



RESEARCH ARTICLE

Teachers' knowledge about type 1 diabetes in public female elementary schools in Northern Saudi Arabia

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Keywords

Type 1 diabetes • Students • Schools • Teachers • Saudi Arabia

Summary

Background. Saudi Arabia ranks the 4th country in the world in incidence rate of Type 1 Diabetes (T1D), which is usually diagnosed in children and teens. Managing T1D at school is important for children's short- and long-term health. Little is known about how much teachers are compatible to support students with diabetes in schools in northern Saudi Arabia. The aim of this study was to assess factual knowledge about T1D among teachers in public female elementary schools.

Materials and methods. This was a cross-sectional survey conducted in 18 elementary schools in Hail region, during October 16, 2019 to January 23, 2020. A structured self-administered questionnaire approached all school teachers and other school staff caring students ($n = 600$).

Results. A total of 504 questionnaires received completed (84.0% response rate). Overall, 220 (43.7%) teachers reported having had or currently having a student/s with T1D. Only a small percentage (10.8%) who stated that they had received

training to support students with T1D. Participant attained an overall fair knowledge score (13.20 ± 3.81 on 20-point scale; 66.0%), however, only 27.3% who attained good score ($\geq 80\%$) compatible with being an effective support person for students with diabetes. The multivariate logistic regression model, revealed that: (1) received training [adjusted Odds Ratio (aOR): 3.38; $p < 0.001$]; (2) have/ever had diabetic student/s (aOR: 2.02; $p = 0.002$); (3) teacher himself is diabetic or have a near contact diabetic person (aOR: 2.35; $p = 0.001$); (4) family history of diabetes (aOR: 1.84; $p = 0.015$); and (5) teacher's capacity to inject insulin (aOR: 1; $p = 0.003$), were factors that predicted teacher's good knowledge.

Conclusion. Teachers in female elementary schools in our region need to improve their knowledge about diabetes in children, especially recognizing and management of diabetic emergencies. Training programs are crucially needed to empower teachers with knowledge and self-confidence in helping students with diabetes.

Introduction

Type 1 diabetes mellitus (T1D), (previously known as insulin-dependent, juvenile or childhood-onset) is a chronic illness characterized by the body's inability to produce insulin due to the autoimmune destruction of the beta cells in the pancreas. Although onset frequently occurs in childhood, the disease can also develop in adults. Neither the cause of T1D nor the means to prevent it are known [1, 2].

The classic symptoms of T1D are, polyuria, polydipsia, polyphagia and unexplained weight loss. Other symptoms may include fatigue, nausea, and blurred vision. The onset of symptomatic disease may be sudden. It is not unusual for patients with type 1 diabetes to present with diabetic ketoacidosis [1].

T1D is quite prevalent in the world, with a proportion of 1 in every 300 persons and steadily rising frequency of incidence of about 3% every year. As per the Diabetes Atlas (8th edition), 35,000 children and adolescents in Saudi Arabia suffer from T1D, which makes Saudi Arabia rank the 8th in terms of numbers of T1D patients and 4th country in the world in terms of the incidence rate (33.5 per 100,000 individuals) of T1D [3].

Students with T1D spend most of the day in school, that

make them at an increased risk of suffering from diabetic emergencies during the school time, so that it is essential that all aspects of T1D management can take place there, in which they need the care of teachers and other school personnel [4-8]. Knowledgeable, trained school personnel are essential to the student's safety and physical well-being when dealing with immediate health risks of high or low blood-glucose level, however several studies worldwide demonstrated knowledge gap about T1D and inadequate specific training among teachers and other school staff [9-14].

Still there is limited data on knowledge and compatibility of teachers to support diabetic students in schools in northern Saudi Arabia, so that we aimed in this study to assess factual knowledge about type 1 diabetes among teachers and other school staff in public elementary female schools in Hail region, Saudi Arabia.

Methods

STUDY DESIGN AND LOCATION

A cross-sectional study was carried out in public elementary (primary and intermediate) female schools

in Hail region, Saudi Arabia. The region is located at the north, in nine governorates with an area of 103,887 km² and an estimated population of 684,619 (2016) [15].

Being a conserving society, schools in the Saudi Arabian education system are unisex, with separate education male and female sector administration within Ministry of Education. Due to logistic limitation, having easy access and decrease administrative efforts, female schools were chosen to be the target setting of the study.

PARTICIPANTS

Classroom teachers and other school personnel in female elementary (primary and middle) schools, in Hail Governorate, were the target population of the study. Primary schools in Saudi Arabia enroll children at the age 6-11 years, while middle schools enroll age groups 12-14 years. All teachers and other school staff in direct contact with students at the time of the survey (n = 600) were approached.

SAMPLING

Among the nine governorates in Hail region, Saudi Arabia, Hail governorate was chosen to be the study setting, since it encompasses 60.7% of population [15]. To ensure representation, a list of all public female elementary schools in Hail governorate (n = 177), were obtained from the Education Authority in the region, and arranged according to school education level (primary-intermediate) and location (urban-rural). From the list 10% of schools (n = 18) were assigned systematically, taking in consideration the (urban-rural and primary-intermediate) school category weights [16].

DATA COLLECTION TOOL

An anonymous, structured, pre-coded self-administered questionnaire was used to assess factual knowledge about type 1 diabetes needed for school staff to know. The content of the questionnaire was developed based on review of literature and related surveys [3, 7, 17]. Data collection tool included three sections. The first section involved eight items to characterize socio-demographic, professional and school aspects. The second section included twenty questions to assess teachers' knowledge about Type 1 diabetes, based on the tool "Test of Diabetes Knowledge for Teachers (TDKT)" [7] and other relevant sources [3, 7]. The last section, included six questions about personal experience, self-efficacy in dealing with a diabetic child, training received, and sources of information.

A pilot test for the data collection tool was carried out on 20 teachers, equally divided between primary and middle schools. Face and content validity of the data collection tool was established based on input of four experts in the field of pediatrics, endocrinology, public health and education with experience in students' school health. The data collection tool indicated high internal consistency (Cronbach's alpha = 0.797) for

the subset of knowledge questions included the 20 point scale to ascertain teachers' knowledge about type 1 diabetes.

QUESTIONNAIRE ADMINISTRATION

The data collection took place during October 16, 2019 to January 23, 2020. After taking permission from the regional education authority in Hail region, our female researcher, contacted all schools involved in the study and met directors of the assigned schools, introduced to the aim of the study, presented the official letters of the regional education authority to facilitate the study conduction and the letter of ethical approval. All schools approached agreed to participate. An assigned coordinator in every school given full details about the study and asked to distribute the questionnaires to all teachers and other school staff in direct contact with students at the time of the survey, emphasizing voluntary participation. Participants were asked not to disclose their identity to assure them that this survey was only for academic purposes. Questionnaires were collected from each school after 2 days of distribution.

STATISTICAL ANALYSIS

Data was analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 23.0 (SPSS, Chicago, IL, USA). Frequencies and percentages, means, and standard deviations were used to summarize data. A scoring system was assigned to summarize participants' correct responses to the twenty questions exploring participants' knowledge about type 1 diabetes. Correct responses scored 1, while non-correct and don't know responses were scored 0, with maximum knowledge score of twenty points. Achieving 16 point (80%) or more was considered an indication of good knowledge of the participant compatible with being an effective support person for students with diabetes in school [9, 17].

Multivariate logistic regression analysis was carried out to predict factors associated with respondents' good knowledge. Respondants attained good knowledge scores ($\geq 80\% = 1$; $< 80\% = 0$) were tested against independent variables assumed to have an influence on the participants' knowledge level and other possible confounders. Variables retained in the final model were determined using a stepwise backwards removal method, deleting variables with p-value above 0.25 in order to exclude the non-important variables from the model until the minimum adequate model was reached. Odds ratios (ORs) as well as their 95% confidence intervals (CIs) were calculated for the predictor variables in the analyses. All statistical tests were two-tailed and differences were considered to be statistically significant at a p-value ≤ 0.05 .

ETHICS

The study protocol was approved by the Bioethics Committee of the General Directorate of Health Affairs, Hail region, Saudi Arabia, with ethical

approval number: 2019-19. Agreed participants signed the study consent form.

Results

Out of 600 questionnaires distributed, 504 were returned completed from 18 public female elementary schools with a response rate 84.0%.

Table I describes the personal characteristics of the study population. Participants had 39.2 ± 6.81 mean age, and 13.7 ± 8.73 mean experience. Two hundred forty-six (48.8%) came from primary schools, while 258 (51.2%) came from intermediate schools. Among all, 423 (85.7%) were classroom teachers, Others (72; 14.3%), were school staff with direct contact with students (Counselors, Supervisors and Administrators).

Table II, describe diabetes related characteristics of the participants. Among all participants, 220 (43.7%) reported ever having a student/s with T1D in their classrooms, 313 (62.0%) were either diabetic themselves or have a near relation with somebody having diabetes and 299 (59.3%) had a family history of diabetes. Less than one third (32.5%) reported that their schools

conducted training programs regard type 1 diabetes, while only 10.8% who reported they attended a training in this field. Participants' who acknowledged attending a training program about type 1 diabetes were 55.7% and almost all of them (95.6%) appreciate a presence of a school nurse. A low proportion (24.6%) of the participants reported self-efficacy in recognizing signals of hypoglycemia in the diabetic student and only 40.1% who reported they can inject insulin if needed to their diabetic student.

Table III, includes the factual knowledge questions, the proportion of teachers who gave correct answers and the total mean knowledge score. The survey respondents obtained a mean score of 13.2 ± 3.81 points on the diabetes knowledge scale (66.0% of the total score). Among all, 132 (25.9%) did not have enough knowledge (score of < 60%), 238 (46.8%) had basic knowledge (score of 60 - < 80%) and only 39 (27.3%)

Tab. I. Characteristics of teachers participating in the study and school setting (n = 504).

| | N | %* |
|--|---------------------|--------|
| Age (years) | | |
| < 30 | 47 | 9.3 |
| 30-39 | 197 | 39.1 |
| ≥ 40 | 260 | 51.6 |
| Mean ± SD (range) | 39.2 ± 6.81 (23-60) | |
| Work experience (years) | | |
| < 5 | 101 | 20.0 |
| 5-9 | 75 | 14.9 |
| 10-19 | 183 | 36.3 |
| ≥ 20 | 145 | 28.8 |
| Mean ± SD (range) | 13.7 ± 8.73 (1-36) | |
| Education | | |
| Diploma | 82 | 16.3 |
| Bachelor | 408 | 81.1 |
| Postgraduate higher education | 13 | 2.6 |
| Teacher role | | |
| Classroom teacher | 432 | 85.7 |
| Others (counsellors, supervision and administration) | 72 | 14.3 |
| Teaching subject | | |
| Science subjects | 216 | 42.9 |
| Other subjects (language, realign, social science, etc.) | 288 | 57.1 |
| School level | | |
| Primary | 246 | 48.8 |
| Middle | 258 | 51.2 |
| School setting | | |
| Urban (hail city) | 436 | 86.50% |
| Semiurban/rural (outside hail city) | 68 | 13.50% |

* The percentages were calculated excluding the missing values.

Tab. II. Diabetes related characteristics of the participants (n = 504).

| Question | No | %* |
|---|-----|------|
| Are you diabetic or somebody intimate to you have diabetes? | | |
| Yes | 312 | 62.0 |
| No | 191 | 38.0 |
| Family History of diabetes | | |
| Yes | 299 | 59.3 |
| No | 205 | 40.7 |
| Have you ever have a diabetic student in your classroom? | | |
| Yes | 220 | 43.7 |
| No | 284 | 56.3 |
| Do your school has conducted training in dealing with students with type 1 diabetes? | | |
| Yes | 163 | 32.5 |
| No | 339 | 67.5 |
| Do you attended any training about type 1 diabetes? | | |
| Yes | 54 | 10.8 |
| No | 448 | 89.2 |
| Do you want to attended a training about type 1 diabetes? | | |
| Yes | 280 | 55.7 |
| No | 111 | 22.1 |
| Not decided | 112 | 22.3 |
| Agree for presence of school nurse | | |
| Agree | 482 | 95.6 |
| Uncertain | 17 | 3.4 |
| Disagree | 5 | 1.0 |
| Can you recognize signals of hypoglycemia in your diabetic student? | | |
| Yes | 125 | 24.6 |
| No | 379 | 75.4 |
| Can you inject insulin, if needed to your diabetic student? | | |
| Can | 202 | 40.1 |
| Can't | 302 | 59.9 |

* The percentages were calculated excluding the missing values.

Tab. III. Factual knowledge questions and proportion of teachers giving correct* answers (n = 504).

| Question | Correct n (%) | Incorrect n (%) | Don't know n (%) |
|--|---------------|-----------------|------------------|
| 1. If not controlled, diabetes leads to frequent urination? (yes) | 471 (93.5%) | 4 (0.8%) | 29 (5.8%) |
| 2. If not controlled, diabetes leads to increased thirst? (yes) | 461 (91.5%) | 8 (1.6%) | 35 (6.9%) |
| 3. Diabetes leads to fatigue and lack of focus for the student. (yes) | 430 (85.3%) | 15 (3.0%) | 59 (11.7%) |
| 4. Diabetes leads to weight loss for the student? (yes) | 357 (70.8%) | 45 (8.9%) | 102 (20.2%) |
| 5. Paleness, shakiness, sweating, difficulty concentrating, confusion, weakness or fainting mean low blood sugar? (yes) | 379 (75.3%) | 5 (1.0%) | 119 (23.7%) |
| 6. Type 1 diabetes is usually diagnosed in children, teens, and young adults? (yes) | 204 (40.6%) | 26 (5.2%) | 273 (54.3%) |
| 7. The child develops type 1 diabetes as a result of excessive sugar intake and lack of physical activity? (no) | 49 (9.7%) | 316 (62.7%) | 139 (27.6%) |
| 8. Type 1 diabetes can be contagious? (no) | 404 (80.2%) | 23 (4.6%) | 77 (15.3%) |
| 9. Type 1 diabetes is treated with insulin? (yes) | 290 (57.8%) | 50 (10.0%) | 162 (32.3%) |
| 10. There is no cure for type 1 diabetes, but it can only be controlled? (yes) | 233 (46.2%) | 61 (12.1%) | 210 (41.7%) |
| 11. A low sugar coma is more dangerous than a high sugar coma? (yes) | 361 (72.1%) | 17 (3.4%) | 123 (24.6%) |
| 12. The diabetic student must eat her meals or snacks at the required times regularly and take her time until it ends? (yes) | 437 (87.2%) | 10 (2.0%) | 54 (10.8%) |
| 13. A student with diabetes may need to eat some snacks outside break? (yes) | 408 (81.1%) | 16 (3.2%) | 79 (15.7%) |
| 14. A diabetic student can fully participate in sport activities like all of her classmates? (yes) | 372 (74.0%) | 43 (8.5%) | 88 (17.5%) |
| 15. The diabetic student must eat sweets or juices before the physical activity class? (yes) | 232 (46.0%) | 71 (14.1%) | 201 (39.9%) |
| 16. In the event of low blood sugar, the diabetic student should take the sweetened juice? (yes) | 414 (82.1%) | 18 (3.6%) | 72 (14.3%) |
| 17. When symptoms of low blood sugar are noticed, the child needs to quickly and properly intervene? (yes) | 453 (89.9%) | 6 (1.2%) | 45 (8.9%) |
| 18. In a coma, a small amount of jam or honey can be placed in the mouth of the diabetic student? (yes) | 288 (57.1%) | 34 (6.7%) | 182 (36.1%) |
| 19. A diabetic student may need to take an insulin dose during the school day? (yes) | 329 (65.3%) | 17 (3.4%) | 158 (31.3%) |
| 20. Do you know the difference between type 1 and type 2 diabetes? (participants' who respond yes, considered right answer) | 140 (27.8%) | 254 (50.4%) | 110 (21.8%) |
| Total knowledge score (**maximum score 20 points) | | | |
| • Mean (SD) | 13.2 (3.81) | | |
| • Attained score/full score (%) | 66.0% | | |
| Knowledge level: n (%) | | | |
| • < 60% knowledge score | 132 (25.9) | | |
| • 60 - < 80% knowledge score | 238 (46.8) | | |
| • ≥ 80% knowledge score | 139 (27.3) | | |

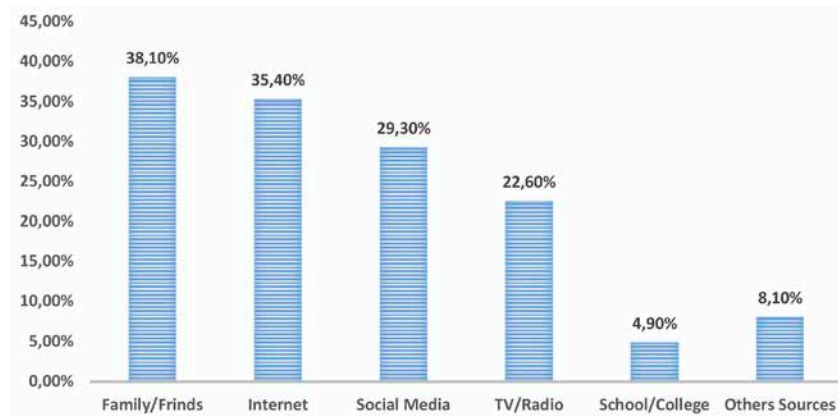
* Correct answer in parenthesis. Percentage were calculated excluding missing values.

who obtained good score ($\geq 80\%$) compatible with being an effective support person for students with diabetes in school [9, 17].

Respondent answers revealed knowledge gap in some important aspects of T1D; a small percentage (27.8%) who can differentiate between type 1 and type 2 diabetes, 40.6% who recognized that type 1 diabetes is usually diagnosed in children, teens and young adults, 90.3% incorrectly thought that type 1 diabetes develops as a result of excessive sugar intake and lack of physical activity and 19.8% beliefs that the disease is contagious. Furthermore, only 46.2% who correctly thought that there is no cure for type 1 diabetes, but can only be controlled, and just 57.8% who recognized that type 1 diabetes is treated with insulin, 65.3% recognized that the diabetic student may need to take an insulin dose during the school day and only 46.0% who acknowledged that a diabetic student must eat sweets or juices before the physical activity class.

However, the participants answers indicated adequate T1D knowledge in other areas. Majority of the participants, were aware about the classic symptoms of uncontrolled T1D as: frequent urination (93.5%), increased thirst (91.5%), fatigue and lack of focus (85.3%) and weight loss (70.8%). With regard knowledge about the disease control, 87.2% of the participants recognized that diabetic student must eat her meals or snacks at the required times regularly and take her time until it ends and 81.1% recognized that she need to eat some snacks outside break. Likewise, participants' expressed good knowledge about acute complication of type 1 diabetes; 75.3% correctly recognized common symptoms of hypoglycaemia such as paleness, shakiness, sweating, difficulty concentrating, confusion, weakness or fainting, and 89.9% correctly thought that in event of low blood sugar the child needs to quickly and properly intervene and 82.1% of them recognized that diabetic student should take the sweetened juice and 89.9% in this

Fig. 1. Participants' main sources of information about type 1 diabetes.



Tab. IV. Multivariate Logistic regression model* capturing independent predictors of good knowledge about type 1 diabetes among teachers.

| Variables | aOR | 95% CI | P-value |
|---|------|-----------|---------|
| The teacher Can recognize hypoglycemia (Yes/no) | 1.45 | 0.89-2.36 | 0.135 |
| The teacher can inject insulin (Can/Cannot) | 1.98 | 1.27-3.10 | 0.003 |
| Teacher's family history of diabetes mellitus (Yes/no) | 1.84 | 1.12-3.01 | 0.015 |
| The teacher himself is diabetic (Yes/No) | 2.35 | 1.40-3.92 | 0.001 |
| The teacher has/had a diabetic student/s in her class (Yes/no) | 2.02 | 1.31-3.13 | 0.002 |
| The teacher has received training in caring diabetic students in schools (Yes/no) | 3.38 | 1.78-6.49 | < 0.001 |

aOR: adjusted Odds Ratio; CI: Confidence interval. Variables initially included in the analysis were: all demographic characteristics of teachers and school setting (variables in Table I) and diabetes related characteristics of the participants (variables in Table II); * Final -2*Log-Likelihood of the model: 503.18; Cases included: 502; Likelihood Ratio: 89.178; P-value = < 0.001.

case and 72.1% correctly recognized that hypoglycemic coma is more dangerous than hyperglycemic coma and 74.0% of the participants were aware that diabetic student can fully participate in sport activities like all of her classmates.

Figure 1, depicts the main sources of the participants' information about type 1 diabetes. family/friends (38.1%), common internet sites (35.4%), social media (29.3%), TV/radio (22.6%) and educational institutions (4.9%) were the main sources.

In the multivariate logistic regression analysis (Tab. IV), the following factors were found have an independent positive association with teacher's good knowledge: (1) received training in caring diabetic students (adjusted Odds Ratio (aOR): 3.38, 95% CI: 1.78-6.49, p < 0.001); (2) have/ever had diabetic student/s in her class (aOR: 2.02, 95% CI: 1.31-3.11, p = 0.002); (3) the teacher himself is diabetic or have a near contact with diabetic patient (aOR: 2.35, 95% CI: 1.40-3.92, p = 0.001); (4) family history of diabetes (aOR: 1.84, 95% CI: 1.12-3.01, p = 0.015); and teacher capacity to inject insulin (aOR: 1.98, 95% CI: 1.27-3.10, p = 0.003).

Discussion

Schools have an important role to play in ensuring that students with diabetes have the support they need to stay

healthy, enjoy the same opportunities for learning and having fun as their peers, and are prepared to do their best in school [8]. For effective diabetes management in school, teachers and other school staff should be well-prepared and equipped to play their role. Knowledge is a prerequisite for establishing prevention beliefs, forming positive attitudes, and promoting positive behaviors [18]. We aimed in this study to assess factual knowledge about type I diabetes among teachers in public female elementary schools in Hail region, northern Saudi Arabia.

In our study, a high percentage (43.7%) of teachers were having had or currently having students with T1D in their classrooms, which is similar to findings of other studies [9]. This high frequency implies that teachers should be well-prepared to deal with this sensitive health problem among students. Findings of our study revealed that, only one in four who achieved good knowledge score compatible with being an effective support person for diabetic students in school based on criteria used in similar tool kits evaluating teachers' knowledge of diabetes [9, 17], and indicate that teachers in our schools have insufficient knowledge level needed to care students with T1D. This result is consistent with findings of other studies elsewhere [9-11, 19, 20].

Our study uncovered significant teachers' misconceptions about the nature and management of T1D. The vast majority incorrectly thought that type 1 diabetes

develops as a result of excessive sugar intake and lack of physical activity, some of them believed that the disease is contagious and just one in four who can differentiate between type 1 and type 2 diabetes. Furthermore, less than half of the participants who recognized that there is no cure for type 1 diabetes and can only be controlled and just 57.8% who recognized that type 1 diabetes is primarily treated with insulin. Our study population is not an exception of such misconceptions, as being also reported by other research [9-11, 20].

In our work, two key themes were identified independently explained teachers' good knowledge; namely received training in T1D and exposure to direct experience with diabetes. Specifically, teachers in our study who received training in caring for diabetic students, were three and half times more likely to have a good level of knowledge about the disease, compared to those who did not receive such training. Inappropriately, less than one-third of our schools which carried out specific training programs for T1D for teachers and disappointingly, just one in ten (10.8%) who attended such programs. The inadequacy specific training among teachers and other school staff was also observed in other studies worldwide [9-14, 21]. Evidence from previous research established that teachers who received training, not only acquired factual knowledge, but also felt more confident when helping students with diabetes and promoted positive impact on teacher-student relationship [22-26].

We can describe the knowledge of our study group as working knowledge, gained from experience. Five out of the six independent predictors for good teachers' knowledge about Type 1 Diabetes in our study were related to the practical experience gained from intimate contact with diabetic patients or being themselves having diabetes. Teachers who had previous experiences with children with diabetes showed in other research a much higher level of knowledge than those who did not [11, 24]. Proper dealing with diabetic emergencies in schools is an important task for students' safety and well-being. Younger children may not be adept at dealing with problems such as hypoglycaemia and will be dependent upon the adult caring for them at the time; which in school time is the teacher. The ability to deal with this sort of problem is important not only to the diabetic child, but to the rest of the class since a poorly managed episode might be generally disturbing [27]. When we see that only one in four (24.6%) of the teachers in our study who reported a self-efficacy in recognizing signals of hypoglycemia in his diabetic student, it will be very disappointing and show how much we are in need to train and raise the capacity of our teachers to recognize and deal with such jeopardizing emergencies. Another important point in teachers role in caring students with T1D is awareness about the dietary requirements and of the need to take extra carbohydrate before exercise as an is important necessity for the diabetic student safety. Despite that 74.0% of teachers in our study group agreed that the diabetic student can fully take part in sport activities like all of her classmates, yet, only 46.0% of them who recognized that the diabetic

student must eat sweets or juices before the physical activity class.

A discouraging note about our study participants is that only about half (55.7%) of teachers who appreciated attending training programs about type 1 diabetes. This denotes that a considerable number of teachers were either unaware about their responsibilities or unwilling to take the responsibility of caring for their diabetic students. This finding confirms a result of a recent report carried out in 2019, among parents or legal guardian of diabetic children to examine the safety of schools and availability of trained staff who may aid in the management of children with type 1 diabetes, parents found to have poor perceptions about diabetes care at school. They reported that children are mostly responsible for their own diabetes care, glucose checking, and insulin administration [28]. These findings indicates the need to discuss and clarify the roles and responsibilities of teachers in caring diabetic students and to create favorable attitude towards students' safety and well-being. The role of teachers should not be restricted to effectively dealing with the diabetic students, but also should be extended to support their mental health and effectively dealing with psychological issues that might occur. Recent studies carried out among teachers in the same setting reported low self-efficacy and capacity to play this role [29].

STUDY LIMITATION

Our study is not exempt from limitations. First, we approached public female school sector to carry out the study to decrease administrative efforts and facilitate study conduction, so that our results might not reflect the situation in male schools and private sector. Second, the majority of schools were located in urban community in Hail city, where more than two-thirds of the population of the region lives in the city and the Hail Governorate, so that the study results cannot be completely apply to rural community schools in other goneronrates. However, a strength of our study is that the data collection tool used to evaluate diabetes knowledge was based on a reliable set of questions used in earlier studies and revealed high internal consistency in our study.

Conclusion

In conclusion, teachers in female elementary schools in our region need to improve their knowledge about diabetes in children, especially recognizing and management of diabetic emergencies. Pre-service and ongoing professional learning for teachers is crucially needed for acquiring factual knowledge and self-confidence in helping students with diabetes and to promote positive impact on teacher-student relationship.

Ethics approval and consent to participate

The protocol of the study was reviewed and approved by the Regional Bioethics Committee of the General

Directorate of Health Affairs, Hail region, with the approval number 2019/19 dated October 6, 2019. Agreed participants signed the study consent form. Participants were guaranteed anonymity confidentiality of the responses and voluntary participation and they can withdraw for any reason and any time, without any implications.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

Both authors conceived the study idea, participated in development of the data collection tool and interpretation of results. FA, coordinated questionnaire distribution, collection, carried out data entry and participated in interpretation of the study results. HH, designed the study, carried out data analysis and drafted the manuscript.

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