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The Awareness-Knowledge Gap and Diabetes Risk-Factor Profile Among Secondary School Adolescents in Lagos, Nigeria: Implications for Early Prevention

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TITLE PAGE

The Awareness-Knowledge Gap and Diabetes Risk-Factor Profile Among Secondary School Adolescents in Lagos, Nigeria: Implications for Early Prevention

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Abstract

Background

Adolescence is a critical period for establishing lifelong health behaviours, yet evidence on diabetes knowledge, risk perceptions, and modifiable risk factors among adolescents in sub-Saharan Africa remains limited. This study assessed diabetes awareness, knowledge, attitudes, perceptions, and risk-factor profiles among secondary school adolescents in Lagos, Nigeria

Methods

We conducted a multi-school cross-sectional study among students from six public secondary schools in Surulere, Lagos. Participants completed a structured questionnaire assessing diabetes awareness, knowledge, attitudes, perceptions, lifestyle factors, and we measured weight, height, and waist circumference. We analyzed the data using descriptive statistics, correlation analyses, bivariate tests, and multivariable logistic regression. Statistical significance was set at <0.05.

Results

Of 517 students, 496 participated (95.9% response rate); the mean age was 15.5 ± 1.3 years, and 69.8% were female. Although 92.0% had heard of diabetes, 60.3% had poor knowledge, 49.0% had good attitude and only 19.6% had good perceptions. Overweight and obesity were present in 6.0% and 0.8% of the adolescents, respectively, 7.3% had a waist-to-height ratio ≥ 0.50, and 10.3% reported a family history of diabetes. Male students had lower odds of moderate-to-good diabetes knowledge than females (aOR = 0.51, 95% CI: 0.30–0.86). Compared with students whose parents/guardians were unemployed, those whose parents/guardian were self-employed had lower odds of moderate-to-good diabetes knowledge (aOR = 0.27, 95% CI: 0.08–0.88). Moderate-to-good knowledge was associated with higher odds of positive attitudes (aOR = 2.93, 95% CI: 1.90–4.56) and good perceptions (aOR = 2.31, 95% CI: 1.41–3.81), while positive attitudes were associated with higher odds of good perceptions (aOR = 2.18, 95% CI: 1.28–3.76). Most students (91.4%) expressed interest in learning more about diabetes, and 83.2% were interested in a school diabetes club.

Conclusion

Despite high awareness, most adolescents had poor knowledge, and important gaps in risk perception remained, indicating a marked awareness-knowledge gap. Strong interest in diabetes

education and the observed associations between knowledge, attitudes, and perceptions support the development and implementation of structured, age-appropriate school-based diabetes education and prevention programmes. School diabetes clubs may provide a practical platform for reinforcing diabetes education, and promoting healthy behaviours.

Keywords: Adolescents, Diabetes mellitus, Awareness, Knowledge, Perception, School-based health promotion

Introduction

Adolescence is a critical period for establishing lifelong health behaviours, yet diabetes prevention efforts have traditionally focused on adults. Diabetes mellitus is a major public health challenge of the twenty-first century, and type 2 diabetes is increasingly being recognized in younger populations, including adolescents. This shift is concerning because dietary practices, physical activity patterns, and other health behaviours established during adolescence often persist into adulthood and may influence the later development of chronic disease [1]. Promoting healthy lifestyles and improving understanding of diabetes risk factors during adolescence may therefore provide an important opportunity for early prevention.

The global burden of diabetes mellitus continues to rise. The International Diabetes Federation estimated that approximately 537 million adults were living with diabetes in 2021, with further increases projected in the coming decades [2]. At the same time, the growing prevalence of overweight and obesity, physical inactivity, unhealthy dietary practices, and other modifiable risk factors has contributed to the emergence of type 2 diabetes in younger age groups [3]. Type 2 diabetes is associated with serious long-term complications, including cardiovascular disease, kidney failure, visual impairment, and reduced quality of life, underscoring the importance of prevention and early intervention [4].

Nigeria is similarly affected by the increasing burden of diabetes. Studies have documented rising prevalence across different population groups, alongside rapid urbanization, changing dietary patterns, declining physical activity, and increasing levels of overweight and obesity [5]. However, diabetes awareness and prevention efforts in Nigeria have largely focused on adults, with little attention given to adolescents [6]. This gap exists because adolescence is a formative period during which lifelong health habits, beliefs, and attitudes are established [7,8]. Schools therefore serve as a valuable setting for disease prevention, with sustained access to large numbers of adolescents in a structured learning environment.

Knowledge and perceptions of diabetes can influence health-related behaviour. Adolescents who understand the causes, risk factors, symptoms, and preventive measures associated with diabetes may be better positioned to adopt healthy practices, recognize personal risk, and seek appropriate health information [9,10]. However, evidence on diabetes-related knowledge and risk perception among secondary school students in Nigeria remains limited [11]. Available studies suggest that although many young people have heard of diabetes, their understanding of its causes, risk factors, symptoms, and prevention is often inadequate [12]. Misconceptions also persist, including beliefs that diabetes is infectious and poor recognition of the roles of obesity, unhealthy diets, and physical inactivity in its development [13-15]. The problem is therefore not simply a lack of awareness, but limited knowledge and persistent inaccurate beliefs among adolescents who may already have some behavioral and familial risk factors. In Nigeria, insufficient evidence on adolescents' diabetes awareness, knowledge, attitudes, perceptions, and risk-factor profiles persists, thereby limiting the development of culturally relevant school-based prevention strategies.

This study assessed diabetes awareness, knowledge, attitudes, perceptions, and risk-factor profiles among secondary school adolescents in six public schools. It also examined factors associated with moderate-to-good knowledge, good attitudes, and good perceptions. The findings are intended to inform the development of school-based diabetes education and prevention programs for Nigerian adolescents.

Methods

Study design

We conducted a multi-school cross-sectional study among adolescents in six public secondary schools in Surulere Local Government Area (LGA) of Lagos State, Nigeria. The study aimed to assess adolescents' KAP regarding diabetes mellitus and its associated risk factors. Data were collected for six weeks from June 3, 2024, to July 8, 2024.

The Study Flow Diagram

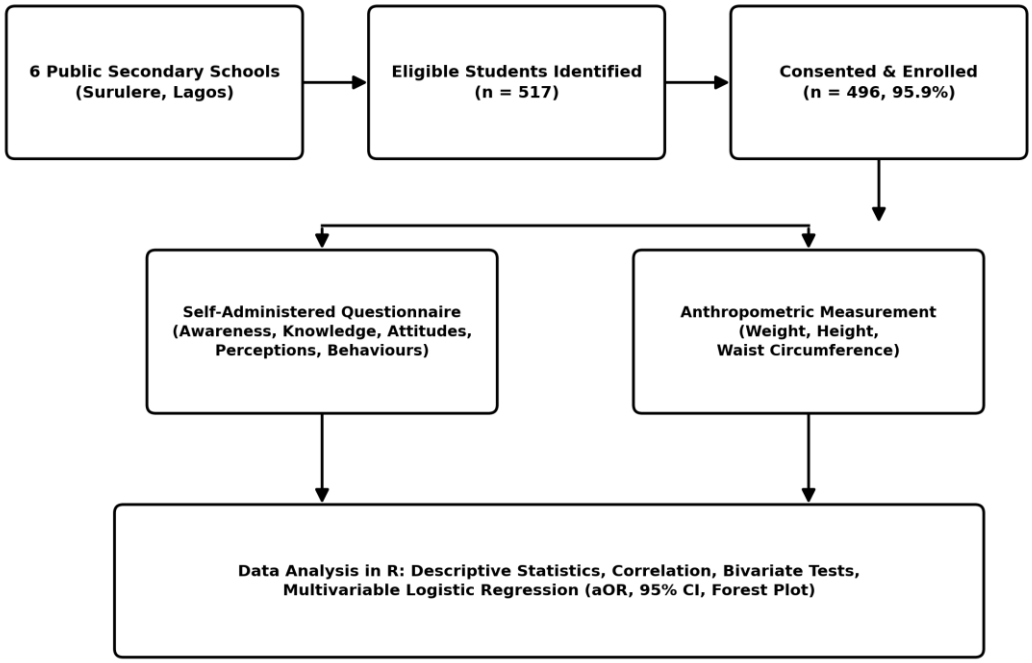

Figure 1. Study flow diagram showing participant recruitment and enrolment across six public secondary schools in Surulere, Lagos, data collection procedures (self-administered questionnaire and anthropometric measurement), and the data analysis approach.

Study setting

The study was conducted in Surulere LGA. It is a densely populated urban district in Lagos with substantial ethnic and socioeconomic diversity and an appropriate setting for an adolescent-related study. The study was conducted in six public senior secondary schools in Surulere LGA, Lagos State. To preserve institutional anonymity, the participating schools are identified as Schools A–F in the geographic Figure 1 below.

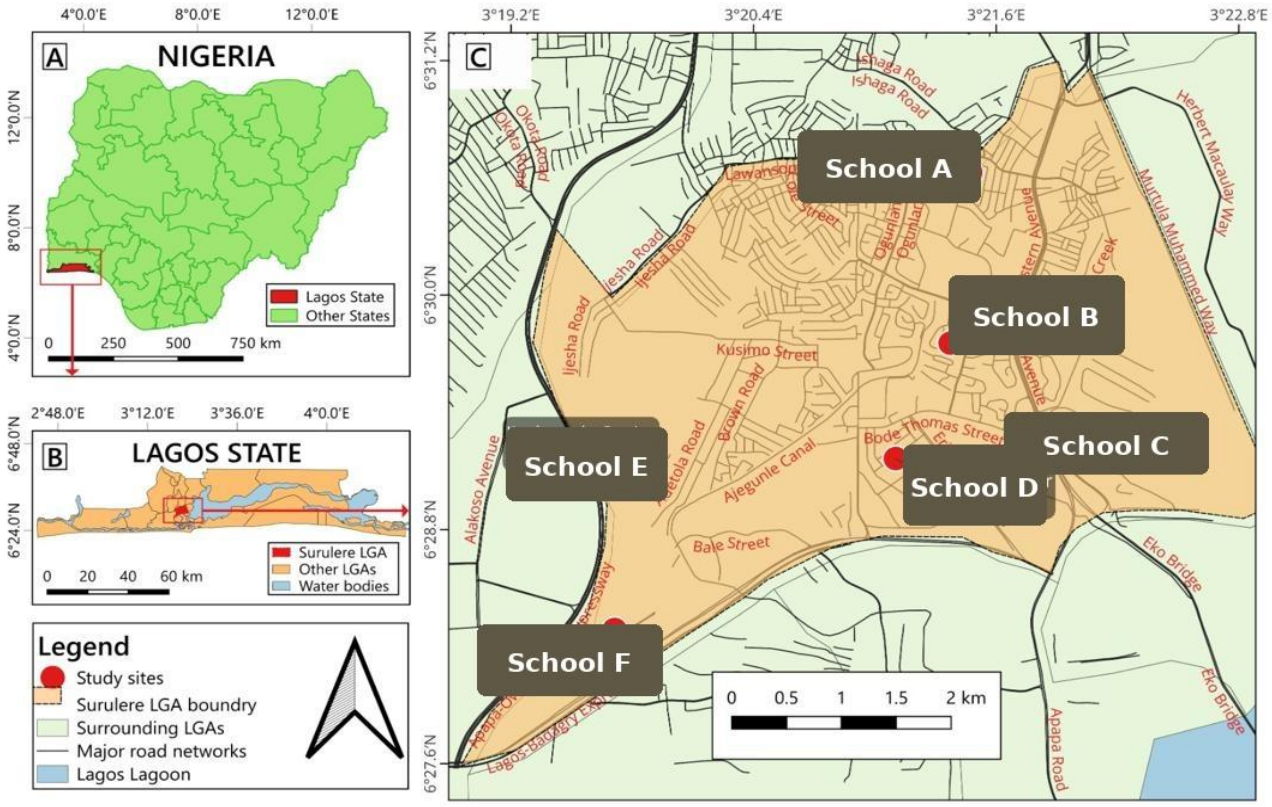

Figure 2. Map showing the relative geographical locations of the six participating Senior Secondary Schools within Surulere Local Government Area of Lagos State

Study population and eligibility criteria

The study population comprised adolescents enrolled in either Senior Secondary School level one (SS1) or level two (SS2) in the selected schools during the study period. Students were eligible if they were enrolled in one of the selected schools, returned written informed consent signed by a parent or legal guardian, and provided written informed assent before participation. We excluded students who declined participation.

Sample size determination

A total of 3,638 eligible SS1 and SS2 students, obtained from the official class registers of the six participating schools served as the sampling frame. We estimated the minimum sample size using the finite population correction formula for cross-sectional studies, as shown below [16],

$$n = \frac{no}{1+(\frac{no-1}{N})}$$ where: n = minimum sample size for a finite population,

n_0 = sample size for an infinite population = Z^2pq/e^2,

N = population size,

Z = standard normal deviate corresponding to a 95% confidence level (1.96),

p = estimated prevalence,

q = 1−p,

e = margin of error set at 5%.

Assuming a 95% confidence level, a 5% margin of error, and a 50% response distribution, the minimum required sample size was 348 participants. Increasing by 10% to allow for non-response and incomplete questionnaires gave a minimum sample of 383 participants. Because proportionate sampling was undertaken across six schools and additional eligible students were available within the sampling frame, 517 students were selected and invited to participate, exceeding the minimum required sample and improving statistical precision. ***Supplementary File 1 (Table S1)*** provides the population size, minimum representative sample for each participating school, and the number of students assessed. Figure 2 illustrates participant recruitment, enrolment, data collection, and analysis.

Sampling procedure

We used a proportionate stratified random sampling technique. Each participating school constituted a sampling stratum, and the required sample size for each school was determined using proportional allocation based on the number of eligible SS1 and SS2 students. Class registers served as the sampling frame within each school. We met with school administrators to explain the study procedures and chose suitable dates for recruitment and data collection. We assigned unique identification numbers to eligible students and used a computer-generated random number list to select participants until we attained the allocated sample size for each school.

Selected students received parental consent forms to take home for review and signature by their parents or legal guardians. Students who returned signed consent forms were invited to participate and provided written assent before data collection.

Study instrument and validation

We collected data using a structured, self-administered paper-based questionnaire adapted from previously published studies assessing diabetes-related knowledge, attitudes, perceptions, and preventive practices among adolescents and young adults [6,17-19]. The questionnaire was adapted to suit the study objectives and local context and comprised six sections. The first section obtained sociodemographic and health-related information, including age, sex, school level, religion, ethnicity, living arrangement, parental or guardian education and occupation, family history of diabetes, previous history of elevated blood glucose, and self-perceived blood glucose status. The second section assessed knowledge of diabetes mellitus using 15 items covering the causes, risk factors, and symptoms of diabetes. Responses were recorded as "Yes" or "No". The third section assessed diabetes-related self-care practices, including participation in physical activity (duration and types), alcohol consumption, cigarette smoking, and television viewing. The fourth and fifth sections assessed attitudes towards diabetes prevention and perceptions of diabetes and its risk using seven and eight statements, respectively, measured on a five-point Likert scale ranging from strongly disagree to strongly agree. The final section assessed awareness of diabetes, sources of diabetes-related information, and willingness to receive diabetes education or participate in school-based diabetes awareness activities. We pretested the questionnaire among 40 students attending a secondary school different from the selected schools. Cronbach's alpha values were 0.72 for knowledge, 0.76 for attitude, and 0.65 for perception, indicating acceptable internal consistency for the knowledge and attitude domains and more modest internal consistency for the perception domain.

240 **Data collection**

241 The research team collected data over multiple visits to the participating schools. On scheduled
242 data collection days, we administered the paper-based questionnaires in classrooms to students
243 who had returned signed parental consent forms. Participants completed the questionnaires
244 independently under supervision; the research team provided clarification where necessary.
245 After administering the questionnaire, we took anthropometric measurements (weight, height,
246 and waist circumference) using standardized procedures. This comprised measuring
247 participants' weight after they had removed their footwear and waist and hip circumference
248 using a tape rule in inches. The measurements were repeated and averaged. We derived the
249 WHO BMI-for-age categories manually, computed and classified nutritional status according
250 to the World Health Organization BMI-for-age growth reference for children and adolescents
251 aged 5-19 years. Waist-to-height ratio (WHtR) was calculated by dividing waist circumference
252 (cm) by height (cm). A WHtR ≥0.50 was used as a screening threshold for increased central
253 adiposity, while values <0.50 were considered below this threshold [20, 21]

254 **Outcome definitions**

255 The primary outcomes were knowledge, attitude, and perception levels; the independent
256 variables included sociodemographic characteristics, family history of diabetes, prior elevated
257 blood glucose, anthropometric measurements, lifestyle behaviors, and diabetes awareness. For
258 the knowledge scale, correct responses were scored 1, and incorrect responses scored 0. For
259 attitude and perception, scores were re-coded on a Likert scale from “one” (strongly disagree)
260 to “five” (strongly agree). Negatively worded statements were reverse-scored before analysis
261 so that higher scores consistently indicated more favorable attitudes and perceptions. We
262 calculated the individual KAP scores by summing the scores for their respective questionnaire
263 items, and converted the raw composite scores to percentages using the formula below.

264 $$\frac{\text{Observed Score} - \text{Minimum Possible Score}}{\text{Maximum Possible Score} - \text{Minimum Possible Score}} X\ 100\%$$

This transformation was carried out to facilitate comparison across domains by having a common 0-100% scale, thereby accounting for the non-zero minimum obtainable score inherent in Likert-type scales.

In line with previous educational and perception studies, we used Bloom's benchmark to classify KAP scores [22]. We classified scores of ≥80% as good, 60-79% as moderate, and <60% as poor. For inferential analyses, knowledge was dichotomized as moderate-to-good (≥60%) versus poor (<60%) to distinguish participants with at least a moderate level of factual knowledge from those with poor knowledge. Attitude and perception were dichotomized as good (≥80%) versus poor-to-moderate (<80%) to identify participants meeting the more stringent threshold for favorable attitudes and perceptions. Because these cut-offs can influence classification, sensitivity analyses were conducted using a uniform threshold of ≥70% across all three domains.

Statistical analysis

Data were cleaned in Microsoft Excel (Version 2016) and imported into R statistical software [23]. Categorical variables were summarized using frequencies and percentages, while continuous variables were summarized using means and standard deviations SD or medians and interquartile ranges IQR, as appropriate. We assessed the distribution of continuous variables using graphical methods (histograms and Q-Q plots), skewness, kurtosis, and the Shapiro–Wilk tests. Pearson's product-moment correlation assessed unadjusted correlations between continuous KAP scores. We examined bivariate associations between participant characteristics and KAP levels using Pearson's chi-square test or Fisher's exact test for categorical variables, independent-samples t-tests for normally distributed continuous variables, and the Wilcoxon rank-sum test for non-normally distributed variables. In the sensitivity analysis, we repeated the bivariate associations using a less stringent uniform threshold of ≥70% of the maximum score to classify good knowledge, attitude, and perception, instead of the

primary Bloom's cut-off classification. The sensitivity analysis evaluated the robustness of the observed associations to an alternative outcome classification.

We used multivariable logistic regression models to identify factors independently associated with moderate-to-good knowledge, good attitudes, and good perceptions. Variables considered theoretically or clinically relevant, together with variables showing evidence of association in the bivariate analyses, were considered for inclusion in the multivariable models, with statistical significance set at < 0.05. We reported crude and adjusted odds ratios (ORs) with 95% confidence intervals (CIs). Multivariable analyses used complete-case analysis, and statistical significance was defined as a two-sided p-value <0.05.

Ethical considerations

We obtained ethical approval from the Health Research Ethics Committee of the Lagos University Teaching Hospital, Idi-Araba, Lagos, Nigeria (Approval No. ADM/DSCST/HREC/APP/6630). The principals of the participating schools approved the study before commencement.

Written informed consent was obtained from parents or legal guardians of eligible students before participation, while written informed assent was obtained from all participating adolescents (see Supplementary file 2: Appendices S1–S3). Participation was voluntary, and participants were informed of their right to decline or withdraw from the study at any time without penalty. All data were anonymized and handled confidentially throughout the study.

Results

Sociodemographic characteristics of study participants

Table 1 presents the sociodemographic characteristics of the study participants. Of 517 selected and invited eligible adolescents, 496 participated in the study (response rate: 95.9%). The mean age was 15.5 ± 1.3 years. Females accounted for 69.8% of participants; 52.4% were in SS1, 60.1% were Christians, 59.9% were of Yoruba ethnicity, and 87.5% lived with their parents. Most mothers (59.4%), fathers (48.9%), and guardians (58.3%) were self-employed. University education was the highest educational attainment among 42.8% of mothers, 48.1% of fathers, and 57.1% of guardians.

Table 1. Sociodemographic characteristics of study participants (n = 496)

Characteristics of participants	Category	n (%) / Mean ± SD
Sex	Female	346 (69.8)
	Male	150 (30.2)
Age (years), mean ± SD	—	15.5 ± 1.3
Secondary school level	SS1	260 (52.4)
	SS2	236 (47.6)
Religion	Christianity	298 (60.1)
	Islam	191 (38.5)
	Others	7 (1.4)
Ethnicity	Yoruba	297 (59.9)
	Igbo	145 (29.2)
	Hausa	16 (3.2)
	Others	38 (7.7)
Lives with	Parent	434 (87.5)
	Guardian	62 (12.5)
Mother's occupation	Unemployed	34 (6.9)
	Self-employed	291 (59.4)
	Employed	165 (33.7)
	Missing	6
Mother's education level	None	24 (5.0)
	Basic/Primary	50 (10.5)
	Secondary	199 (41.7)
	University	204 (42.8)
	Missing	19
Father's occupation	Unemployed	29 (6.0)

	Self-employed	236 (48.9)
	Employed	218 (45.1)
	Missing	13
Father's education level	None	25 (5.3)
	Basic/Primary	33 (7.0)
	Secondary	187 (39.6)
	University	227 (48.1)
	Missing	24
Guardian's occupation (n=62)	Unemployed	2 (4.2)
	Self-employed	28 (58.3)
	Employed	18 (37.5)
	Missing	14
Guardian's education level (n=62)	None	2 (4.1)
	Basic/Primary	4 (8.2)
	Secondary	15 (30.6)
	University	28 (57.1)
	Missing	13

Diabetes risk-factor profile of study participants

Table 2 presents participants' diabetes risk-factor profile, including family history, anthropometric measures, prior glycaemic history, and lifestyle behaviours. Most participants reported no family history of diabetes (84.5%), while 10.3% reported a positive family history and 5.2% were unsure. Most had never been told they had high blood sugar (89.1%), while 11.1% believed they have high blood sugar. The mean weight, height, waist circumference, and BMI were 49.2 ± 9.50 kg, 1.6 ± 0.08 m, 69.8 ± 7.5 cm, and 18.9 ± 3.3 kg/m², respectively. According to the WHO BMI-for-age classification, 75.9% of participants had normal weight, 10.2% were thin, 7.1% had severe thinness, 6.0% were overweight, and 0.8% were obese. Regarding lifestyle practices, 89.3% reported engaging in exercise, with walking (n = 186/441, 42.2%) being the most common exercise, and 50.1% (n = 219/437) reported exercising more than 30 minutes per day. These self-reported exercise data should not be interpreted as the proportion meeting recommended physical-activity guidelines. Alcohol consumption and cigarette smoking were reported by 8.5% and 4.5% of participants, respectively. The mean

WHtR was 0.43. Most participants (92.7%) had a WHtR <0.50, while 7.3% had a WHtR >=0.50, indicating increased central adiposity based on the commonly used screening threshold.

Table 2. Diabetes risk-factor profile of study participants (n = 496)

Characteristics	Category	n (%) / Mean ± SD
Family history of diabetes	No	419 (84.5)
	Yes	51 (10.3)
	Not sure	26 (5.2)
Mean weight (kg)	—	49.2 ± 9.50
Mean height (m)	—	1.6 ± 0.08
Mean waist circumference (cm)	—	69.8 ± 7.50
Body mass index (kg/m^2)	—	18.9 ± 3.32
WHO BMI-for-age category	Severe thinness	34 (7.1)
	Thinness	49 (10.2)
	Normal weight	365 (75.9)
	Overweight	29 (6.0)
	Obesity	4 (0.8)
	Missing	15
Waist-to-height ratio (WHtR)	<0.05	460 (92.7)
	≥0.05	36 (7.3)
Told I have high blood sugar	No	442 (89.1)
	Yes	47 (9.5)
	Not sure	7 (1.4)
Believed I have high blood sugar	Yes	54 (11.1)
Engage in exercise	Yes	441 (89.3)
	Missing	2
Type of exercise (n=441)	Walking	186 (42.2)
	Football	110 (24.9)
	Running	102 (23.1)
	Bicycling	53 (12)
	Swimming	41 (9.3)
Duration of exercise (n=441)	10–20 minutes	115 (26.3)
	20–30 minutes	103 (23.6)
	>30 minutes	219 (50.1)
	Missing	4
Alcohol intake	Yes	42 (8.5)
	Missing	2
Frequency of alcohol intake (n=42)	Daily	18 (46.2)
	2–3 times/week	10 (25.6)
	4–5 times/week	11 (28.2)
	Missing	3

Cigarette smoking	Yes	22 (4.5)
	Missing	4
Frequency of cigarette smoking (n=22)	Daily	12 (57.1)
	2–3 times/week	5 (23.8)
	4–5 times/week	4 (19.0)
	Missing	1
Eating breakfast	Yes	294 (59.2)
Watching television, mean time = 4 hours ± 3.56 hours	Yes	443 (89.1)

340

341 **Diabetes awareness, information sources, and interest in diabetes education**

342 According to the findings, of the 489 participants who responded to the awareness question,
343 450 (92.0%) had heard about diabetes mellitus. The most commonly reported sources of
344 information were television (29.7%), friends or family members (28.7%), doctors (26.2%),
345 radio (14.7%), class teachers (14.4%), and nurses (12.9%). About 91.4% expressed interest in
346 learning more about diabetes, while 83.2% were interested in having a diabetes club (Table 3)

347 **Table 3. Diabetes awareness, information sources, and interest in school-based diabetes**
348 **education among study participants (n= 496)**

Characteristic	**Category**	**n (%) / Mean ± SD**
Heard about diabetes mellitus	Yes	450 (92.0)
Sources of information (n=450)	Television	134 (29.7)
	Friends/family members	129 (28.7)
	Healthcare providers	118 (26.2)
	Radio	66 (14.7)
	Class teacher	65 (14.4)
	Nurses	58 (12.9)
	Pharmacists	52 (11.6)
	TikTok	51 (11.3)
	WhatsApp	24 (5.3)
	Instagram	15 (3.3)
Interested in knowing more about diabetes	Yes	447 (91.4)
Interested in having a school diabetes club	Yes	406 (83.2)

349
350

Knowledge of diabetes mellitus among adolescents

Table 4 presents the proportion of correct responses to the knowledge items on diabetes mellitus. The highest proportions of correct responses were for the statements that diabetes occurs when there is a high amount of sugar in the blood (Q1: 86.5%) and that eating more sweets and sugary foods increases the chances of developing diabetes (Q9: 79.8%). Diabetes can occur due to lack of physical activity or exercise (Q8: 52.4%). More than half of participants also correctly identified weight loss (Q10: 59.9%), persistent tiredness (Q11: 62.7%), frequent urination (Q13: 62.1%), and that diabetes is not transmissible from one person to another (Q5: 57.3%) as features of diabetes. In contrast, fewer respondents correctly identified that diabetes can run in families (Q4: 39.7%), that diabetes can occur when insulin does not work effectively (Q2: 33.9%), that type 1 and type 2 are the two main types of diabetes (Q3: 33.7%), that diabetes can occur when the body does not produce enough insulin (Q7: 40.7%), and that slow wound healing (Q14: 39.5%), blurry vision (Q15: 35.1%), and persistent hunger and thirst (Q12: 29.0%) are symptoms of diabetes.

Table 4. Correct responses to diabetes knowledge items among adolescents (N =496)

Items	Knowledge statement	Expected response	Frequency of correct responses (%)
Q1	Diabetes occurs when there is a high amount of sugar in the blood	Yes	429 (86.5)
Q2	Diabetes occurs when insulin does not work effectively again	Yes	168 (33.9)
Q3	Type 1 & type 2 diabetes are the two main types of diabetes	Yes	167 (33.7)
Q4	Diabetes is a disease that runs in a family	Yes	197 (39.7)
Q5	Diabetes is transmitted from one person to another	No	284 (57.3)

Q6	Obesity or being overweight causes someone to have diabetes	Yes	208 (41.9)
Q7	Diabetes occurs when the body does not have enough insulin	Yes	202 (40.7)
Q8	Diabetes occurs due to lack of physical activity or exercise	Yes	260 (52.4)
Q9	Eating more sweets and sugary food increases one's chance of having diabetes	Yes	396 (79.8)
Q10	Weight loss is a symptom of diabetes	Yes	297 (59.9)
Q11	Always feeling tired is a symptom of diabetes	Yes	311 (62.7)
Q12	Always feeling hungry and thirsty is a symptom of diabetes	Yes	144 (29)
Q13	Always urinating is a symptom of diabetes	Yes	308 (62.1)
Q14	Slow healing of wounds or injuries is a symptom of diabetes	Yes	196 (39.5)
Q15	Blurry vision is a symptom of diabetes	Yes	174 (35.1)

Attitudes towards diabetes mellitus among adolescents

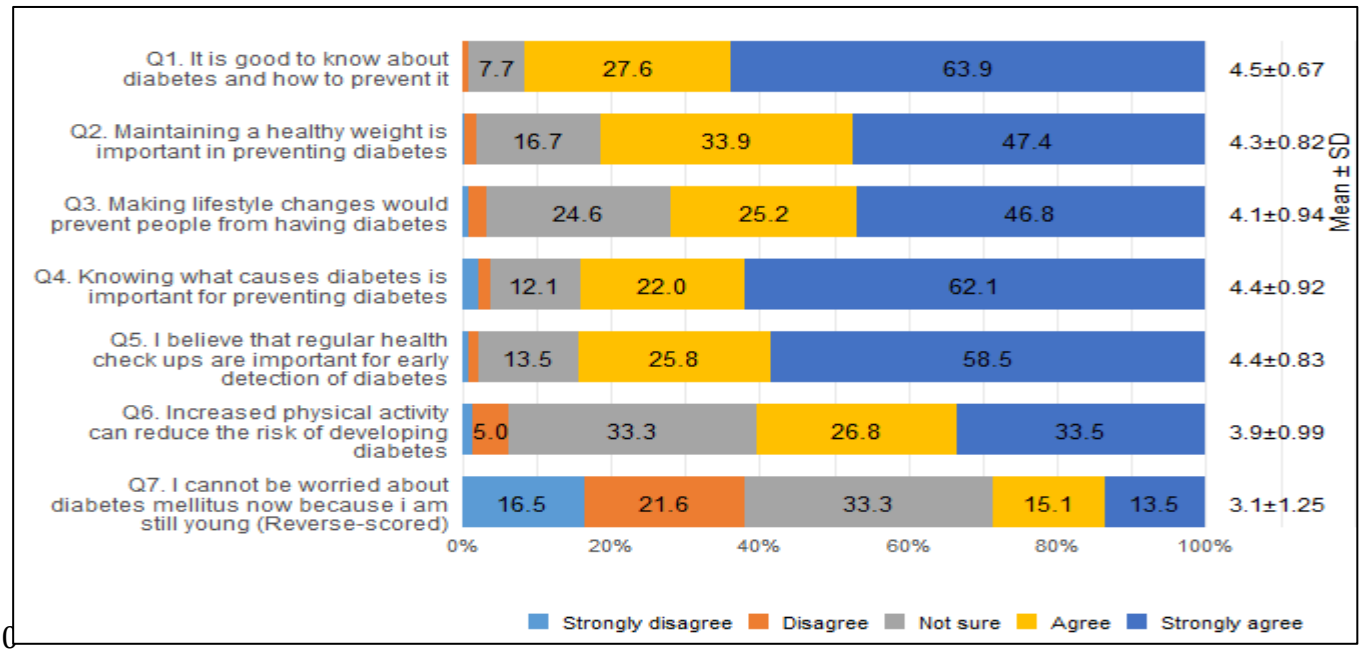

Figure 3 shows the distribution of responses to attitude items related to diabetes mellitus among adolescents (N = 496). *Bars represent the percentage of participants selecting each response category on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Median scores and interquartile ranges (IQRs) are shown on the right-hand axis. Reverse-worded item Q7 was reverse-scored for calculation of summary statistics only; response distributions are presented in their original form.*

As shown above, most participants agreed or strongly agreed that it is important to know about diabetes and its prevention (Q1: 91.5%), maintain a healthy weight (Q2: 81.3%), adopt healthy lifestyle changes (Q3: 80.7%), understand the causes of diabetes (Q4: 84.1%), undergo regular health check-ups (Q5: 84.3%), and engage in physical activity to reduce diabetes risk (Q6: 60.3%). In contrast, fewer participants disagreed or strongly disagreed that they could not be worried about diabetes because they were still young (Q7: 38.1%).

Perceptions of diabetes mellitus among adolescents

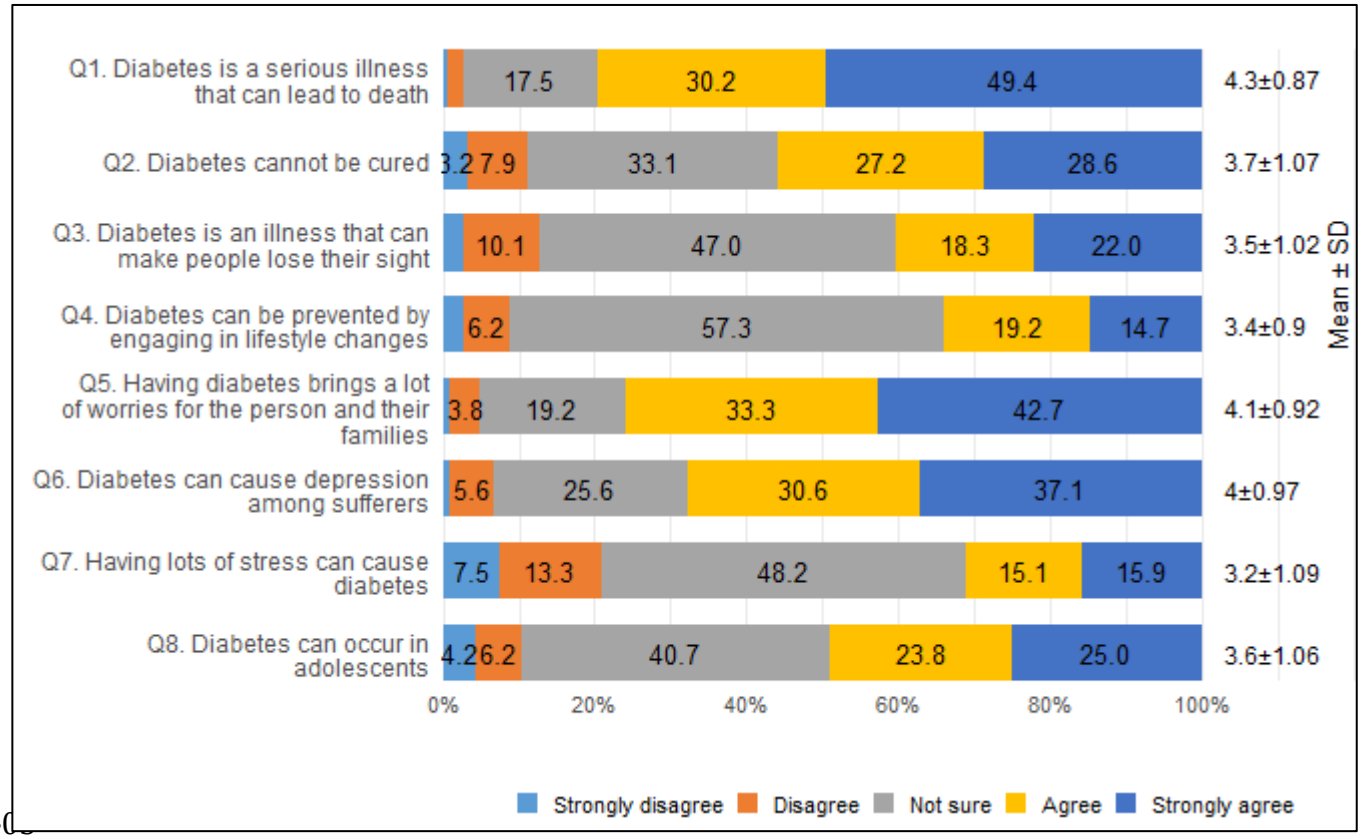

Figure 4 shows the distribution of participants' perceptions on diabetes mellitus risk among adolescents (N = 496).

Bars represent the percentage of participants selecting each response category on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Median scores and interquartile ranges (IQRs) are shown on the right-hand axis.

Figure 4 revealed that participants commonly recognized that diabetes may cause death (Q1:79.6%), depression (Q6: 67.7%,) and substantial burdens for affected individuals and their families (Q5; 76.0%), however, fewer recognized loss of vision as a potential complication (Q3: 40.3%). Notably, about one-third recognized that diabetes can be prevented through lifestyle modification (33.9%), while 57.3% were unsure (Q4). Also, 10.4% disagreed or strongly disagreed that diabetes can occur in adolescents, while 40.7% were unsure (Q8). However, 55.8% believed that diabetes cannot be cured (Q2).

Overall knowledge, attitude, and perception scores regarding diabetes mellitus among adolescents

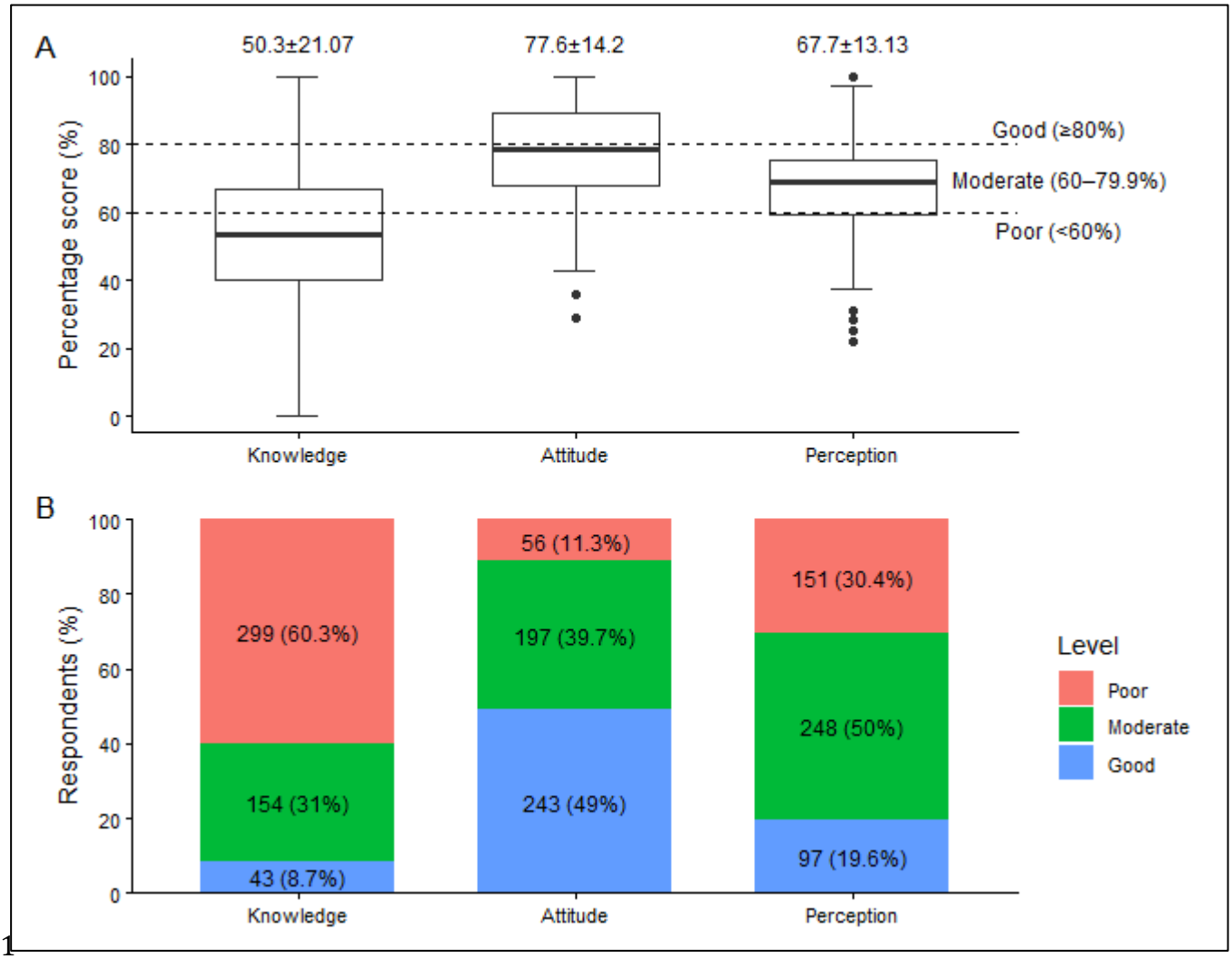

Figure 5. Percentage scores and categorical distribution of knowledge, attitude, and perception regarding diabetes mellitus among adolescents (N = 496)

Panel A shows the distribution of percentage scores for knowledge, attitude, and perception outcomes using boxplots. The central line within each box represents the median, the box represents the interquartile range (IQR), and the whiskers indicate the spread of the data. Dashed horizontal lines at 60% and 80% represent Bloom's cut-off thresholds used to classify participants as having poor (<60%), moderate (60-79.9%), or good (≥80%) domain levels. Mean and standard deviation values are displayed above each boxplot. Panel B shows the proportions of participants classified as having poor, moderate, and good levels according to Bloom's cut-off thresholds.

The mean KAP scores were 50.3 ± 21.1%, 77.6 ± 14.2%, and 67.7 ± 13.1%, respectively (Figure 5). Based on the predefined score classifications, 299 participants (60.3%) had poor knowledge, while 154 (31.0%) and 43 (8.7%) had moderate and good knowledge, respectively. For the dichotomized attitude outcome used in the regression analyses, 243 participants (49.0%) met the threshold for good attitude (≥80%), while 253 (51.0%) were classified as poor-to-moderate. For perception, 248 participants (50.0%) had moderate perception, 151 (30.4%) had poor perception, and 97 (19.6%) had good perception. Overall KAP scores were positively correlated. Knowledge score showed moderate positive correlations with attitude score ($r = 0.393$, $p < 0.001$) and perception score ($r = 0.430$, $p < 0.001$); attitude score was also positively correlated with perception score ($r = 0.380$, $p < 0.001$).

Associations between participant characteristics and knowledge, attitude, and perception of diabetes mellitus

Table 5 presents the bivariate associations between participant characteristics and KAP levels. At the bivariate level, knowledge of diabetes was significantly associated with sex ($p = 0.004$), parent/guardian occupation status ($p = 0.008$), body weight ($p = 0.012$), WHO BMI-for-age category ($p = 0.006$), and waist circumference ($p = 0.024$). Attitude towards diabetes mellitus was significantly associated with sex ($p = 0.002$), age ($p = 0.004$), secondary school level ($p < 0.001$), ethnicity ($p = 0.007$), living with parent/guardian ($p = 0.038$), cigarette smoking ($p < 0.001$), and knowledge level ($p < 0.001$). Perception was significantly associated with sex ($p = 0.005$), secondary school level ($p = 0.045$), knowledge ($p < 0.001$), and attitude ($p < 0.001$). Sensitivity analyses using a less stringent but uniform 70% threshold demonstrated that the principal associations between knowledge, attitude, and perception outcomes were maintained

455 **Table 5. Associations between participant characteristics and knowledge, attitude, and perception**

456

Characteristic	Knowledge Level			Attitude Level			Perception Level		
	Moderate-to-good N = 197[1]	**Poor** N = 299[1]	**p-value**	**Good** N = 243[1]	**Poor-to-moderate** N = 253[1]	**p-value**	**Good** N = 97[1]	**Poor-to-moderate** N = 399[1]	**p-value**
Sex			**0.004**[2]			**0.002**[2]			**0.005**[2]
Female	152 (77%)	194 (65%)		185 (76%)	161 (64%)		79 (81%)	267 (67%)	
Male	45 (23%)	105 (35%)		58 (24%)	92 (36%)		18 (19%)	132 (33%)	
Age (years)	15.6±1.4	15.5±1.3	0.46[3]	15.3±1.2	15.7±1.4	**0.004**[3]	15.6±1.3	15.5±1.3	0.62[3]
Secondary school level			0.33[2]			**<0.001**[2]			**0.045**[2]
SS1	98 (50%)	162 (54%)		109 (45%)	151 (60%)		42 (43%)	218 (55%)	
SS2	99 (50%)	137 (46%)		134 (55%)	102 (40%)		55 (57%)	181 (45%)	
Religion			0.73[4]			0.061[4]			0.33[4]
Christianity	122 (62%)	176 (59%)		158 (65%)	140 (55%)		55 (57%)	243 (61%)	
Islam	73 (37%)	118 (39%)		83 (34%)	108 (43%)		42 (43%)	149 (37%)	
Others	2 (1.0%)	5 (1.7%)		2 (0.8%)	5 (2.0%)		0 (0%)	7 (1.8%)	
Ethnicity			0.75[2]			**0.007**[2]			0.50[4]
Yoruba	120 (61%)	177 (59%)		129 (53%)	168 (66%)		64 (66%)	233 (58%)	
Igbo	59 (30%)	86 (29%)		84 (35%)	61 (24%)		23 (24%)	122 (31%)	
Hausa	6 (3.0%)	10 (3.3%)		6 (2.5%)	10 (4.0%)		2 (2.1%)	14 (3.5%)	
Others	12 (6.1%)	26 (8.7%)		24 (9.9%)	14 (5.5%)		8 (8.2%)	30 (7.5%)	
Lives with			0.22[2]			**0.038**[2]			0.10[2]
Parent	168 (85%)	266 (89%)		205 (84%)	229 (91%)		80 (82%)	354 (89%)	
Guardian	29 (15%)	33 (11%)		38 (16%)	24 (9.5%)		17 (18%)	45 (11%)	
Parent/guardian education level			0.46[2]			0.27[2]			0.57[2]
None/Basic	11 (5.7%)	25 (8.7%)		13 (5.5%)	23 (9.3%)		7 (7.2%)	29 (7.5%)	
Secondary	69 (36%)	101 (35%)		86 (36%)	84 (34%)		30 (31%)	140 (36%)	
University	114 (59%)	162 (56%)		137 (58%)	139 (57%)		60 (62%)	216 (56%)	
Missing	3	11		7	7		0	14	

Parent/guardian occupation status			**0.008**[2]			0.10[2]			**0.050**[4]
Unemployed	8 (4.1%)	6 (2.0%)		5 (2.1%)	9 (3.6%)		4 (4.1%)	10 (2.5%)	
Self-employed	69 (35%)	144 (49%)		95 (39%)	118 (47%)		32 (33%)	181 (46%)	
Employed	120 (61%)	146 (49%)		142 (59%)	124 (49%)		61 (63%)	205 (52%)	
Missing	0	3		1	2		0	3	
Family history of diabetes			0.33[2]			>0.99[2]			0.70[2]
No/unsure	180 (91%)	265 (89%)		218 (90%)	227 (90%)		86 (89%)	359 (90%)	
Yes	17 (8.6%)	34 (11%)		25 (10%)	26 (10%)		11 (11%)	40 (10%)	
Told they have high blood sugar			0.68[2]			0.13[2]			0.40[2]
No/unsure	177 (90%)	272 (91%)		215 (88%)	234 (92%)		90 (93%)	359 (90%)	
Yes	20 (10%)	27 (9.0%)		28 (12%)	19 (7.5%)		7 (7.2%)	40 (10%)	
Believed they have high blood sugar	24 (12%)	30 (10%)	0.46[2]	26 (11%)	28 (11%)	0.83[2]	13 (14%)	41 (11%)	0.40[2]
Missing	4	7		3	8		1	10	
Weight (Kg)	50.6±9.6	48.2±9.4	**0.012**[3]	49.9±9.8	48.5±9.2	0.11[3]	49.1±9.3	49.2±9.6	0.66[3]
Missing	6	5		3	8		3	8	
Height (m)	1.6±0.1	1.6±0.1	0.19[3]	1.6±0.1	1.6±0.1	0.56[3]	1.6±0.1	1.6±0.1	0.97[3]
Missing	5	6		2	9		4	7	
Body mass index (Kg/m2)	19.3±3.5	18.7±3.2	0.071[3]	19.1±3.5	18.7±3.2	0.16[3]	18.9±3.0	18.9±3.4	0.61[3]
Missing	6	6		3	9		4	8	
WHO BMI-for-age category			**0.006**[4]			0.14[4]			0.85[4]
Severe thinness	13 (6.9%)	21 (7.2%)		19 (7.9%)	15 (6.2%)		5 (5.4%)	29 (7.5%)	
Thinness	13 (6.9%)	36 (12%)		19 (7.9%)	30 (12%)		9 (9.8%)	40 (10%)	
Normal weight	141 (75%)	224 (77%)		179 (75%)	186 (77%)		71 (77%)	294 (76%)	
Overweight	19 (10%)	10 (3.4%)		19 (7.9%)	10 (4.1%)		7 (7.6%)	22 (5.7%)	
Obesity	3 (1.6%)	1 (0.3%)		3 (1.3%)	1 (0.4%)		0 (0%)	4 (1.0%)	

Missing	8	7		4	11		5	10	
Waist circumference (cm)	68.6 (66.0, 73.7)	68.6 (63.5, 73.7)	**0.024**[3]	68.6 (66.04, 73.7)	68.6 (63.5, 73.7)	0.15[3]	68.6 (63.5, 71.1)	68.6 (66.0, 73.7)	0.22[3]
Missing	6	5		2	9		4	7	
Engages in exercises	177 (90%)	264 (89%)	0.74[2]	215 (88%)	226 (90%)	0.57[2]	88 (91%)	353 (89%)	0.61[2]
Missing	0	2		0	2		0	2	
Exercises for			0.28[2]			0.30[2]			0.35[2]
10-20 minutes	51 (29%)	64 (25%)		55 (26%)	60 (27%)		21 (24%)	94 (27%)	
20-30 minutes	45 (26%)	58 (22%)		57 (27%)	46 (21%)		17 (19%)	86 (25%)	
>30 minutes	80 (45%)	139 (53%)		101 (47%)	118 (53%)		50 (57%)	169 (48%)	
Missing	21	38		30	29		9	50	
Alcohol intake	17 (8.7%)	25 (8.4%)	0.91[2]	16 (6.6%)	26 (10%)	0.13[2]	9 (9.4%)	33 (8.3%)	0.73[2]
Missing	1	1		0	2		1	1	
Cigarette smoking	7 (3.6%)	15 (5.1%)	0.44[2]	3 (1.2%)	19 (7.6%)	**<0.001**[2]	5 (5.3%)	17 (4.3%)	0.59[4]
Missing	2	2		1	3		3	1	
Knowledge level						**<0.001**[2]			**<0.001**[2]
Moderate-to-good				127 (52%)	70 (28%)		59 (61%)	138 (35%)	
Poor				116 (48%)	183 (72%)		38 (39%)	261 (65%)	
Attitude level									**<0.001**[2]
Good							65 (67%)	178 (45%)	
Poor-to-moderate							32 (33%)	221 (55%)	

[1]n (%); Mean ±SD; Median (Q1, Q3); [2]Pearson's Chi-squared test; [3]Wilcoxon rank sum test; [4]Fisher's exact test
Note: Cell percentages are based on available data for each characteristic; missing observations are shown where applicable. Knowledge was dichotomized as moderate-to-good versus poor, and attitude and perception as good versus poor-to-moderate, according to the prespecified scoring thresholds.

Factors associated with moderate-to-good knowledge of diabetes among adolescents

In the complete-case multivariable model (n = 456; Table 6), sex and parent/guardian occupation status remained independently associated with knowledge level (Table 6). Male participants had lower odds of moderate-to-good knowledge of diabetes mellitus than females (aOR = 0.51, 95% CI: 0.30-0.86; p = 0.010). Participants whose parents or guardians were self-employed had lower odds of moderate-to-good knowledge compared with those whose parents or guardians were unemployed (aOR = 0.27, 95% CI: 0.08-0.88; p = 0.002). This should be interpreted cautiously because the unemployed reference category was small.

Table 6. Multivariable logistic regression analysis of factors associated with moderate-to-good knowledge (N = 456)

Characteristics	Category	n	Crude OR (95% CI)	P	Adjusted OR (95% CI)	p
Sex	Female	325	1.00 (Ref.)	0.003	1.00 (Ref.)	0.010
	Male	131	0.52 (0.33–0.80)		0.51 (0.30–0.86)	
Parent/guardian occupation status	Unemployed	13	1.00 (Ref.)	0.001	1.00 (Ref.)	0.002
	Self-employed	202	0.29 (0.08–0.90)		0.27 (0.08–0.88)	
	Employed	241	0.55 (0.16–1.70)		0.52 (0.15–1.68)	
Body mass index (kg/m²)	—	456	1.06 (1.00–1.12)	0.048	1.02 (0.95–1.10)	0.62

OR = odds ratio; CI = confidence interval; Ref. = reference category. Estimates are associations from complete-case logistic regression analyses and should not be interpreted as causal effects.

Factors associated with good attitudes towards diabetes

In the complete-case multivariable model (n = 456; Table 7), age, secondary school level, living arrangement, and knowledge level were independently associated with attitude (Table 7). Increasing age was associated with lower odds of a good attitude towards diabetes (aOR = 0.69, 95% CI: 0.57-0.83; p < 0.001). Compared with SS1 students, SS2 students had higher odds of

a good attitude (aOR = 2.60, 95% CI: 1.66-4.11; p < 0.001). Students living with a guardian had higher odds of a good attitude than those living with their parents (aOR = 2.35, 95% CI: 1.22-4.65; p = 0.010). Participants with moderate-to-good knowledge also had higher odds of a good attitude than those with poor knowledge (aOR = 2.93, 95% CI: 1.90-4.56; p < 0.001).

Table 7. Multivariable logistic regression analysis of factors associated with good attitude (N = 456)

Characteristics	Category	n	Crude OR (95% CI)	p	Adjusted OR (95% CI)	p
Sex	Female	325	1.00 (Ref.)	0.007	1.00 (Ref.)	0.36
	Male	131	0.57 (0.38–0.86)		0.78 (0.45–1.34)	
Age (years)	—	456	0.84 (0.73–0.97)	0.021	0.69 (0.57–0.83)	<0.001
Secondary school level	SS1	243	1.00 (Ref.)	<0.001	1.00 (Ref.)	<0.001
	SS2	213	1.94 (1.34–2.82)		2.60 (1.66–4.11)	
Ethnicity	Yoruba	270	1.00 (Ref.)	0.024	1.00 (Ref.)	0.10
	Igbo	136	1.76 (1.16–2.68)		1.81 (1.03–3.21)	
	Hausa	13	1.06 (0.33–3.26)		1.04 (0.30–3.48)	
	Others	37	2.02 (1.01–4.19)		2.22 (0.97–5.24)	
Lives with	Parent	397	1.00 (Ref.)	0.021	1.00 (Ref.)	0.010
	Guardian	59	1.93 (1.11–3.46)		2.35 (1.22–4.65)	
Cigarette smoking	No	437	1.00 (Ref.)	0.007	1.00 (Ref.)	0.10
	Yes	16	0.22 (0.05–0.68)		0.31 (0.06–1.24)	
Knowledge level	Poor	271	1.00 (Ref.)	<0.001	1.00 (Ref.)	<0.001
	Moderate-to-good	185	2.92 (1.99–4.33)		2.93 (1.90–4.56)	

OR = odds ratio; CI = confidence interval; Ref. = reference category.
Estimates are associations from complete-case logistic regression analyses and should not be interpreted as causal effects.

Factors associated with good perceptions of diabetes

In the complete-case multivariable model (n = 456; Table 8), knowledge level and attitude level remained independently associated with perception (Table 8). Participants with moderate-to-good knowledge had higher odds of good perceptions than those with poor knowledge (aOR = 2.31, 95% CI: 1.41-3.81; p < 0.001). Likewise, participants with good attitudes had higher odds

of good perceptions than those with poor-to-moderate attitudes (aOR = 2.18, 95% CI: 1.28-3.76; p = 0.004).

Table 8. Multivariable logistic regression analysis of factors associated with good perception (N = 456)

Characteristic	Category	N	Crude OR (95% CI)	p	Adjusted OR (95% CI)	p
Sex	Female	325	1.00 (Ref.)	0.012	1.00 (Ref.)	0.070
	Male	131	0.50 (0.27–0.86)		0.58 (0.31–1.04)	
Knowledge level	Poor	271	1.00 (Ref.)	<0.001	1.00 (Ref.)	<0.001
	Moderate-to-good	185	2.83 (1.78–4.57)		2.31 (1.41–3.81)	
Attitude level	Poor-to-moderate	226	1.00 (Ref.)	<0.001	1.00 (Ref.)	0.004
	Good	230	2.73 (1.69–4.50)		2.18 (1.28–3.76)	

OR = odds ratio; CI = confidence interval; Ref. = reference category.
Estimates are associations from complete-case logistic regression analyses and should not be interpreted as causal effects.

Discussion

This study assessed diabetes awareness, knowledge, attitudes, perceptions, lifestyle-related factors, and anthropometric indicators among secondary school adolescents in Lagos, Nigeria. The findings revealed a marked awareness-knowledge gap: although most participants had heard of diabetes, many had poor knowledge, and important gaps in risk perception remained.

The sociodemographic characteristics of the students indicated that more than half were female and from the Yoruba ethnic group, with most living with their parents. These findings are consistent with the ethnic distribution of southwestern Nigeria, where the Yoruba are the predominant ethnic group. A study conducted in southwest Nigeria [6] and another among school-going children [24] similarly reported a higher percentage of female students.

Nutritional status and the double burden of malnutrition

According to the WHO BMI-for-age classification, more than half of the students are of normal weight; 6% were overweight, 0.8% were obese, and 17.3% showed evidence of undernutrition,

including thinness and severe thinness. Thinness, rather than excess weight, was the predominant nutritional concern in this population. Several Nigerian studies have reported a similar pattern, with thinness, overweight, and obesity coexisting within the same adolescent population. In Ebonyi State, adolescents showed a higher combined burden of stunting and thinness than of overweight and obesity [25]. A study across Osun and Gombe States similarly found both undernutrition and overnutrition present in the same population [26], and a comparative study in Gombe and Uyo found thinness alongside overweight and obesity; the proportions varied by location and socioeconomic characteristics [27]. Nigerian adolescents therefore continue to carry this double burden, with undernutrition persisting even as overweight and obesity become more prevalent elsewhere.

Current epidemiological understanding of type 2 diabetes identifies overweight and obesity as major modifiable risk factors in young people [28, 29, 30,31], yet in this study, overweight and obesity remained comparatively low while undernutrition predominated. Waist-to-height ratio (WHtR) provided additional information on central adiposity beyond BMI. The mean WHtR was 0.43, and 7.3% of participants had a WHtR $\geq$0.50, suggesting that increased central adiposity was relatively uncommon in this adolescent population. This finding was broadly consistent with the BMI-for-age profile, in which most students (75.9%) had normal weight. Nevertheless, the presence of increased central adiposity in a subgroup, together with a reported family history of diabetes in 10.3% of participants, supports school-health approaches that promote healthy eating, regular physical activity, and appropriate growth without focusing exclusively on excess body weight.

Awareness and knowledge of diabetes mellitus

Most students reported having heard of diabetes, yet their knowledge of the disease was poor. These findings are similar to a study by Orok et al. (2024) that found that only about 25% of

undergraduates had good knowledge despite 92% being aware of diabetes mellitus [6,11]. The knowledge gap identified in this study may be attributed to the sources through which students first learned about diabetes: most heard about it through television, family, and friends. These sources likely conveyed that diabetes exists and is linked to sugar, without offering a deeper explanation of what the disease actually involves. This was evident in the varied pattern observed across the knowledge items. Two statements correctly answered by most adolescents were that diabetes involves high blood sugar and that eating sugary food raises the risk of developing diabetes; however, items requiring more detailed medical reasoning, such as the role of insulin, the distinction between type 1 and type 2 diabetes, and the significance of family history, were answered incorrectly by most students. Only 39.7% of students correctly identified family history as a risk factor, underscoring the need for targeted educational intervention.

Attitudes, perceptions, and the belief that youth confer immunity

Attitude scores were higher than knowledge scores in this study, with a mean of 77.6%. Most participants agreed that learning about diabetes, maintaining a healthy weight, and attending regular check-ups are important, a finding aligning with the generally positive disposition toward diabetes prevention reported among Nigerian students in other settings [6, 11]. In this study, the belief that youth confer immunity to diabetes was evident: only about 38% of students disagreed or strongly disagreed that they need not worry about diabetes because they are still young, meaning that most either agreed with this statement or remained unsure. This finding is consistent with earlier work showing that adolescents often perceive themselves as less likely than others to develop future health problems [32], a tendency first described by Weinstein [33] and since reported in studies of chronic disease risk, including cardiovascular risk among adolescents [34].

Both the International Diabetes Federation and the American Diabetes Association have nonetheless identified the rising incidence of type 2 diabetes among children and adolescents as a growing concern, driven by factors that accumulate well before adulthood [28, 29]. Early risk recognition therefore remains essential to curbing the prevalence of diabetes within the adolescent population.

Perceptions of diabetes in this study also revealed important gaps in understanding. More than half of the students believed that diabetes cannot be cured, a view that aligns with the chronic nature of the disease, even though diabetes can be effectively managed through lifestyle modification, appropriate treatment, and regular monitoring. Only one-third of students recognized that lifestyle modification could help prevent diabetes, while half remained unsure. These findings are worth noting, as adolescents who do not recognize that diabetes risk can be reduced may be less inclined to value healthy eating, regular physical activity, weight control, and reduced sedentary behaviour. This observation is consistent with the Health Belief Model, in which perceived susceptibility, perceived severity, and perceived benefit of preventive action shape health behaviour [35].

Factors associated with Knowledge, attitude, and perception

Knowledge, attitude, and perception were positively associated. Adolescents with moderate-to-good knowledge had almost three times the odds of a good attitude, while both knowledge and attitude were independently associated with good perception. This aligns with findings among Nigerian adolescents elsewhere, where better diabetes knowledge was associated with more positive attitudes and perceptions [11]. These associations support evaluating whether structured diabetes education can improve knowledge alongside attitudes and perceptions; however, the cross-sectional design does not establish the direction of these relationships.

Sex was an important determinant of knowledge: male students had about half the likelihood of moderate-to-good knowledge compared with females. Similar gender differences have been reported in some studies of adolescent health literacy, although the evidence remains mixed; some studies report higher health literacy among females, particularly in areas related to diet, weight, and general wellbeing, while others report that boys may have easier access to health information yet engage in different health behaviours [36]. This finding may therefore reflect differences in the type of health information that attracts male and female adolescents' attention. Since diabetes education commonly focuses on diet, body weight, sugar intake, and healthy lifestyles, girls may have had greater prior exposure to this kind of information. This points to a need for school-based diabetes education that deliberately engages boys, rather than assuming that a single approach will be equally effective for both sexes.

Parental or guardian occupation was also independently associated with knowledge. Adolescents whose parents or guardians were self-employed had lower odds of moderate-to-good diabetes knowledge than those whose parents or guardians were unemployed. This finding should be interpreted cautiously because the unemployed reference category was small (n = 13 in the complete-case model), resulting in a relatively imprecise comparison. The study did not assess parental working hours, health communication within households, or other mechanisms that could explain this association; therefore, causal explanations would be speculative.

Age and school level showed different associations with attitude. Increasing age was associated with lower odds of a positive attitude, whereas SS2 students had higher odds of a positive attitude than SS1 students. Because age and school level are related constructs, these apparently divergent associations should be interpreted cautiously and in light of the multivariable model diagnostics.

Living arrangement was a further determinant of attitude, with students living with guardians showing higher odds of a positive attitude than those living with parents. This finding should

be interpreted cautiously, given the relatively wide confidence interval and the possibility of unmeasured differences between households; it may reflect differences in supervision, household structure, or other social factors not captured in this study. Further qualitative or longitudinal research would help clarify this association.

Taken together, these findings indicate that diabetes knowledge, attitudes, and perceptions are closely linked and shaped by both individual and household characteristics. The associations observed with sex, age, school level, parental or guardian occupation, and living arrangement suggest that school-based diabetes education should be tailored to these characteristics.

Implications for school-based diabetes prevention

The high level of interest in further diabetes education among students is encouraging: about nine in ten students (91.4%) expressed interest in learning more about diabetes, and 83.2% indicated willingness to participate in a school diabetes club. These findings suggest that limited access to structured, sustained diabetes education, rather than a lack of interest, may be the more important barrier to improving knowledge, attitudes, and perceptions in this population. This aligns with international school-based initiatives that show the value of delivering diabetes education in a school environment. The International Diabetes Federation's Kids and Diabetes in Schools (KiDS) programme provides structured educational materials for students and teachers, emphasizing diabetes awareness, prevention, healthy lifestyles, and stigma reduction [29, 37]. The WHO and UNESCO's 2021 Global Standards for Health-Promoting Schools similarly support integrating health education into routine school activities and recognize schools as important settings for non-communicable disease prevention [38, 39]

The positive relationships observed in this study between knowledge, attitude, and perception further support an integrated approach. Rather than addressing each domain separately, a well-structured school programme could strengthen knowledge while also improving attitudes and perceptions of diabetes risk. Such a programme should directly address the misconceptions identified in this study, particularly the belief that diabetes mainly affects older adults and the uncertainty around whether type 2 diabetes can be prevented through lifestyle modification.

These findings also suggest that school-based programmes should reach male students as deliberately as female students, given the lower odds of moderate-to-good knowledge observed among boys. Integrating diabetes education into the secondary school curriculum, supported by school diabetes clubs and age-appropriate health promotion activities, may therefore offer a practical and sustainable approach to improving diabetes literacy and promoting healthier behaviours among adolescents.

Strengths and limitations

This study has several strengths. Proportionate stratified random sampling across six schools improved sampling coverage across the participating schools, while the sample size and high response rate strengthened the precision of the estimates. Anthropometric measurements were obtained directly rather than relying on self-reported weight and height, reducing the likelihood of reporting bias. In addition, sensitivity analyses using an alternative threshold for classifying knowledge, attitude, and perception outcomes allowed assessment of the robustness of the principal associations to outcome classification.

The study also has several limitations. First, its cross-sectional design does not establish temporal or causal relationships. Although knowledge, attitude, and perception were positively associated, it is not possible to determine the direction of these relationships or exclude the influence of other factors such as educational exposure, family environment, or access to health

information. Second, physical activity, alcohol use, smoking, and other behavioural measures were self-reported and may be subject to recall or social desirability bias. Third, biochemical measures, including fasting blood glucose and HbA1c, were not obtained; therefore, the study assessed risk-related characteristics and perceptions rather than undiagnosed diabetes. Finally, the study was conducted among public secondary school students in one densely populated local government area of Lagos State and did not include adolescents attending private schools, adolescents in rural settings, or out-of-school adolescents. The findings may therefore not be directly generalizable to all adolescents in Lagos State or Nigeria.

Conclusion

Diabetes awareness was high among adolescents in this study population, but this did not translate into adequate knowledge of the disease. Important misconceptions remained, particularly regarding the possibility of developing diabetes during adolescence and the role of lifestyle modification in prevention. Attitudes were generally favourable, but perceptions were less consistent, indicating that awareness alone is not sufficient to support appropriate risk recognition and preventive behaviour among adolescents.

Sex, parental or guardian occupation, age, school level, and living arrangement were associated with differences in knowledge or attitude, suggesting that educational approaches may need to account for variation across student and household characteristics. The observed associations between knowledge, attitudes, and perceptions provide a rationale for evaluating whether structured diabetes education can improve these outcomes, but the cross-sectional design does not establish that improving knowledge will cause changes in attitudes or perceptions.

Students expressed strong interest in further diabetes education, and schools provide a practical setting in which prevention strategies can be evaluated. Structured, teacher-supported diabetes education, informed by models such as the International Diabetes Federation's Kids and

Diabetes in Schools programme, could be incorporated into routine school health activities to address the misconceptions identified in this study while engaging male and female students. Future studies should prospectively evaluate such interventions and determine their effects on knowledge, attitudes, perceptions, and health-related behaviours.

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Abbreviations

HbA1c- Glycated Heamoglobin
OR – Odds ration
aOR- Adjusted Odds ratio
CI- Confidence Interval
LGA- Local Government Area
KAP – Knowledge, Attitude & Perception
SS1 – Senior Secondary 1
SS2 – Senior Secondary 2
BMI- Body Mass Index
WHtR- Waist- to- Heighr Ratio

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Health Research Ethics Committee of the Lagos University Teaching Hospital, Idi-Araba, Lagos, Nigeria (Approval No. ***ADM/DSCST/HREC/APP/6630***). The principals of the participating schools approved the study before commencement. Written informed consent was obtained from parents or legal guardians of eligible students before participation, while written informed assent was obtained from all participating adolescents (see ***Supplementary file 2: Appendices S1–S3***). All data were anonymized and handled confidentially throughout the study.

Consent for publication, the authors of this manuscript gave consent for the publication, and they confirm that the results presented have not been published previously in whole or part in any local or international journal.

Data availability All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Competing interests the authors declare no competing interests

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Author contributions EEO- conceptualized the study, developed the methodology, guided data collection, involved in final manuscript writing and editing; OBA contributed to data collection and literature review and writing, CSO provided statical guidance, contributed to data analysis and interpretation, JMO contributed in data analysis and interpretation, writing and editing, OPE- contributed in literature review, and editing, SOU – contributed in manuscript editing & formatting, EO did literature review, UGO contributed in the final manuscript editing and writing. All authors reviewed and approved the final version of the manuscript for publication, hence accountable for the content of the manuscript.

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