Monte Carlo simulation because more than 20% of cells had expected counts below 5. Household income is in naira per month.

Food taboos, cultural beliefs, food fallacies and nutritional status (Hypotheses 1 to 3)

Table 14 shows the relationship between the sociocultural factors and nutritional status. Avoiding at least one food (excluding snails) was not associated with nutritional status (p = 0.795), and neither was the taboo exposure level (p = 0.495). Cultural belief level was also not associated with nutritional status (p = 0.572). The relationship with food fallacy level was statistically significant in this crude comparison (χ^2 = 13.02, df = 4, p = 0.011, V = 0.16). However, this was not a steady trend. Overweight and obesity were most common in the moderate fallacy group (22.1%) and least common in the high group (5.7%), while thinness was similar across the three groups. The result is explained by age: older girls held more fallacies (Table 19) and were also less often overweight. After adjusting for age, the association was no longer significant (moderate versus low level: OR = 1.77, 95% CI 0.70–4.46, p = 0.228; high versus low: OR = 0.61, 95% CI 0.20–1.90, p = 0.397). The belief that beliefs influence daily food choice, and having stopped a nutritious food because of a belief, were also not associated with nutritional status.

Table 14: Association between food taboos, cultural beliefs, food fallacies and nutritional status (n = 251)

Factor	Thin n (%)	Normal n (%)	Overweight/ obese n (%)	χ^2 (df)	p-value	Cramér's V
Avoids any food (excluding snails)				**0.46 (2)**	**0.795**	**0.04**
No	25 (16.6)	105 (69.5)	21 (13.9)			
Yes	17 (17.0)	72 (72.0)	11 (11.0)			
Food taboo exposure level				**3.45 (4)**	**0.495†**	**0.08**
None	5 (14.3)	26 (74.3)	4 (11.4)			
Low (1–2 foods)	36 (18.5)	133 (68.2)	26 (13.3)			
High (3+ foods)	1 (4.8)	18 (85.7)	2 (9.5)			
Cultural belief level				**2.91 (4)**	**0.572**	**0.08**
Low	15 (20.0)	48 (64.0)	12 (16.0)			
Moderate	9 (14.1)	46 (71.9)	9 (14.1)			
High	18 (16.1)	83 (74.1)	11 (9.8)			
Food fallacy level				**13.02 (4)**	**0.011**	**0.16**
Low	12 (17.4)	48 (69.6)	9 (13.0)			

Factor	Thin n (%)	Normal n (%)	Overweight/ obese n (%)	χ^2 (df)	p-value	Cramér's V
Moderate	15 (19.5)	45 (58.4)	17 (22.1)			
High	15 (14.3)	84 (80.0)	6 (5.7)			
Beliefs influence daily food choice				**3.19 (4)**	**0.532†**	**0.08**
Yes, strongly	10 (14.7)	53 (77.9)	5 (7.4)			
Yes, somewhat	28 (17.8)	106 (67.5)	23 (14.6)			
No	4 (15.4)	18 (69.2)	4 (15.4)			
Ever stopped a nutritious food because of beliefs				**1.72 (4)**	**0.827†**	**0.06**
Yes	9 (16.7)	39 (72.2)	6 (11.1)			
Maybe	1 (14.3)	4 (57.1)	2 (28.6)			
No	32 (16.8)	134 (70.5)	24 (12.6)			

Percentages are row percentages. † p-value from Monte Carlo simulation because more than 20% of cells had expected counts below 5.

The chi-square test only compares broad categories, so the BMI-for-age z-scores were also compared directly (Table 15 and Figure 8). The median z-score was almost the same across taboo exposure levels (Kruskal-Wallis p = 0.484), cultural belief levels (p = 0.779) and food fallacy levels (p = 0.846). Girls who avoided at least one food other than snails had a median z-score of −0.37, compared with −0.39 for girls who did not (Mann-Whitney p = 0.844).

Table 15: Comparison of BMI-for-age z-scores by food taboo, belief and fallacy groups

Group	n	Median z-score (IQR)	Test	p-value
Avoids any food (excluding snails)			**Mann-Whitney U**	**0.844**
No	151	−0.39 (−1.67 to 0.63)		
Yes	100	−0.37 (−1.39 to 0.51)		
Food taboo exposure level			**Kruskal-Wallis H**	**0.484**
None	35	−0.31 (−1.27 to 0.52)		
Low (1–2 foods)	195	−0.45 (−1.71 to 0.60)		
High (3+ foods)	21	−0.38 (−0.52 to 0.49)		
Cultural belief level			**Kruskal-Wallis H**	**0.779**
Low	75	−0.57 (−1.80 to 0.56)		
Moderate	64	−0.27 (−1.61 to 0.52)		
High	112	−0.40 (−1.43 to 0.60)		
Food fallacy level			**Kruskal-Wallis H**	**0.846**
Low	69	−0.47 (−1.38 to 0.52)		

Group	n	Median z-score (IQR)	Test	p-value
Moderate	77	−0.28 (−1.74 to 0.65)		
High	105	−0.39 (−1.43 to 0.54)		
Beliefs influence daily food choice			**Kruskal-Wallis H**	**0.836**
Yes, strongly	68	−0.34 (−1.24 to 0.52)		
Yes, somewhat	157	−0.39 (−1.66 to 0.59)		
No	26	−0.35 (−1.53 to 0.66)		
Stopped a nutritious food because of a belief			**Kruskal-Wallis H**	**0.765**
Yes	54	−0.49 (−1.63 to 0.54)		
Maybe	7	0.20 (−1.13 to 0.87)		
No	190	−0.37 (−1.57 to 0.58)		

IQR = interquartile range (25th to 75th percentile).

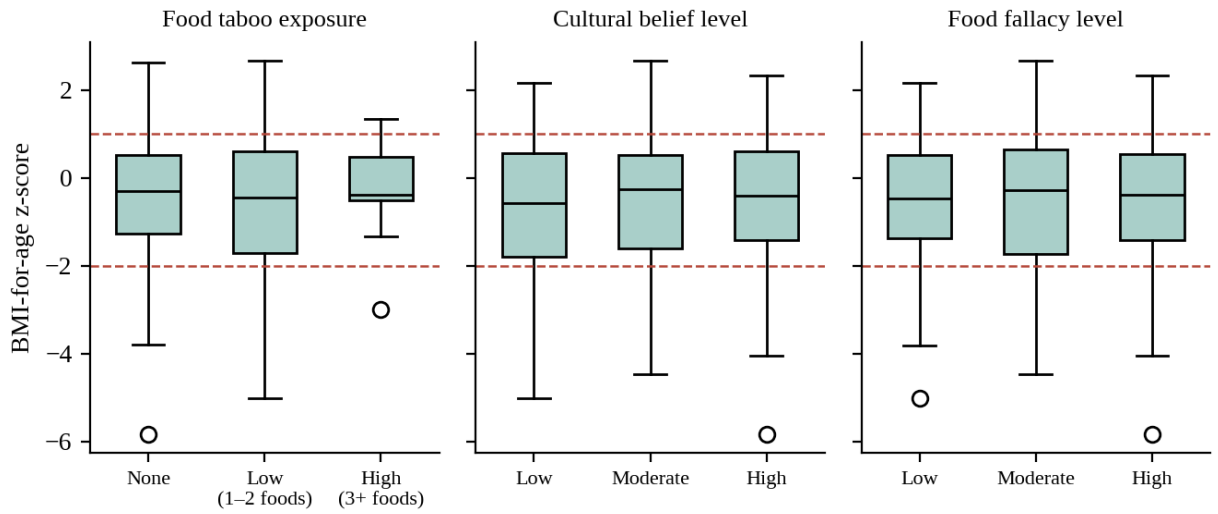

Fig. 8. BMI-for-age z-scores by food taboo exposure, cultural belief level and food fallacy level.

The correlation results agree with this (Table 16 and Figure 9). The BMI-for-age z-score had no correlation with the food taboo count, the cultural belief score or the food fallacy score (all |rho| ≤ 0.02, p > 0.77). The food taboo count (excluding snails), the cultural belief score and the food fallacy score were weakly related to one another (rho = 0.16 to 0.19), and the cultural belief and food fallacy scores were strongly related (rho = 0.89). Raw BMI rose with age (rho = 0.45, p < 0.001), as expected in growing girls, but BMI-for-age z-scores, which take age into account, did not.

Table 16: Spearman's correlation between sociocultural scores and nutritional indicators (n = 251)

Score	rho (z-score)	p-value	rho (BMI)	p-value

Score	rho (z-score)	p-value	rho (BMI)	p-value
Food taboo count (excluding snails)	0.00	0.943	0.06	0.375
Food taboo count (all 12 foods)	−0.02	0.775	−0.02	0.809
Cultural belief score	0.01	0.864	0.04	0.480
Food fallacy score	−0.01	0.827	0.06	0.337

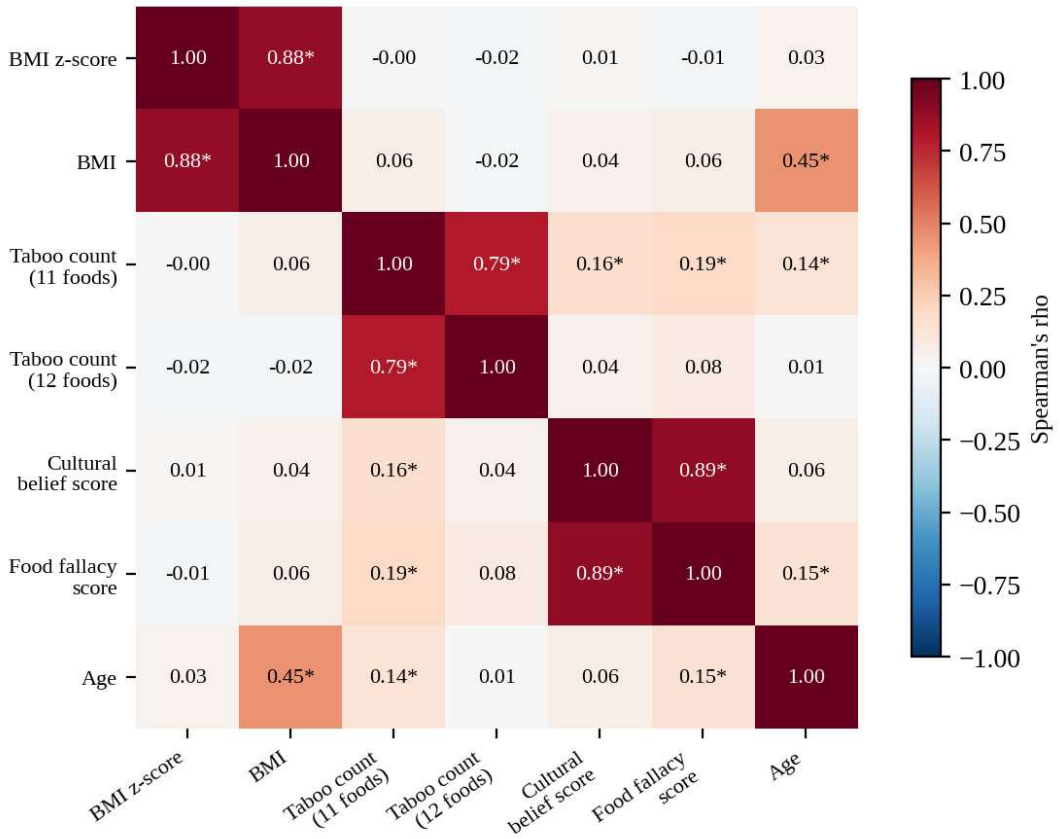

Fig. 9. Spearman correlation matrix (* p < 0.05).

Regression analysis

Multiple regression was used to check whether the sociocultural factors were linked to nutritional status once other factors were held constant. Each factor was tested alone and after adjusting for age, religion, household income, food security and mother's education (Table 17). None of the three sociocultural factors was significantly related to the BMI-for-age z-score or to the odds of thinness, before or after adjustment. For example, each extra food avoided (excluding snails) changed the z-score by only 0.03 (95% CI −0.16 to 0.23), and the adjusted odds ratio for thinness was 0.96 (95% CI 0.64 to 1.43).

Table 17: Regression of nutritional status on food taboos, cultural beliefs and food fallacies

Factor and model	Unadjusted (95% CI)	p	Adjusted (95% CI)	p
Food taboo count (per food avoided, excl. snails)				
Linear (β for z-score)	0.049 (−0.136 to 0.234)	0.603	0.034 (−0.162 to 0.231)	0.730
Logistic (OR for thinness)	0.89 (0.62 to 1.27)	0.511	0.96 (0.64 to 1.43)	0.833
Cultural belief score (per point)				
Linear (β for z-score)	0.003 (−0.022 to 0.028)	0.833	−0.004 (−0.034 to 0.026)	0.802
Logistic (OR for thinness)	1.00 (0.96 to 1.04)	0.939	1.00 (0.94 to 1.06)	0.964
Food fallacy score (per point)				
Linear (β for z-score)	0.000 (−0.021 to 0.020)	0.976	−0.008 (−0.035 to 0.018)	0.526
Logistic (OR for thinness)	1.00 (0.96 to 1.03)	0.854	1.00 (0.95 to 1.05)	0.936

β = change in BMI-for-age z-score. OR = odds ratio for thinness (z-score below −2 SD) compared with not thin. Adjusted for age, religion, household income, household food security and mother's education.

When all three sociocultural factors and the other variables were placed in one model, the linear regression explained only 3.6% of the variation in z-scores (adjusted $R^2 = -0.013$; $F = 0.73$, $p = 0.717$) (Table 18). No predictor was significant. In the logistic model for thinness (Figure 10), the only significant predictor was age. The odds of thinness fell by about 26% for every extra year of age (OR = 0.74, 95% CI 0.64 to 0.86, $p < 0.001$). The food taboo, cultural belief and food fallacy scores were not significant (all $p > 0.78$). The cultural belief and food fallacy scores are closely related, so their separate effects in one model are hard to tell apart (variance inflation factors of 6.4 and 7.0). This is why each factor was also tested on its own in Table 17, with the same result.

Table 18: Multiple linear regression of BMI-for-age z-score (n = 251)

Predictor	β	SE	95% CI	p-value
Food taboo count (excl. snails)	0.047	0.101	−0.152 to 0.246	0.643
Cultural belief score	0.021	0.032	−0.042 to 0.085	0.513
Food fallacy score	−0.025	0.028	−0.081 to 0.030	0.366
Age (years)	0.048	0.033	−0.018 to 0.113	0.157
Christian (ref: Muslim)	0.072	0.304	−0.526 to 0.671	0.813
Income ₦61,000–100,000 (ref: ≤₦60,000)	−0.207	0.266	−0.731 to 0.316	0.436
Income >₦100,000 (ref: ≤₦60,000)	−0.070	0.325	−0.711 to 0.570	0.829
Often go without food (ref: food secure)	−0.722	0.433	−1.575 to 0.131	0.097
Sometimes go without (ref: food secure)	−0.151	0.249	−0.640 to 0.339	0.545
Mother: none/Qur'anic only (ref: primary)	−0.476	0.314	−1.095 to 0.143	0.131
Mother: secondary (ref: primary)	−0.227	0.274	−0.768 to 0.313	0.409

Predictor	β	SE	95% CI	p-value
Mother: tertiary (ref: primary)	−0.200	0.424	−1.035 to 0.635	0.637

$R^2 = 0.036$; adjusted $R^2 = -0.013$; $F(12, 238) = 0.73$, $p = 0.717$.

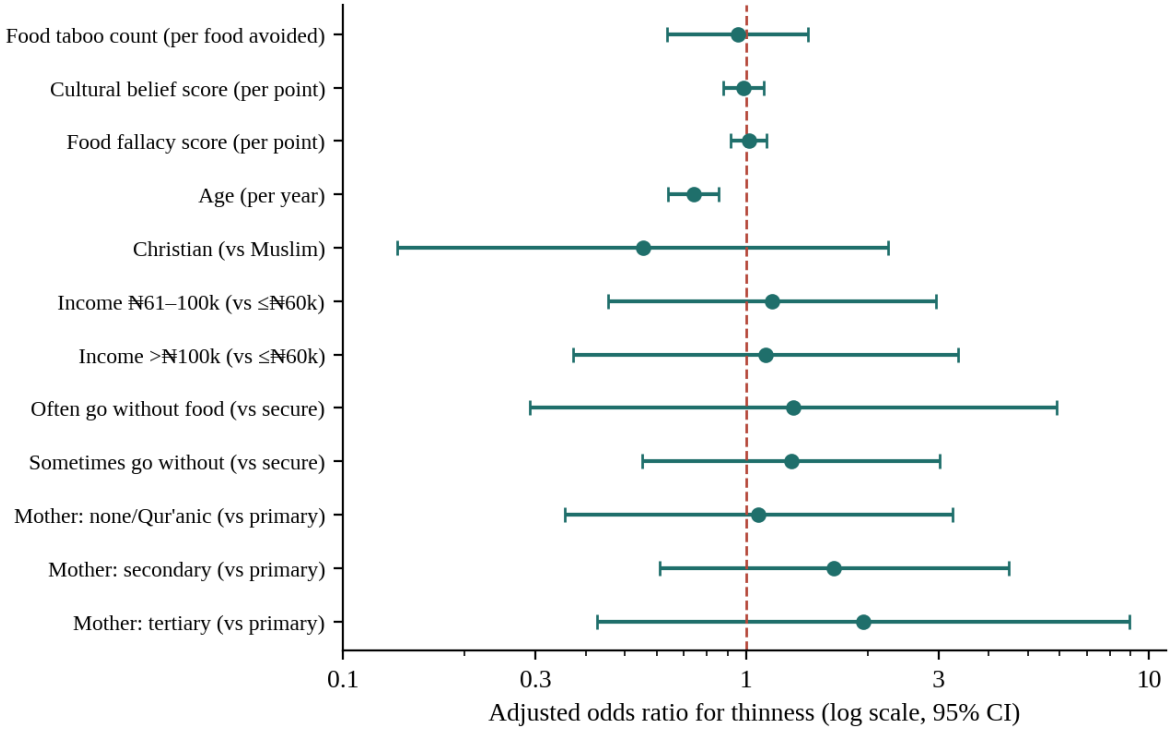

Fig. 10. Adjusted odds ratios for thinness from the multiple logistic regression (n = 251).

A sensitivity check was done in two ways. First, the two girls with z-scores below −5 SD, which are extreme, were removed, and the correlations with the three sociocultural scores stayed near zero (all $p > 0.80$). Second, using the exact completed age instead of mid-year age changed the number of thin girls from 42 to 41 and of overweight or obese girls from 32 to 36, which does not change the conclusions.

Who holds the beliefs? Sociocultural scores by background characteristics

Table 19 shows how the taboo, cultural belief and fallacy scores differ by background characteristics. Cultural belief and fallacy scores were significantly higher among girls from lower-income households ($p < 0.001$) and among girls who reported food shortage in the household ($p = 0.003$ for beliefs and 0.004 for fallacies). The scores were lowest among girls whose mothers had no formal or only Qur'anic education and highest among those whose mothers had secondary education ($p < 0.001$). Fallacy scores rose with age ($p = 0.016$). Religion and ethnic group did not affect the belief scores, but Christian and non-Hausa girls avoided

slightly more of the other listed foods than Muslim and Hausa girls (p = 0.007 and 0.010 respectively).

Table 19: Median food taboo, cultural belief and food fallacy scores by background characteristics

Characteristic	n	Taboo score	Belief score	Fallacy score	p (taboo)	p (belief)	p (fallacy)
Age group					**0.202**	**0.219**	**0.016**
Early (10–13)	126	0	25	30			
Middle (14–16)	54	0	29	34			
Late (17–19)	71	0	31	37			
Religion					**0.007**	**0.658**	**0.949**
Muslim	212	0	26	31			
Christian	39	1	31	37			
Ethnic group					**0.010**	**0.557**	**0.154**
Hausa	195	0	25	31			
Yoruba	44	1	31	37			
Igbo	8	0	27	18			
Others	4	1	34	41			
Household income					**0.150**	**<0.001**	**<0.001**
≤60,000	74	0	33	38			
61,000–100,000	99	0	30	33			
>100,000	78	0	23	26			
Mother's education					**0.156**	**<0.001**	**<0.001**
None/Qur'anic only	67	0	16	18			
Primary	58	0	26	33			
Secondary	101	0	31	37			
Tertiary	25	0	25	22			
Food security					**0.247**	**0.003**	**0.004**
Food secure	115	0	25	29			
Sometimes go without	118	0	31	37			
Often go without	18	0	30	35			

Medians are shown. Taboo score = number of the 11 foods avoided (excluding snails). p-values are from the Mann-Whitney U or Kruskal-Wallis H test and are shown on the shaded rows.

Summary of hypothesis testing

Table 20 brings together the tests of the four hypotheses stated in the Introduction.

Table 20: Summary of hypothesis tests

Hypothesis	Tests and results	Decision ($p < 0.05$)
H_{01}: No relationship between food taboos and BMI-for-age	Chi-square: any food avoided $p = 0.795$; exposure level $p = 0.495$. Kruskal-Wallis/Mann-Whitney: $p = 0.844$ and 0.484. Spearman: rho = 0.00, $p = 0.943$. Adjusted regression: $p = 0.730$	No significant relationship. H_{01} not rejected
H_{02}: No relationship between cultural beliefs and BMI-for-age	Chi-square: $p = 0.572$. Kruskal-Wallis: $p = 0.779$. Spearman: rho = 0.01, $p = 0.864$. Adjusted regression: $p = 0.802$	No significant relationship. H_{02} not rejected
H_{03}: No relationship between food fallacies and BMI-for-age	Chi-square: $p = 0.011$ (crude; not significant after adjusting for age). Kruskal-Wallis: $p = 0.846$. Spearman: rho = −0.01, $p = 0.827$. Adjusted regression: $p = 0.526$	No significant relationship after adjusting for age. H_{03} not rejected
H_{04}: No relationship between socio-demographic characteristics and BMI-for-age	Chi-square: age group $p < 0.001$; level of education $p < 0.001$. All other characteristics $p > 0.05$ (religion, ethnic group, LGA, living arrangement, parents' education, family type, income, food security, meals, meal skipping)	Significant for age group and level of education (H_{04} rejected for these). Not significant for the rest (H_{04} not rejected)

4. Discussion

The discussion below considers the findings in the order in which they were presented, beginning with the socio-demographic and household profile of the girls and ending with the central question of whether food taboos, cultural beliefs and food fallacies are related to their nutritional status.

Socio-demographic and household characteristics

The study reached 251 adolescent girls in Sokoto North and Sokoto South, aged 10 to 19 years, with a mean age of 13.8 years. The group was mixed. Most girls were Hausa and Muslim, which fits the population of Sokoto Metropolis described in the Methods, but about one in six were Christian and one in five were from other ethnic groups. This mix is useful because it allowed religion to be compared, although the numbers of non-Muslim girls are small. The parents were fairly well educated, with 40.6% of fathers having tertiary education. Even so, 54.2% of girls said their households sometimes or often went without enough food, which shows that food shortage is common even in households with educated parents. Household income, parental education and food security were not linked to BMI-for-age in this study. This differs from Jiya et al. (2024), who found that parental education, household size and social class predicted BMI among in-school adolescents in Sokoto, and from Uba et al. (2020), who found that family income and maternal education were associated with BMI status among girls in Bauchi State.

Prevalence of food taboos

Food avoidance was common. 86.1% of the girls avoided at least one of the listed foods, and 39.8% did so when snails were left out. The latter figure is close to the report of Chakona et al. (2019), who found that over a third of women in the Eastern Cape observed at least one food taboo, and lower than the two-thirds reported by Ramulondi et al. (2021) among Zulu women. Snails were by far the most avoided food. Because 82% of Muslim girls avoided snails compared with 8% of Christian girls, and because the most common reason given was religious prohibition, this is best understood as a religious dietary rule. The avoidance of pork, which 46 girls added on their own, follows the same pattern. Snails are not a major food in the diet of most adolescents, so this kind of avoidance is unlikely to harm nutritional status.

The foods that matter most for adolescent girls were avoided by few. Eggs, milk, red meat, fruits and vegetables were each avoided by less than 4% of the girls. This is different from the picture in the literature reviewed above. Mekonnen et al. (2015) reported that adolescent girls in rural Ethiopia were forbidden eggs, milk and fatty meats, and Lekey et al. (2024) reported restrictions on animal protein among adolescent girls in Tanzania. Ekwochi et al. (2016) and Ugwa (2016) recorded long lists of tabooed foods, but among pregnant and lactating women, not adolescent girls. The girls in the present study avoided groundnuts (17.9%), fish (10.8%) and bone marrow (8.8%) more than other nutritious foods. Some of these answers came with health reasons such as skin rash and eczema, which suggests that part of the avoidance is a response to perceived allergy or skin problems and not a taboo in the strict sense. Fish and groundnuts are good sources of protein and healthy fats, so girls who avoid them should be advised on suitable substitutes.

The sources of the food rules show the role of the family. Fathers (30.5%), grandmothers (20.3%) and mothers (16.9%) taught most of the food avoidance. This agrees with Chakona et al. (2019), who found that taboos were passed on mainly by mothers and grandmothers. The strong place of fathers is worth noting. It fits the "circumscribed agency" described by Conrad et al. (2024), where adolescent girls in northern Nigeria have little say over food, and fathers and husbands make the decisions. In this study, nearly half of the girls (47.4%) named the father as an influence on the food restrictions they follow.

Cultural beliefs

Between 57% and 64% of the girls agreed with each of the cultural belief statements. Restriction of some foods during menstruation, following elders' advice without asking why, and the role of religious teaching in deciding which foods are proper for girls had the highest agreement. These results show that food decisions in Sokoto are guided by respect for elders and religion. More than half also agreed that some foods are reserved for adults or men and that food can affect a girl's marriage prospects. This is in line with Conrad et al. (2024), who found that girls and their families held gender-based ideas about who should eat which foods, including the belief that boys need more meat. The belief that some foods cause infertility in girls (57%) is also similar to the food beliefs about infertility noted earlier (Ugwa, 2016).

The belief items asked about what is believed "in your household or community", so they measure the food norms around the girl and not only her own opinion. This may explain why agreement was high (over half for every item) while personal avoidance of most foods was low. For example, 57% of the girls agreed that eating too many eggs makes a girl promiscuous, a belief also reported in Ethiopia by Mekonnen et al. (2015), but only 2.8% of the girls said they avoid eggs. A belief in the community does not always lead to personal avoidance, especially when a girl does not control what is cooked or when the food is affordable and available at home.

The scores were higher among girls from lower-income households and from households with food shortage. Households under economic pressure may depend more on traditional advice, and may have less contact with formal nutrition information. Interestingly, the lowest scores were among girls whose mothers had no formal or only Qur'anic education, not among those with tertiary education. This shows that more schooling does not automatically remove these beliefs, which agrees with Ramulondi et al. (2021), who found no clear difference in taboo adherence between women with and without formal education. Also, 15.9% of the girls said they first learnt these beliefs at school, and 13.9% at religious gatherings. These are places where correct nutrition information should be given.

Food fallacies

Belief in food fallacies was widespread, with 55% to 63% of the girls agreeing with each false statement. Some of these fallacies can directly harm nutrition. Sixty-one percent believed that

skipping breakfast keeps a girl slim and attractive, and 26% said they skip meals often or sometimes. In Kano, Abubakar et al. (2025) also found meal skipping and low fruit and vegetable intake among schoolgirls. About 58% believed that vegetables have little value compared with meat, and 63% believed that vitamin supplements are not needed if a girl eats any food at all. Both ideas can lower the variety of the diet. The belief that a fuller body shape shows better health than a slim one (58%) may lead families to ignore early signs of overweight, while the belief that sugar is the main cause of all illness (63%) is an oversimplification that may distract from other risks such as poor diet quality.

The girls themselves said that these ideas affect their eating. Nine in ten said the beliefs influence what they eat, and about one in five (21.5%) had stopped eating a nutritious food because of a belief. This shows that beliefs are not only opinions; they change behaviour for a good number of girls. Lekey et al. (2024) made a similar point in Tanzania, where food restrictions continued in spite of nutrition education. The result also shows a need to correct these beliefs in a way that respects the family and religious setting in which they were learnt.

The cultural belief and food fallacy scores were strongly related (rho = 0.89). Girls who agreed with one type of statement tended to agree with the other. This could mean that the two sets of beliefs really come from the same background of tradition and trust in elders. It could also be a response style, where some girls agree with most statements. The answers were also split into two groups, with many girls scoring low and many scoring high, and very few in the middle. This pattern, together with the very high alpha values, means the scale scores should be read with some care.

Nutritional status of the girls

The results show a double burden of malnutrition. 16.7% of the girls were thin, and 8.8% were severely thin, while 12.7% were overweight or obese. This double burden is in line with the systematic reviews of Gabriel et al. (2024) and Abubakar et al. (2024), which describe undernutrition and overnutrition occurring together among Nigerian adolescents. The prevalence of thinness is lower than the roughly one-quarter reported among in-school adolescents in Sokoto by Jiya et al. (2024) and the more than one-third reported among girls in Bauchi State by Uba et al. (2020). It is higher than the 12% of girls aged 15 to 19 years classified as thin in the national survey cited by Abubakar et al. (2024). The prevalence of overweight and obesity (12.7%) is

higher than that reported in Bauchi (less than 10%) but lower than the 28% national figure for older adolescents. Differences in age range, school type and method of classification make exact comparison difficult.

The most important pattern was the effect of age. Among girls aged 10 to 13 years, more than one in four (27.8%) were thin and more than one in five (22.2%) were overweight or obese. Among girls aged 14 to 19 years, both conditions were rare (about 6% thin and 3% overweight or obese). Age category was also a significant predictor of BMI in Sokoto in the study of Jiya et al. (2024), and age was associated with BMI status in Bauchi (Uba et al., 2020). Early adolescence is the time when girls start puberty, and girls of the same age can differ a lot in growth and body composition because they mature at different times. Puberty was not measured here, so this explanation cannot be confirmed. Some of the wide spread in early adolescence could also come from errors in recorded ages or measurements in younger children. It is therefore important that ages are confirmed from school records.

Relationship between sociocultural factors and nutritional status

The main finding of the study is that food taboos, cultural beliefs and food fallacies were not significantly related to BMI-for-age. This was true whether nutritional status was treated as categories, as a z-score, or as thinness, and whether or not other factors were controlled for. The correlations were close to zero ($|rho| \leq 0.02$). The one crude association, between food fallacy level and nutritional status ($p = 0.011$), was explained by age: older girls held more fallacies and were less often overweight. When age was controlled for, it disappeared. Since about twenty tests were done at the 5% level, one such result could also arise by chance. The study therefore does not support a link between these sociocultural factors and BMI-for-age in this group of girls, and the null hypotheses H_{01}, H_{02} and H_{03} were not rejected.

There are several possible reasons for this. First, most of the food avoidance was for snails and pork, which are not major sources of energy for adolescents. The foods that matter most for growth, such as eggs, milk, meat, fruits and vegetables, were avoided by very few girls. Second, BMI-for-age reflects total energy intake and many other things, such as physical activity, illness, and pubertal growth. Sociocultural beliefs may affect the quality and variety of the diet, and the intake of specific nutrients like iron, calcium and vitamin A, without changing BMI. This is consistent with the UNICEF (2020) framework used in this study, where culture and norms are

basic and underlying causes that act through dietary intake and care practices. Their effect on BMI may be indirect and weak. Third, beliefs were so widespread (over half of the girls agreed with every statement) that there was little difference between girls to detect. Fourth, the study had enough power to detect only correlations of about 0.18 or more, so small effects cannot be ruled out.

The effect of belief may also work in different directions. Some fallacies, such as skipping breakfast to stay slim, may lower weight, while others, such as believing that a fuller body is healthier, may push weight up. Such opposite effects can cancel out when the whole group is analysed together. Finally, this study did not measure actual food intake, so it cannot show whether avoided foods were replaced by other nutritious foods.

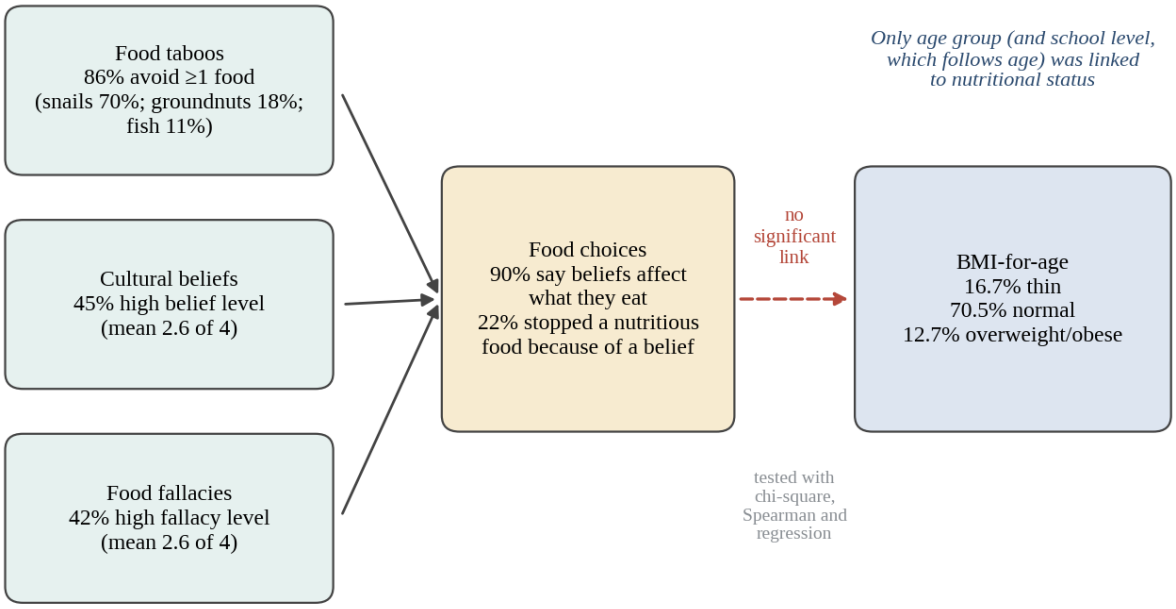

Fig. 11. Summary of the main findings.

In contrast to the sociocultural factors, age group and level of education were significantly associated with nutritional status. The education result mostly reflects age, since primary school pupils in this sample were the youngest. Religion, ethnic group, household income, food security, parents' education and meal skipping showed no significant relationship with BMI-for-age. The lack of a link with food security is somewhat surprising, given that more than half of the households reported food shortage. Self-reported food security is a rough measure, and BMI-

for-age may respond to food shortage only when the shortage is severe or long-lasting; only 7.2% of the households often went without food.

Strengths and Limitations

The findings should be read with the following limitations in mind:

- The study is cross-sectional, so it can show association but not cause and effect.
- Food taboos, beliefs and fallacies were self-reported. Girls may have given answers they thought were expected, and the yes/no questions on food avoidance did not capture how strictly or how often a food was avoided.
- Actual dietary intake was not measured (for example by a 24-hour recall or dietary diversity score), so the study could not show whether food avoidance changed nutrient intake.
- Age was recorded in completed years only, and mid-year age was used to calculate the z-scores. A number of girls aged 10 were in early primary classes, so the accuracy of the recorded ages should be confirmed. Puberty stage, which affects BMI in early adolescence, was not measured.
- The sample included primary, secondary and tertiary students and girls who attended only Islamiyya school, and about one in six were Christian. Only girls in school were included, from two Local Government Areas, so the results cannot be applied to out-of-school girls or to all adolescent girls in Sokoto.
- The belief and fallacy scales were strongly related and produced a two-group pattern, which suggests some response style effect and limits how far the two constructs can be separated.
- With 251 girls, the study could detect only moderate or larger associations. Small effects of taboos, beliefs or fallacies on BMI-for-age may have been missed.

5. Conclusion

This study assessed the effect of food taboos, cultural beliefs and food fallacies on the nutritional status (BMI-for-age) of adolescent girls in Sokoto Metropolis. Based on the findings, the following conclusions are drawn:

- Food avoidance was common (86% avoided at least one food; 40% when snails are excluded), but it was mainly for snails, pork and groundnuts, and for religious and health reasons. Nutritious foods such as eggs, milk, meat, fruits and vegetables were avoided by very few girls. Fathers, grandmothers and mothers were the main sources of these food rules.
- Cultural beliefs about food were strong, with more than half of the girls agreeing with every belief statement, and the strongest were menstrual food restrictions, obedience to elders, and the role of religion.
- Food fallacies were widespread (55% to 63% agreement), including harmful ideas such as skipping breakfast to stay slim. Nine in ten girls said their beliefs affect what they eat, and about one in five had stopped eating a nutritious food because of a belief.
- The nutritional status of the girls showed a double burden of malnutrition: 16.7% were thin and 12.7% were overweight or obese. Both problems were mostly found among girls aged 10 to 13 years.
- No significant relationship was found between food taboos, cultural beliefs or food fallacies and BMI-for-age, so the null hypotheses H_{01}, H_{02} and H_{03} were not rejected. Only age group and level of education were significantly associated with nutritional status, so H_{04} was rejected for these two characteristics only.
- These sociocultural practices are still important for public health because they shape the food choices of many girls. Their effect may be on diet quality and micronutrient intake, which BMI-for-age does not show.

Implications and Recommendations

Recommendations based on the findings

1. **School-based nutrition education.** The Ministries of Education and Health and school authorities should include adolescent nutrition in the primary, secondary and Islamiyya curricula. The lessons should correct the specific fallacies found in this study, such as skipping breakfast to stay slim, groundnuts causing appendicitis, fish causing worms, vegetables having little value, and vitamins being unnecessary. Teachers should be trained first, since some girls said they first learnt these beliefs at school.

2. **Involve family and religious leaders.** Nutrition programmes should work with fathers, mothers, grandmothers, and religious leaders and teachers, who were the main influencers of food rules. Religious leaders can help separate the food rules that have a religious basis from those that do not, and can support the eating of safe and nutritious foods for girls.
3. **Screen and counsel early adolescents.** Schools and primary health centres should measure the weight and height of girls at least once a year, with BMI-for-age classification, starting at age 10. Girls found to be thin, overweight or obese should receive counselling and be referred to a health facility, as promised in the ethical procedures of this study. Special attention should be given to girls aged 10 to 13 years.
4. **Culturally sensitive counselling.** Nutritionists and dietitians should ask adolescent girls which foods they avoid and why, and should suggest acceptable substitutes. For example, a girl who avoids fish or groundnuts can be advised to get protein from beans, milk, eggs or meat if these are allowed in her home.
5. **Healthy eating habits.** Girls should be encouraged to eat regular meals, especially breakfast, to eat fruits and vegetables often, and to limit sugary and fried foods. Messages should challenge the idea that thinness is the same as beauty or that a fuller body is always healthier.
6. **Reduce household food shortage.** More than half of the households reported some food shortage. State and local governments and partners should strengthen school feeding, support for low-income households and home gardening so that nutritious food is within reach of all families.
7. **Wider community messages.** Correct nutrition information should be spread through radio, television, mosques, churches, community meetings and social media, which few girls currently mention as sources of nutrition beliefs.
8. **Policy.** Adolescent girls' nutrition should be given a clear place in the State nutrition plan, with culturally appropriate messages and regular monitoring of BMI-for-age in schools.

Suggestions for further research

1. Future studies should use a larger, randomly selected sample that includes more Local Government Areas.
2. They should measure actual food intake (24-hour recall) and micronutrient status such as haemoglobin, so that the effect of food avoidance on diet quality can be shown.
3. Qualitative studies with adolescent girls, fathers, grandmothers and religious leaders would help explain why the beliefs persist and how they can be changed.
4. Intervention or follow-up (longitudinal) studies could test whether nutrition education that involves families and religious leaders reduces fallacies and improves diet and BMI-for-age.

Declarations

Ethics approval and consent to participate: This study was conducted in accordance with the Declaration of Helsinki. Ethical clearance was obtained from the Sokoto State Ministry of Health (Ref. No. SMH/1580/V.IV). Written informed consent was obtained from parents/guardians, with assent from the girls themselves.

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