

Awareness of Type 2 Diabetes Mellitus and Hypertension among Secondary School Adolescents in Morogoro Region, Tanzania

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Abstract

Background: Several studies have consistently shown that adolescents' awareness of diabetes mellitus and hypertension is inadequate. The main objective was to assess adolescents' awareness of type 2 diabetes and hypertension and identify areas for improvement.

Methods: A cross-sectional survey was conducted with 384 secondary school students from public and private day schools in Kilosa district and Morogoro municipality. Face-to-face interviews were undertaken to collect data on awareness of type 2 diabetes mellitus and hypertension. Data were analyzed using IBM Statistical Packages for Social Sciences (SPSS version 21), and total awareness scores for various sections were calculated by adding the results from all 34 questions and assigning a score of 1 for a yes response and a score of 0 for a no, or a don't know the response.

Results: The main awareness scores for hypertension and diabetes mellitus were 51.4% and 50.2%, respectively, of the possible total score. The scores for general diabetes awareness and hypertension were 53.5% and 42.6%, respectively. Other scores for type 2 diabetes and hypertension were 32.1% vs 42.6% on the "Awareness of Risk Factors" section, 49.5% vs 46% on the "Awareness of Symptoms and Complications" section, 54.1% vs 52.9% on the "Awareness of Treatment and Available Medication Section" and 67.6% vs 66.9% on the "Awareness of Lifestyle Changes and Management Section".

Conclusion: Except for a few areas, such as risk factors, symptoms, and complications that necessitate intervention, adolescents exhibited an average level of information regarding Type 2 Diabetes Mellitus and hypertension. Non-communicable disease risk factors, symptoms, and complications should be taught in schools at a young age to improve primary prevention.

Keywords: Awareness, risk factors, Type 2 diabetes mellitus, hypertension, adolescents

Introduction

Type 2 Diabetes Mellitus (T2DM) was previously regarded as an adult disease; nevertheless, there has been a significant rise in T2DM prevalence in adults and children worldwide in the last ten years (Serbis *et al.*, 2021). Adolescent hypertension has also increased in significance in the last few decades as a global public health issue (Okpokowuruk *et al.*, 2017). According to systematic reviews, between 1 and 7% of children and adolescents in poor countries have hypertension (Meena *et al.*, 2021).

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Obesity prevalence has increased in both developed and developing countries, as has the incidence of T2DM and hypertension, owing to a more sedentary lifestyle and a greater intake of processed foods (Jaja & Yarhere, 2015; Song, 2012). However, many people are unaware that they have hypertension or T2DM until they acquire one of the diseases' life-threatening repercussions. One of the most essential components of T2DM and hypertension prevention techniques is raising public awareness and knowledge. This helps with early detection and changes in modifiable risk variables (Khan *et al.*, 2019). Increased awareness of hypertension and T2DM is expected to drive people to seek health care earlier and lower the likelihood of complications arising (Mbuya *et al.*, 2014).

According to studies from Kuwait and Nigeria, adolescent awareness of the symptoms, consequences, and treatment of diabetes mellitus and hypertension is low (Al-Hussaini & Mustafa, 2016; Omisore *et al.*, 2014). Furthermore, Sitaula *et al.* observed that awareness and knowledge scores were lower in the urban municipality and rural municipality compared to the metropolitan city in a rural-urban study on diabetes and hypertension among secondary school students in Nepal in 2022. This highlights the crucial need for school-based interventions focusing on non-communicable illnesses and lifestyle change while prioritizing rural populations. The primary objective of this study was to assess adolescents' awareness of T2DM and hypertension and to identify any weak points that require additional educational efforts and should be reinforced through interventions. The findings of this study would allow for changes to existing programs to address weak areas, which would aid in early disease detection and reduce the likelihood of repercussions.

Materials and Methods

Study areas

This study was conducted in two districts of the Morogoro region, Kilosa district representing a rural area and Morogoro municipality representing an urbanized population. Morogoro is one of Tanzania's 31 major regions, including seven districts: Morogoro Rural, Morogoro Urban (municipality), Ulanga, Kilombero, Gairo, Mvomero, and Kilosa. The region has a total population of 2,218,492 people, according to the 2012 Tanzania National Population Census. The rural and urban populations have different proportions, with the rural population being 1,582,434 and the urban population being 636,058. Adolescents aged 10 to 19 comprised 495 654 of the total population (NBS, 2012).

Study design and sample size

A descriptive cross-sectional study design was used for the investigation. The study comprised 14 to 19-year-old adolescent pupils from public and private secondary schools attending ordinary-level secondary schools. Boarding schools were excluded. The sample was selected from a sampling frame that included 50 secondary schools in the municipality of Morogoro and 43 secondary schools in the Kilosa district. Eight secondary schools, four public and four private, were randomly chosen from urban and rural locations to build up the sample. A stratified sampling strategy based on age, gender, and educational level was used to acquire a total sample of 405, following which 50 or more students were randomly picked from each school.

The sample size was computed using the Overall *et al.* (2006) formula;

$$N = N_0 / (1 - DRP)$$

Where:

N = desired sample size.

N_0 = Cochran's sample size recommendation where by $N_0 = \frac{Z^2 p (1-p)}{e^2}$

Z is level of statistically significant at 95% confidence interval =1.96, p is proportion of adolescents to be included = 50%/0.5 and e= precision = 5%/0.05

Therefore, $N_0 = ((1.96)^2 (0.5) (0.5)) / (0.05)^2 = 384$

DRP = average dropout rate across all subjects (5%)

Substituting for this would be;

$$N = (384)/(1-0.05) = 405$$

Therefore, the sample size was 405 respondents

Data collection methods

A self-administered questionnaire was adapted from Al-Hussaini and Mustafa (2016), and the survey instructions were explained to them. The students were directed to answer the pre-tested questions with a 'Yes,' 'No,' or 'Do not know' response. The questionnaire was divided into seven main sections, each focusing on a different aspect of diabetes mellitus, such as general awareness about T2DM and hypertension (eight questions), awareness of risk factors (seven questions), symptoms (seven in T2DM and six in hypertension), complications (five questions), treatment and available medications (two questions), lifestyle and non-medical measures (four in T2DM and five in hypertension), and management of the two diseases. Total awareness scores for each part were calculated by adding the results from all 34 questions and assigning a score of 1 for a yes response and 0 for a no or do not know response. The following parts received scores: general awareness, risk factors, symptoms and problems, drugs available, lifestyle adjustments, and management. The participants' first-degree relatives (mother, father, or sibling) were asked about their family history of diabetes and hypertension. Students were asked to check the box if any of their first-degree relatives had diabetes or hypertension.

Ethical consideration

This study commenced upon ethical approval from the National Institute for Medical Research (NIMR/HQ/R.8a/Vol.IX/3319) and Sokoine University of Agriculture. The regional administrative officer, the appropriate District Executive Officer, and the school's principals approved the study. Data was shared without revealing any personal information and was kept private. Students above 18 signed a consent form; for those under 18, a form of assent was signed along with parental consent.

Data analysis

The statistical analysis used the IBM Statistical Packages for Social Sciences (SPSS version 21). For categorical variables, data are provided as percentages (%). The scores for all 34 questions were added after assigning a score of 1 for the correct response and a score of 0 for no response or don't know. The five components, general awareness, risk factors, symptoms and problems, therapy, and management, received a score. The overall accurate score assessed adolescents' awareness of the causes, symptoms, consequences, and risk factors for T2DM and hypertension.

Results

Socio-demographic characteristics and family history of diabetes and hypertension

This study enrolled 405 adolescent pupils, and 384 (95%) completed the questionnaire. Most participants were in the age group of 14-16 years (79.7%), and only 20.3% were in the age group of 17-19 years, with a mean age of 15.53. As for education level, adolescents were selected equally (33.3%) in each level (Forms 2, 3 and 4). Diabetes and hypertension were **reported** in 15.6% and 16.7% of the subjects' first-degree relatives, respectively (Table 1).

Table 1: Socio-demographic characteristics and family history of diabetes and hypertension (N=384)

Variables	n (%)	Mean
Age (years)		
14-16	306 (79.7)	15.53
17-19	78 (20.3%)	
Education levels (Form 2, 3 and 4)	128 (33.3)	2.00
First-degree relatives with diabetes	60 (15.6)	0.16
First-degree relatives with hypertension	64 (16.7)	0.17

Awareness of T2DM and hypertension

Awareness on T2DM

The overall level of awareness (average correct answer) was 51.4%. The lowest percentage of the correct answer was for "Diabetes is not curable" (27.1%) in the general awareness section, "Pregnancy" (9.1%) in the risk factors section, "Headache" (32.8%) in the symptoms section, "Stroke and heart diseases" (34.9%) in the complications section, "Body weight maintenance" (52.6%) in the lifestyle section and "Regular eye check-up" (47.9%) in the management section (Table 2).

Table 2: Responses of the participants for different sections of the questionnaire (N = 384)

Questions	YES	NO	DON'T KNOW
General awareness of diabetes	n (%)	n (%)	n (%)
Diabetes is a condition of high blood sugar	250 (65.1)	68 (17.7)	66 (17.2)
Diabetes is a condition of not having enough insulin in the blood	198 (51.5)	48 (12.5)	138 (35.9)
Diabetes is a condition of the body not responding to insulin	156 (40.6)	63 (16.4)	165 (43.0)
Diabetes is not curable	104 (27.1)	205 (53.4)	75 (19.5)
Diabetes occurs in children, adolescents, and adults	319 (83.1)	33 (8.6)	32 (8.3)
Risk factors			
Family history of diabetes	85 (22.1)	143 (38.0)	153 (39.8)
Unhealthy diet	189 (49.2)	63 (16.4)	132 (34.4)
Overweight and obesity	158 (41.1)	96 (25.0)	130 (33.9)
Low physical activity	218 (56.8)	65 (16.9)	101 (26.3)
Age above 40 years old	42 (10.9)	211 (54.9)	131 (34.1)
Pregnancy	35 (9.1)	212 (55.2)	137 (35.7)
Alcohol consumption	136 (35.4)	114 (29.7)	134 (34.9)
Symptoms			

Headache	126 (32.8)	119 (31.0)	139 (36.2)
Tiredness and weakness	217 (56.5)	58 (15.1)	109 (28.4)
Visual disturbances or problems	168 (43.8)	100 (26.0)	116 (30.2)
Slow healing of cuts and wounds	217 (56.5)	87 (22.7)	80 (20.8)
Frequent urination	265 (69.0)	49 (12.8)	70 (18.2)
Constant feeling of thirsty	222 (57.8)	57 (14.8)	105 (27.3)
Too much sweating	197 (51.3)	82 (21.4)	105 (27.3)
Complications			
Eye problems	206 (53.6)	58 (15.1)	120 (31.3)
Kidney problems or disease	182 (47.4)	75 (19.5)	127 (33.1)
High blood pressure	210 (54.7)	53 (13.8)	121 (31.5)
Loss of sensation in arms and legs	139 (36.2)	87 (22.7)	158 (41.1)
Stroke and heart diseases	134 (34.9)	79 (20.6)	171 (44.5)
Medications available			
Medicines are available for the control of BGL	223 (58.1)	26 (6.8)	135 (35.2)
Insulin injections are available for the control of BGL	192 (50.0)	37 (9.6)	155 (40.4)
Lifestyle changes and non-medical measures			
Regular physical activities	270 (70.3)	64 (16.7)	50 (13.0)
Stop alcohol use	251 (65.4)	45 (11.7)	88 (22.9)
Body weight maintenance	202 (52.6)	76 (19.8)	106 (27.6)
Diet modification	256 (66.7)	52 (13.5)	76 (19.8)
Management			
Testing blood sugar regularly	301 (78.4)	42 (10.9)	41 (10.7)
Regular eye check-up	184 (47.9)	90 (23.4)	110 (28.6)
Regular check-ups for general health	318 (82.8)	21 (5.5)	45 (11.7)
Healthy lifestyle changes	294 (76.6)	19 (4.9)	71 (18.5)

Awareness level for the five domains

The section on lifestyle changes and management received the most correct responses (67.6%), followed by the section on medications available (54.1%) and general information (53.5%). The sections on risk factor knowledge, symptoms, and complications had the lowest percentages (32.1% and 49.5%, respectively) (Table 3). More analysis was performed to identify the questions with a percentage of correct responses less than the average of 51.4%. Sixteen questions had a percentage that was lower than average, including two from the general awareness section, six from risk factors, three from symptoms, three from complications, one from drugs available, and one from the management area in question. Six questions had a lower percentage than the overall average, indicating that most students were unaware of the risk factors for T2DM. However, all questions in the lifestyle changes and non-medical measures section had a higher percentage than the overall average, demonstrating that they were aware of lifestyle changes that can be made to manage and prevent diabetes mellitus (Table 4).

Table 3: Maximum possible score (MPS) and average correct answer (ACA) for the 5 sections (N= 384)

Section	MPS	ACA n (%)
General Awareness	5	205 (53.5)
Risk factors	7	123 (32.1)
Symptoms and complications	12	190 (49.5)
Medications available	2	208 (54.1)
Lifestyle changes & management	8	260 (67.6)
Total score	34	197 (51.4)

Table 4: Questions with per cent correct answers less than the overall average, 51.4% (N= 384)

Questions	n (%)
General awareness about diabetes	
Diabetes is a condition of the body not responding to insulin	156 (40.6)
Diabetes is not curable	104 (27.1)
Risk factors	
Family history of diabetes	85 (22.1)
Unhealthy diet	189 (49.2)
Overweight and obesity	158 (41.1)
Age above 40 years old	42 (10.9)
Pregnancy	35 (9.1)
Alcohol consumption	136 (35.4)
Symptoms	
Headache	126 (32.8)
Visual disturbances or problems	168 (43.8)
Too much sweating	197 (51.3)
Complications	
Kidney problems or disease	182 (47.4)
Loss of sensation in arms and legs	139 (36.2)
Stroke and heart diseases	134 (34.9)
Medications available	
Insulin injections are available for the control BGL	192 (50.0)
Management	
Regular eye check-up	184 (47.9)

Awareness on hypertension

The average percentage of correct responses (general awareness) was 50.2%. The question with the lowest percentage of correctly answered questions in the general awareness section was "Hypertension is not curable" (14.3%), followed by "Pregnancy" (19.8%), "Blood in the urine" (16.7%), "Trouble with memory" (32.3%), "Hydrazaline injections are available for the control of hypertension" (42.2%), and "Regular eye check-up" (44.5%) in the management section (Table 5).

Table 5: Responses of the participants for different sections of the questionnaire (N = 384)

Questions	YES	NO	DON'T KNOW
General awareness of hypertension	n (%)	n (%)	n (%)
Hypertension is a condition of high blood pressure	238 (62.0)	32 (8.3)	114 (29.7)
A condition in which blood vessels have rapidly raised pressure	138 (35.9)	79 (20.6)	167 (43.5)
NBP is a blood pressure of 120mmHg SBP and 80mmHg DBP	122 (31.8)	35 (9.1)	227 (59.1)
Hypertension is not curable	55 (14.3)	193 (50.3)	137 (35.4)
Hypertension occurs in children, adolescents, and adults	266 (69.3)	40 (10.4)	78 (20.3)
Risk factors			
Family history of hypertension	140 (36.5)	117 (30.5)	127 (33.1)
Unhealthy diet	178 (46.4)	83 (21.6)	123 (32.0)
Overweight and obesity	235 (61.2)	53 (13.8)	96 (25.0)
Low physical activity	255 (66.4)	57 (14.8)	72 (18.8)
Age above 40 years old	91 (23.7)	156 (40.6)	137 (35.7)
Pregnancy	76 (19.8)	151 (39.3)	157 (40.9)
Cigarette smoking and alcohol consumption	171 (44.5)	86 (22.4)	127 (33.1)
Symptoms			
Severe headache and stress	256 (66.7)	53 (13.8)	75 (19.5)
Tiredness and weakness	219 (57.0)	62 (16.1)	103 (26.8)
Visual disturbances or problems	170 (44.3)	64 (16.7)	150 (39.1)
Chest pain and difficulty breathing	175 (45.6)	69 (18.0)	140 (36.5)
Irregular heartbeat	265 (69.0)	48 (12.5)	71 (18.5)
Blood in the urine	64 (16.7)	138 (35.9)	182 (47.4)
Complications			
Eye problems	173 (45.1)	90 (23.4)	121 (31.5)
Heart attack or stroke	183 (47.7)	73 (19.0)	128 (33.3)
Heart failure	169 (44.0)	99 (25.8)	116 (30.2)
Trouble with memory or understanding	124 (32.3)	90 (23.4)	170 (44.3)
Kidney problems or disease	146 (38.0)	71 (18.5)	167 (43.5)
Medications available			
Medicines are available for the control of hypertension	244 (63.5)	22 (5.7)	118 (30.7)
Hydralazine injections are available for the control of hypertension	162 (42.2)	46 (12.0)	176 (45.8)
Lifestyle changes and non-medical measures			
Regular physical activities	286 (74.5)	50 (13.0)	48 (12.5)
Stopping cigarette smoking and alcohol consumption	259 (67.4)	47 (12.2)	78 (20.3)
Body weight maintenance	241 (62.8)	53 (13.8)	90 (23.4)
Diet modification	261 (68.0)	42 (10.9)	81 (21.1)
Not to use drugs and energizing products	236 (61.5)	37 (9.6)	111 (28.9)
Management			

Measuring blood pressure regularly	298 (77.6)	39 (10.2)	47 (12.2)
Regular eye check-up	171 (44.5)	83 (21.6)	130 (33.9)
Regular check-up for general health	292 (76.0)	33 (8.6)	154 (59.0)
Healthy lifestyle changes	268 (69.8)	35 (9.1)	81 (21.1)

Awareness level for the five domains (section)

The management and changes in lifestyle aspects had the most significant percentage of correct answers (66.9%), followed by the drugs available section (52.9%). The sections on general awareness, risk factor awareness, and symptoms and complications received the lowest ratings (42.6%, 42.6%, and 46.0%, respectively) (Table 6). More data analysis was performed on the acquired information to identify the questions with a lower percentage of correctly answered questions than the average, 50.2%. Three questions from the general awareness part, five from risk factors, three from symptoms, five from complications, one from drugs available, and one from the management section had a percentage lower than the average (Table 7). The fact that five questions in each section had a rate lower than the overall average shows that many of the adolescents were unaware of the risk factors for hypertension and its complications. However, they were aware of lifestyle changes that can be made to manage and prevent hypertension because all questions in this section had a percentage higher than the overall average.

Table 6: Maximum possible score (MPS) and average correct answer (ACA) for the five domains (N = 384)

Section	MPS	ACA n (%)
General Awareness	5	164 (42.6)
Risk factors	7	164 (42.6)
Symptoms and complications	11	177 (46.0)
Medications available	2	203 (52.9)
Lifestyle changes & management	9	257 (66.9)
Total score	34	193 (50.2)

Table 7: Questions with a percent correct answer less than the overall average, 50.2 % (N= 384)

Questions	n (%)
General awareness of hypertension	
A condition in which the blood vessels have persistently raised pressure	138 (35.9)
NBP is defined as a blood pressure of 120mmHg SBP and 80mmHg DBP	122 (31.8)
Hypertension is not curable	55 (14.3)
Risk factors	
Family history of hypertension	140 (36.5)
Unhealthy diet	178 (46.4)
Age above 40 years old	91 (23.7)
Pregnancy	76 (19.8)
Cigarette smoking and alcohol consumption	171 (44.5)
Symptoms	
Visual disturbances or problems	170 (44.3)

Chest pain and difficulty breathing	175 (45.6)
Blood in the urine	64 (16.7)
Complications	
Eye problems	173 (45.1)
Heart attack or stroke	183 (47.7)
Heart failure	169 (44.0)
Trouble with memory or understanding	124 (32.3)
Kidney problems or disease	146 (38.0)
Medications available	
Hydrazaline injections are available for the control of hypertension	162 (42.2)
Management	
Regular eye check-up	171 (44.5)

Discussion

Adolescent students had an average level of awareness regarding type 2 diabetes mellitus (T₂DM) and hypertension. Contrary to expectations, this average level was lower than anticipated, considering that students at this stage typically possess information garnered from secondary school lessons or media exposure. Notably, students exhibited higher awareness of lifestyle changes and management but lower awareness regarding risk factors, symptoms, and complications. For instance, less than 20% of students were aware that pregnancy increases the risk of elevated blood glucose and hypertension due to physiological changes such as decreased maternal insulin sensitivity and increased insulin resistance, potentially leading to outcomes like pregnancy-induced hypertension (Mwanri *et al.*, 2014). Consequently, it is imperative to educate adolescents, particularly females, about pregnancy-induced diabetes and hypertension to prevent early onset.

Moreover, students showed a lack of awareness regarding the complications associated with diabetes and hypertension, possibly indicating shortcomings in our educational system. Therefore, further investigation is warranted. Although overall awareness levels are relatively high, there is a pressing need to enhance awareness through curriculum revisions or large-scale media campaigns. Understanding the risk factors and potential complications of diabetes and hypertension can empower individuals, especially when prevention efforts are initiated early. Comparative analysis with prior studies reveals similar patterns. Al Hussaini and Mustafa (2016), who assessed adolescents' knowledge and awareness of diabetes mellitus in Kuwait, found comparable levels of average diabetes awareness among adolescent students, with better performance in lifestyle change areas and poorer performance in other sections. Sitaula *et al.* (2022) reported lower awareness and knowledge ratings in urban and rural municipalities compared to metropolitan cities in Nepal, emphasizing the need for targeted educational interventions. Similarly, Divakaran *et al.* (2010) observed minimal awareness of lifestyle risk factors among school children.

Studies conducted among adult populations further emphasize the importance of comprehensive awareness campaigns. Anyanti *et al.* (2021) highlighted the need to provide accurate information on diabetes and high blood pressure to promote healthy practices, considering the prevalent lifestyle-related risk factors identified in Nigerian communities. Mbuya *et al.* (2014) revealed gaps in awareness among teaching staff regarding the hereditary nature of hypertension and the association of increasing age with diabetes and hypertension risk. Unfortunately, understanding the origins, symptoms, risk factors, and complications was lower than expected.

These adolescent groups should be well-informed about diabetes, hypertension, and other NCDs since they have the potential to be powerful advocates for the Tanzanian community and decision-makers.

Likewise, Abdullahi et al. (2011) noted limited awareness among the personnel of the University of Ibadan in Nigeria regarding hereditary factors contributing to hypertension. Moreover, findings from studies conducted in Tanzania underscore the lack of awareness surrounding T2DM. Ruhembe et al. (2014) reported alarmingly low levels of awareness among adult respondents regarding the symptoms, causes, management, and risk factors of T2DM. These findings suggest a critical need for targeted educational initiatives to improve public awareness and understanding of diabetes and hypertension. The influence of media, particularly television, on dietary habits and lifestyle choices cannot be overlooked. The prevalence of advertisements promoting unhealthy food choices may contribute to the low awareness of T2DM and hypertension risk factors observed in the study. Given the global significance of diabetes and hypertension as NCDs, efforts to raise awareness among children and families are paramount in combating the growing burden of NCDs in developing countries.

Conclusions and recommendations

Our study shows that adolescents were aware of T2DM and hypertension. However, they were unaware of the risk factors, symptoms, and repercussions. It is recommended that T2DM and hypertension awareness be spread at a young age to lower the risks of contracting these non-communicable diseases. The Ministry of Education should add lectures on noncommunicable diseases related to diet to primary and secondary school curricula. Furthermore, media awareness campaigns should be produced utilizing a simple communication language accessible to people of all ages.

Author contributions

KM developed the idea, oversaw all research efforts, helped with data administration and collection, and wrote the manuscript. AM developed the concept, oversaw the study's methods, and edited the manuscript. All writers read and approved the final manuscript.

Conflict of interest: None

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