Original Article

Assessment of Public School Teachers' Knowledge of Type 1 Diabetes among Adolescent Students in Saudi Arabia: A Cross-sectional Study

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Abstract

Background: The prevalence of diabetes among children and adolescents in Saudi Arabia highlights the need for enhanced teacher education and training in diabetes management within the school environment. This study aimed to evaluate the knowledge of public school teachers regarding diabetes among adolescent students in Saudi Arabia. **Materials and Methods:** We used a cross-sectional design and distributed an online questionnaire via social media and email to collect data between April and June 30, 2022. A convenience sample of 290 intermediate and secondary public school teachers was recruited. Statistical analysis, including Chi-square tests and logistic regression, assessed associations and predictors of diabetes knowledge among teachers. **Results:** Of the 290 responses, 80.3% were female, 61% lived with a family member with diabetes mellitus, and 33.4% had prior diabetic training. The study found that 62% of participants had fair knowledge about diabetes. Age, education level, and speciality were significantly associated with knowledge ($p < 0.001$). Regression analysis showed no statistically significant influence of the combined variables on knowledge ($F_{9, 86.97} = 1.585$, $p = 0.129$), but age group significantly influenced knowledge ($\beta = 1.171$, $p = 0.008$). **Conclusions:** The study revealed that Saudi teachers require additional educational programs to enhance their understanding of diabetes. The findings suggest training courses to improve teachers' knowledge, providing written instructions for diabetic emergencies, and incorporating trained nurses in educational institutes.

Keywords: *Diabetes mellitus, diabetes, Saudi Arabia, students, sudden-onset, teachers, type 1*

Introduction

Diabetes Mellitus (DM) is a metabolic disease characterized by abnormally elevated blood glucose levels, with types including Type 1 (T1DM), Type 2, maturity-onset diabetes of the young (MODY), and gestational diabetes. T1DM is usually found in kids and teens and is caused by beta cell dysfunction in the pancreas, which means that insulin does not work or make enough of an impact because of autoimmune destruction.[1-3] In Saudi Arabia, diabetes affects approximately 5% of children, with an estimated 187,108 diabetic children reported in 2016.[4] This prevalence highlights the substantial presence of diabetes within the school environment, especially given the country's over 36,000 public schools and a population of 5,816,755 children aged 5 to 19.[5] Despite the high prevalence, diabetic students are not classified as special needs individuals in Saudi schools, leading to potential gaps in training and preparedness among teachers for managing diabetes-related situations.[4] A recent study highlighted that a significant percentage of teachers feel unprepared to manage diabetes-related emergencies, indicating a critical need for improved training programs.[6] Teachers' lack of sufficient education can impact their ability to handle emergencies such as hypoglycemia or hyperglycemia, which are common among diabetic students.[5,7] Several studies have demonstrated that teachers with prior training in diabetes management are more confident and effective in handling diabetes-related emergencies.[8-10] Furthermore, cooperation among families, healthcare professionals, and educators is crucial for ensuring optimal care and safety for diabetic students within the school setting.[11] Previous studies have highlighted deficiencies in teachers' knowledge of diabetes and schools' readiness to handle

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diabetic emergencies.[7,12] A study conducted among secondary school teachers in Nigeria highlighted poor knowledge of diabetes risk factors, with 60% of teachers categorized as having poor knowledge and a significant portion being overweight or obese. The findings underscore the urgent need for routine diabetes screening and better health education for teachers, who play a crucial role in educating teenagers about healthy living.[13] This study aims to fill a critical gap by specifically evaluating public school teachers' knowledge of diabetes among adolescent students in Saudi Arabia. This research examines the depth of teachers' understanding and preparedness to manage diabetes in a school setting. By identifying areas for improvement in teachers' education and training, this study seeks to contribute to enhanced diabetes care and management practices in schools, ultimately benefiting the health outcomes and academic performance of diabetic students. This approach highlights the importance of targeted educational programs and training initiatives for teachers to enhance the safety and well-being of diabetic students in schools.

Materials and Methods

A cross-sectional study was conducted in Saudi Arabia between April and June 30, 2022, using an online questionnaire. The study targeted 290 public school teachers at the intermediate and secondary levels. A convenience sampling approach was employed to ensure diversity, capturing teachers from different geographic regions, school levels, and teaching disciplines. The study was advertised on widely used social media platforms, including Twitter, Instagram, and Facebook, to recruit participants and reach a broad audience of educators across various cities and regions. Recruitment efforts were further intensified through WhatsApp groups, a platform commonly used by teachers in Saudi Arabia. These groups, often organized by schools or educational departments, provided direct access to actively engaged educators. Invitations to participate included detailed information about the study's objectives, eligibility criteria, and a link to the questionnaire, ensuring that teachers were well-informed and could voluntarily decide to participate.

Eligible participants for the study were required to meet specific criteria: they had to be actively employed as intermediate or secondary public school teachers in Saudi Arabia during the study period and willing to provide informed consent. Teachers who were on leave, working in private schools, or who did not fully complete the questionnaire were excluded from the final analysis. To recruit a diverse sample efficiently, we utilized convenience sampling, promoting the study through public social media platforms and targeted educator groups. The sample size calculation was conducted using G*Power 3.1 software (Faul *et al*., 2007),[14] with parameters set to an effect size of 0.5 (medium effect), a significance level of 0.05, and a desired power of 0.80. The calculation recommended a minimum sample size of 300 participants. Although the study was completed with 290 participants, slightly below the recommended number, this sample size still provides robust data. The small shortfall is unlikely to significantly impact the study's power, ensuring the results remain valid and meaningful.

This study employed online questionnaires adapted from previous studies.[7,12,15] Two assistant professors of medical-surgical nursing and one associate professor of critical care nursing looked over the questionnaire's content validity. The language and clarity of the survey questions were also improved with the help of a pilot sample of 15 people. The pilot sample was not included in the analysis of the study samples. The final questionnaire was designed to take between 5 and 10 min to complete, and it was initially written in English before being translated into Arabic. We distributed and tested the survey in Arabic, dividing it into two parts. The first part collected participants' demographic and background information, such as age, gender, level of education, teaching experience, speciality, whether they had a family member or student with diabetes, and whether they had received training on diabetic emergencies. The second part was a diabetes knowledge test with 18 multiple-choice questions to assess the teachers' understanding of diabetes. Each question had three options, with one correct and two incorrect choices. We assigned a score of 1 to correct responses and a score of 0 to incorrect ones. The total knowledge score was categorized as good knowledge (12–18 scores), fair knowledge (11–14 scores), or poor knowledge (0–10 scores), with a Cronbach's alpha of 0.736 indicating good reliability for this section. The study obtained ethical approval from the University Ethical Committee (Approval Number: UT-199-60-2022). Prior to participation, all individuals were provided with a consent form detailing the voluntary nature of their involvement and their right to withdraw at any time. Participants' personal information was handled with strict confidentiality, and their privacy was safeguarded throughout the study. There were no anticipated psychological, social, or physical risks associated with participation, and no financial incentives were offered.

Ethical considerations

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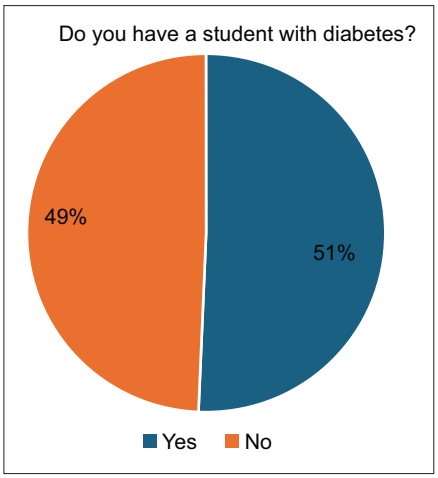

Figure 1: Percentage of teachers who had students with DM (*n* = 290)

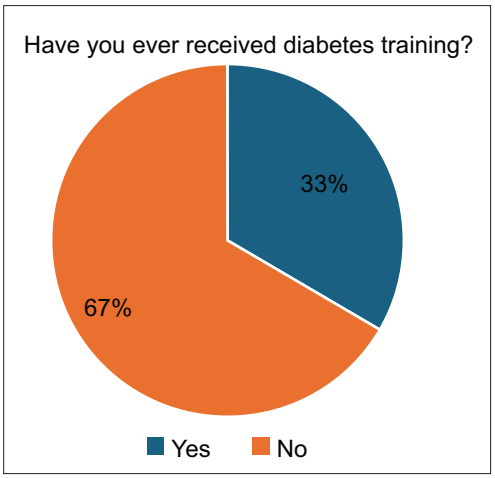

Figure 2: Percentage of teachers who had received diabetes training (*n* = 290)

Results

Among the 290 surveyed teachers, the majority were female (80.30%) and held bachelor's degrees (74.80%). Most had 5–20 years of teaching experience, with 23.10% having less than 5 years. The most common teaching majors were Science (17.90%) and Social Studies (17.6%). Notably, 61.0% of the teachers had a family member with diabetes, and 50.70% had taught students with the disease [Figure 1]. While only 33.4% had prior training in diabetes management [Figure 2], a significant 81.7% expressed a need to attend future training [Table 1].

The teachers' knowledge level regarding diabetes disease among adolescent students was fair (M = 11.26, SD = 3.45). Teachers' understanding of what to do when a student has a low blood glucose level was inadequate. Only 30.0% answered correctly. There was also significant poor knowledge regarding the cause of low blood glucose (26.0% answered correctly) [Table 2].

Notably, only 30.0% of teachers correctly identified the appropriate response to low blood glucose levels. Additionally, 26.0% of respondents provided the correct answer regarding the cause of low blood glucose. Teachers demonstrated a broader understanding of certain aspects of diabetes. For instance, 85.20% of teachers correctly identified pancreatic beta cells as the cells responsible for producing insulin.

The regression analysis was conducted to examine the relationship between participants' knowledge regarding diabetes (measured as the combined score). It demonstrated statistical nonsignificance (($F_{9, 86}$) or ($F_{9, 97}$) = 1.585, p = 1.585) and accounted for approximately 23.70% of the variance in participants' knowledge regarding diabetes (R^2 = 0.237). This indicates that the combination of these variables has no statistically significant influence on participants' knowledge about diabetes. Upon closer inspection of the coefficients, it was found that age group exhibited the only substantial influence (β = 1.171, p = 0.008) on participants' knowledge regarding diabetes [Table 3]. The cross-tabulation analysis revealed a statistically significant association between participants' majors and their knowledge scores regarding diabetes (χ^2 = 187.829, $p < 0.001$). Notably, the Chi-square test indicates that these variables are not independent.

Discussion

The current study aimed to evaluate the knowledge of public school teachers regarding diabetes among adolescent students in Saudi Arabia. In the present study, there were 290 participants, primarily females and bachelor's degree holders; more than half had a family member living with diabetes, while about half had a diabetic student. Only a few had previous training. The current study showed that teachers' knowledge about diabetes was fair in many aspects. However, the study revealed a lack of knowledge in several crucial aspects of diabetes. Knowledge gaps were observed in the knowledge of the causes of low and high blood glucose levels and the appropriate response when the teacher has a student with a low blood glucose level. Almehmad *et al*.[12] conducted a prior study in the Makah region that supports these results. Their research similarly found that school teachers exhibited a moderate level of knowledge about diabetes, and this knowledge level was influenced by factors such as age, gender, and educational background. Moreover, the study findings align with Alzahrani's[4] 2019 report, which found that although teachers had some knowledge about diabetes, there were significant gaps, particularly in understanding the disease's causes and management. The similarity in findings may stem from the similar study design and setting used in both studies, which highlights a recurring issue in diabetes education for teachers. Although basic knowledge is often present, there is a consistent lack of detailed and practical understanding.

The lack of significance for years of experience as a predictor of diabetes knowledge in our study is

Table 1: Demographic and professional characteristics of surveyed teachers (*n*=290)

	Frequency (%)
Age	
<25 years	62 (21.38%)
25<40 years	110 (37.93%)
40<50 years	90 (31.03%)
≥50 years	28 (9.66%)
Sex	
Female	233 (80.34%)
Male	57 (19.66%)
Education level	
Bachelor's degree	217 (74.83%)
Master's Degree	54 (18.62%)
Doctorate degree	19 (6.55%)
Years of experience	
<5 years	67 (23.10%)
5–9 years	64 (22.07%)
10–14 years	56 (19.31%)
15–19 years	53 (18.28%)
>20 years	50 (17.24%)
Major	
Arabic	39 (13.45%)
Art education	15 (5.17%)
Computer	22 (7.59%)
English	16 (5.52%)
Family education	20 (6.90%)
Islamic education	34 (11.72%)
Maths	25 (8.62%)
Others	16 (5.52%)
Science (Chemistry, Physics, Biology)	52 (17.93%)
Social studies	51 (17.59%)
Does your family have a member diagnosed with diabetes?	
Yes	177 (61%)
No	113 (39%)
Are you willing to participate in diabetes management training?	
Yes	237 (81.70%)
No	53 (18.30%)

Table 2: Survey responses on diabetes awareness and perceptions (*n*=290)

	Frequency (%)
1. Diabetes is a condition caused by high levels of ..... in the blood?	
Do not know	16 (5.52%)
Glucose	137 (47.24%)
Insulin	137 (47.24%)
2. What are the cells that produce insulin called?	
Do not know	28 (9.66%)
Kidney cells	15 (5.17%)
Pancreatic beta cells	247 (85.17%)
3. How many common types of diabetes exist?	
Do not know	76 (26.21%)
Four types	59 (20.34%)
Two types	155 (53.45%)
4. Diabetes is associated with a problem in the:	
Do not know	24 (8.28%)
Kidney	18 (6.21%)
Pancreas	248 (85.52%)
5. Which type of diabetes is most common among children?	
Type 1	146 (50.34%)
Type 2	108 (37.24%)
Type 3	36 (12.41%)
6. What are the most common complications of diabetes?	
Do not know	52 (17.93%)
Foot problems	163 (56.21%)
Heart problems	75 (25.86%)
7. Which complication is not commonly associated with diabetes?	
Lung complications	165 (56.90%)
Nerve complications	70 (24.14%)
Vision and eye complications	55 (18.97%)
8. What can cause high blood glucose levels?	
Do not know	56 (19.31%)
High insulin in blood	108 (37.24%)
No enough insulin	126 (43.45%)
9. What can lead to low blood glucose levels?	
Do not know	47 (16.21%)
Not taking Insulin	167 (57.59%)
Prolonged Exercise	76 (26.21%)
10. How does fruit juice affect blood sugar levels?	
Do not know	37 (12.76%)
elevate it	220 (75.86%)
Lower it	33 (11.38%)
11. How can you identify if a student has hypoglycemia?	
When he/she has a fever	36 (12.41%)
When he/she has a rash	27 (9.31%)
When he/she sweats a lot	227 (78.28%)
12. How can you recognize if a student has hyperglycemia?	

Contd...

surprising and challenges the common assumption that greater experience equates to increased knowledge about health-related topics. This finding aligns with the research by Almehmad *et al*.,[12] which also observed that experience did not significantly impact teachers' knowledge about diabetes. This similarity suggests that, regardless of years of experience, teachers may have similar levels of knowledge about diabetes, potentially highlighting a need for more focused and consistent professional development in this area. Moreover, our study's findings are consistent with research conducted in Spain in 2018, which similarly revealed insufficient knowledge about Type 1 Diabetes (T1D) management among teachers. Both studies found that while teachers had a basic understanding of T1D symptoms and hypoglycemia treatment, their overall grasp

Table 2: Contd...

	Frequency (%)
When he/she has acne	21 (7.24%)
When he/she is hyperactive	49 (16.9%)
When he/she needs to urinate frequently	220 (75.86%)
13. What is the use of insulin?	
Do not know	43 (14.83%)
Elevate blood glucose	77 (26.55%)
Lower blood glucose	170 (58.62%)
14. How are insulin doses administered?	
By subcutaneous injection	228 (78.62%)
Do not know	25 (8.62%)
Orally	37 (12.76%)
15. "If a student has low blood glucose, what should you do?	
Give a glass of orange juice	147 (50.69%)
give a glass of water	56 (19.31%)
Give a tablespoon of sugar	87 (30%)
16. Diabetes is an infectious disease. Do you think this statement is:	
Correct	20 (6.90%)
Do not know	18 (6.21%)
Wrong	252 (86.90%)
17. Do students with diabetes require special treatment in the classroom?	
Do not know	30 (10.34%)
No	73 (25.17%)
Yes	187 (64.48%)
18. Do you think diabetes prevents a student from participating in sports activities?	
Do not know	31 (10.69%)
No	212 (73.10%)
Yes	47 (16.21%)

of comprehensive diabetes management was lacking.[16] This similarity underscores a broader issue in diabetes education for teachers, indicating that improvements are needed in how diabetes management is taught and understood, regardless of geographic or cultural differences. The current study also revealed that science teachers had better knowledge about diabetes compared to teachers from other disciplines. Their educational background in science likely contributed to this finding. This observation aligns with research by Mikkonen *et al*.,[17] which highlighted the influence of educational backgrounds on teachers' knowledge levels. Similarly, Gutiérrez-Manzanedo *et al*.[18] found that teachers with high general awareness of diabetes benefitted from ongoing education and awareness initiatives. All of these studies agree on one thing: having a background in science or a related field helps people understand health topics better. This shows how important it is for all teachers to get specific training to learn more about diabetes.

Teachers in our study demonstrated a positive attitude toward accommodating diabetic students, as evidenced by their willingness to attend diabetes training and support students' participation in classroom activities and sports. This positive attitude mirrors findings from Sparapani *et al*.,[6] where teachers also showed empathy and actively supported the integration of children with T1D into school settings. However, this contrasts with the study by Aljefree *et al*.,[16] which found moderate knowledge, favorable attitudes, but poor practices related to T1D among Saudi public school teachers. Their research indicated that while teachers had a positive attitude and moderate knowledge, there was significant room for improvement in actual practices related to T1D management. This divergence highlights a broader issue where positive attitudes do not always translate into effective practices, underscoring the need for enhanced training and practical support for teachers to bridge this gap.

Overall, these findings underscore the importance of comprehensive diabetes education programs for teachers and the need for ongoing training and support systems to ensure the safety and well-being of students with diabetes in schools. Targeted interventions, tailored to educators' backgrounds and needs, are essential for fostering inclusive and supportive educational environments for diabetic students.

The study's limitations include its cross-sectional design, which offers only a snapshot of knowledge at a single point in time and does not capture changes over time. Additionally, the sample size of 290 participants may not fully represent all public school teachers in Saudi Arabia, potentially introducing sampling bias. The collection of data through an online questionnaire may exacerbate this bias by excluding teachers who are not active online. Additionally, using self-reported data from an online survey could lead to recall and social desirability biases, which would make the knowledge assessment less accurate and complete. Recommendations stemming from these limitations include the implementation of comprehensive training programs for teachers, particularly targeting those who express interest in such initiatives. These programs should aim to enhance teachers' knowledge of diabetes management. Additionally, written guidelines detailing appropriate steps during diabetic emergencies should be developed and made readily available to all school staff. Furthermore, integrating healthcare professionals, such as trained nurses, educational institutions can offer essential support and expertise in handling diabetes-related situations. These measures can significantly enhance diabetes care and safety for students in schools.

Conclusion

The present study aimed to evaluate the knowledge of public-school teachers in Saudi Arabia regarding diabetes among adolescent students. Findings revealed a fair overall knowledge level among participants, with science teachers demonstrating a higher level of understanding

Table 3: Regression coefficients for predictors of participants' knowledge regarding Diabetes

Variables	Unstandardized coefficients		Standardized coefficients	*t*	*p*	95.0% confidence interval for B	
	B	Std. Error	Beta			Lower bound	Upper bound
Age group	1.17	0.42	0.44	2.78	0.008	0.32	2.02
Sex	0.18	0.71	0.03	0.26	0.795	−1.24	1.61
Education level	−0.18	0.57	−0.04	−0.31	0.754	−1.32	0.90
Years of experience	−0.41	0.31	−0.21	−1.29	0.203	−1.05	0.23
Major	−0.02	0.14	−0.01	−0.12	0.901	−0.3	0.26
Does your family have a member diagnosed with diabetes?	1.13	0.72	0.21	1.57	0.122	−0.31	2.58
Do you have a student with diabetes?	−0.72	0.79	−0.13	−0.91	0.365	−2.31	0.86
Have you ever received diabetes training?	−1.00	0.72	−0.19	−1.38	0.173	−2.46	0.45
Are you willing to participate in diabetes management training?	1.53	0.94	0.22	1.62	0.112	−0.37	3.44

compared to teachers from other majors. Despite this, there remains a notable gap in teachers' knowledge, particularly concerning the appropriate response to low blood glucose levels. While teachers displayed a positive attitude towards diabetes and expressed a willingness to undergo training, it is evident that further educational programs are needed to enhance their understanding of the disease. Closing these knowledge gaps is essential for ensuring the safety and well-being of diabetic students within the educational system. We can achieve this by prioritizing comprehensive diabetes education for teachers, providing access to relevant resources and support networks, and continuously evaluating and adapting educational initiatives and supportive environments for diabetic students in Saudi Arabia's schools.

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Conflicts of interest

Nothing to declare.

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