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AWARENESS LEVEL TOWARD MANAGEMENT OF HYPOGLYCEMIA AMONG TEACHERS IN THE KINGDOM OF SAUDI ARABIA: A CROSS-SECTIONAL STUDY.

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Abstract

Introduction : Type 1 Diabetes Mellitus (DM1) is predominant in Saudi Arabia. Over 2500 children aged 0-14 are diagnosed with DM1 yearly. And one of the acute complications of the disease is hypoglycemia. It occurs when blood glucose level falls below 3.9 mmol/L. The early symptoms of hypoglycemia are headache, palpitation, pallor, hunger, and sweating. When the late signs will appear as decrease in level of consciousness and seizures. Hypoglycemia is a common and serious condition that might be fatal if not treated properly. Teachers must be aware of the correct management in dealing with hypoglycemic episode in diseased students, to prevent any further complications of the attack. **Objective**: This study aims to determine the knowledge, awareness and attitude regarding hypoglycemia management among Saudi schoolteachers. **Methodology**: This is an observational cross-sectional study conducted in the Kingdom of Saudi Arabia among schoolteachers. The calculated minimum sample size with 95% level of confidence is 384 teachers. Data collected using an electronic self-administered questionnaire and analyzed using SPSS version 20. **Results**: The study examined the awareness level of teachers in Saudi Arabia regarding the management of hypoglycemia, involving 397 participants. The demographic analysis revealed a predominantly female cohort (65.2%) with an average age of 44.9 years. Notably, 99.3% of teachers recognized the importance of understanding hypoglycemia symptoms, and 97.5% supported training in blood glucose meter use. Despite a high participation rate (83.9%), significant knowledge gaps were identified, with 65% of participants categorized as low in hypoglycemia communication skills. Engagement was notably influenced by

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factors such as having a diabetic child and gender, indicating areas for targeted educational interventions. **Conclusion:** In conclusion, while our study indicates a commendable level of awareness and participation among Saudi teachers regarding hypoglycemia management, significant gaps in knowledge and practice remain.

Keywords: Diabetes mellitus, type 1 diabetes, hypoglycemia, diabetic emergencies, schoolteachers, school health, awareness, knowledge, Saudi Arabia.

Introduction :

Diabetes Mellitus (DM) is caused by reduced insulin production or increased peripheral resistance, or both, which is the hallmark of this disease. Diabetes is brought on by an imbalanced metabolism in protein, carbohydrate, and lipid as a result of excessive or insufficient insulin secretion [1]. Primary types of Diabetes Mellitus (DM) are DM1 or DM2. The loss of the beta cells which create insulin will cause diabetes, commonly known as Type 1 Diabetes Mellitus (DM1), which is a chronic metabolic disorder [2]. Moreover, Diabetes type 2 (DM2) is caused by two factors: beta cells' inability to produce enough insulin, or the body's inability to use the insulin effectively because of insulin sensitivity [3]. Diabetes patients frequently have hypoglycemia attacks as a result of the medications used to treat the condition, including sulfonylureas and insulin [4]. Hypoglycemia occurs when blood glucose (BG) levels fall below the normal range (3.9-7.1 mmol/L) [5]. Hunger, increased perspiration, pallor, palpitations, and headache are some of the first symptoms. Behavior problems, brain problems, consciousness problems, seizures, or loss of consciousness are examples of progressive symptoms [6]. According to data from the International Diabetes Federation for 2019, Saudi Arabia has one of the highest rates of new T1D cases worldwide. Each year, over 2500 children aged 0 to 14 are diagnosed with T1D [7]. By 2030, the World Health Organization (WHO) and the United Nations (UN) have established worldwide goals to improve healthcare, decrease the number of diabetic-related early deaths, achieve universal health coverage, and give everyone access to reasonably priced basic drugs [8]. In 2018, descriptive observational research was published in Spain. The knowledge and readiness to care for diabetic pupils were assessed using a questionnaire Only 0.8% of the sample of 765 teachers, according to the findings, got training specifically for diabetes [9].

Another study of cross-sectional research was conducted in the Saudi Arabian area of hail in 2020. To evaluate the knowledge and understanding of the schoolteachers regarding diabetes mellitus, a survey was provided to 433 teachers. The majority of participants (57%) were found to have a moderate degree of understanding of diabetes, whereas 11.5% had little to no knowledge. Only 52.2 percent of teachers stated they would administer glucose to pupils who were trembling and dizzy [10]. Furthermore, published in 2023, cross-sectional research was conducted in Jeddah city. 378 instructors were given a survey to fill out. Poor procedures and a lack of information on DM were shown by the results of the questionnaire. 73.4% of the male instructors were aware of the symptoms of hypoglycemia, namely tremors and sweating [11].

The hypoglycemic episode is a common and serious problem in diabetic patients. A medical emergency that may lead to death if not treated rapidly. Teachers need to be aware of the immediate actions and proper steps in dealing with hypoglycemic students. The previous studies in Saudi Arabia showed

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intermediate levels of knowledge and awareness regarding diabetes and hypoglycemia among teachers. Teachers have an insufficient level of training; they need to be familiar with the correct procedures for managing hypoglycemia. Our study was designed to assess the level of knowledge and awareness regarding hypoglycemia management among Saudi teachers.

Materials and Methods:

Study design:
This is a cross-sectional questionnaire survey that performed in Saudi Arabia. The study's population consists of Saudi male and female teachers who teach all levels from primary school to high school in all areas.

Inclusion Criteria:
All teachers currently working in Saudi Arabia eligible to participate in the study, irrespective of their age, gender, or nationality.

Exclusion Criteria:
School administrators, support staff, and special education teachers not be included in this study. In addition, those who refuse to agree to the consent presented in the questionnaire
excluded from the study.

Sample size:
The sample size was determined using the Raosoft calculator with a 95% level of confidence, therefore the minimum sample size was 384.
The sample size was calculated using the following formula:

$n= P (1-P) * Z\alpha^2 / d^2$ with a confidence level of 95%.
n: Calculated sample size
Z: The z-value for the selected level of confidence (1- a) = 1.96.
P: An estimated knowledge
Q: (1 – 0.50) = 50%, i.e., 0.50
D: The maximum acceptable error = 0.05.
So, the calculated minimum sample size was:
$n = (1.96)^2 X 0.50 X 0.50/ (0.05)^2 = 384.$

Method for data collection and instrument (Data collection Technique and tools):
Data collected was done by using an electronic self-administered questionnaire. The questionnaire was created by using data from previous relevant studies done in Saudi Arabia. Before participating, participants in our research must electronically agree. The questionnaire included demographic features such as (area, age, and specialty). The participants were asked about their knowledge about the hypoglycemic symptoms like (sweating, tremor, and behavior change). And they were asked about their attitude towards students with the hypoglycemic attack in different situations (if the patient is conscious,

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if the patient is unconscious, if the blood sugar levels remain below 70mg 15 minutes after administering 15 grams of sugars). And the last part they asked about school preparations for students with hypoglycemic attacks (if the medical clinic is available, is there a blood glucose meter).

Scoring system:
Our survey included 28 questions; it is divided into sections to calculate variable aspects of awareness. The total score (63), the participants e divided into three groups based on their scores, and it is classified as follows: high awareness (50 to 63), moderate awareness (38 to 49), and low awareness (37 or less).

Proceeding the demographic data, the first section is intended to evaluate the level of knowledge. The maximum given score (30), while the minimum a (0).
In this response category, the scores as follows: 'I totally agree' (5),
'I agree' (4), 'I don't know' (3), 'I don't agree' (2), 'strongly disagree' (1).

The second section was designed to assess the attitude and practices.
The maximum given score (17), while the minimum a (0).
Similarly, the scores of agreement questions were out of (5), the same as the first section.
If the respondent answered the correct answer or 'yes', it scored as (1). Conversely, no negative marking is given for the wrong answer or 'no'.

The third section is to estimate the school preparations. The maximum given score (14), while the minimum a (0).
In this agreement class the responses scores are as the following: 'I totally agree' (4), 'I agree' (3), 'I don't agree' (2), and 'I strongly disagree' (1).
A score (1) is given for 'yes', and (0) for 'no'

Analyzes and entry method:
After data collection, the data is entered into the computer system by using the Microsoft Office Excel software program 2016 for Windows. Then, the data was transferred to the SPSS: Statical Package of Social Science software program, version 20 to be statically analyzed.

Scoring system:
Knowledge level: (6 statements) (30 score)
High knowledge level: 24 or more
Moderate knowledge level: 18 to 23
Low knowledge level: 17 or less

Attitude and practice level: (13 statements) (17 score)
High level: 12 or more
Moderate level: 8 to 11
Low level: 7 or less

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Participation level: (5 statements) (14 score)

High level: 11 or more
Moderate level: 10
Low level: 9 or less

Results:

Table (1) displays various demographic parameters of the participants with a total number of (397). The age distribution has a mean age of 44.9 years and a standard deviation of 8.2 years, so a relatively mature cohort. Most of the sample is female, constituting 65.2%, males represent 34.8%. In terms of geographic representation, this is comprehensive, with central (31.7%) and western (33.0%) regions well represented, but little participation from the northern (0.3%). An overwhelming trend toward marriage is shown in marital status of 83.4 per cent of people who are married mean that familial responsibilities might influence a person professional engagement. Educational contexts showed balance and marked engagement in teaching in elementary (36.8%) and high school (34.8%). By their variety of specialties, the participants are educated in a broad range of subjects, with almost half (38.0%) being labelled 'other' (as many may describe nontraditional teaching or educational practice).

Table (1): Sociodemographic characteristics of participants (n=397)

Parameter		***No.***	***Percent (%)***
Age	39 or less	86	21.7
(Mean:44.9, STD:8.2)	40 to 45	112	28.2
	46 to 50	115	29.0
	51 or more	84	21.2
Gender	Female	259	65.2
	Male	138	34.8
Residential region	Northern region	1	.3
	Southern region	116	29.2
	Central region	126	31.7
	Eastern region	23	5.8
	Western region	131	33.0
Marital status	Single	37	9.3
	Married	331	83.4
	Divorced	24	6.0
	Widowed	5	1.3
Place of work	Kindergarten	21	5.3
	Elementary School	146	36.8
	Middle School	92	23.2
	High School	138	34.8
Speciality	Biology	19	4.8
	Social Studies	45	11.3

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	Mathematics	32	8.1
	Religious Studies	54	13.6
	Arabic Language	61	15.4
	Science	21	5.3
	Chemistry	14	3.5
	Other	151	38.0

As shown in figure 1, public perception on this topic is elicited from data collected from a total sample of 397 respondents regarding the belief that sweating is a symptom of low blood sugar. This assertion, however, is specifically agreed with by 31.2% (124 individuals) who do so completely, and by a significant 39.8% (158 individuals). On the contrary, 24.9% (99 respondents) remain unsure, suggesting a great deal to be unknown or ambivalent about regarding this medical symptom. Only 4.0% (16 individuals) disagree, and a minimal dissenting viewpoint, they only agree with the notion. In general, most of these participants (71% combined for both levels of agreement) express a strong propensity to admit to sweating as a symptom of low blood sugar.

Figure (1): Illustrates whether sweating is a symptom of low blood sugar among participants.

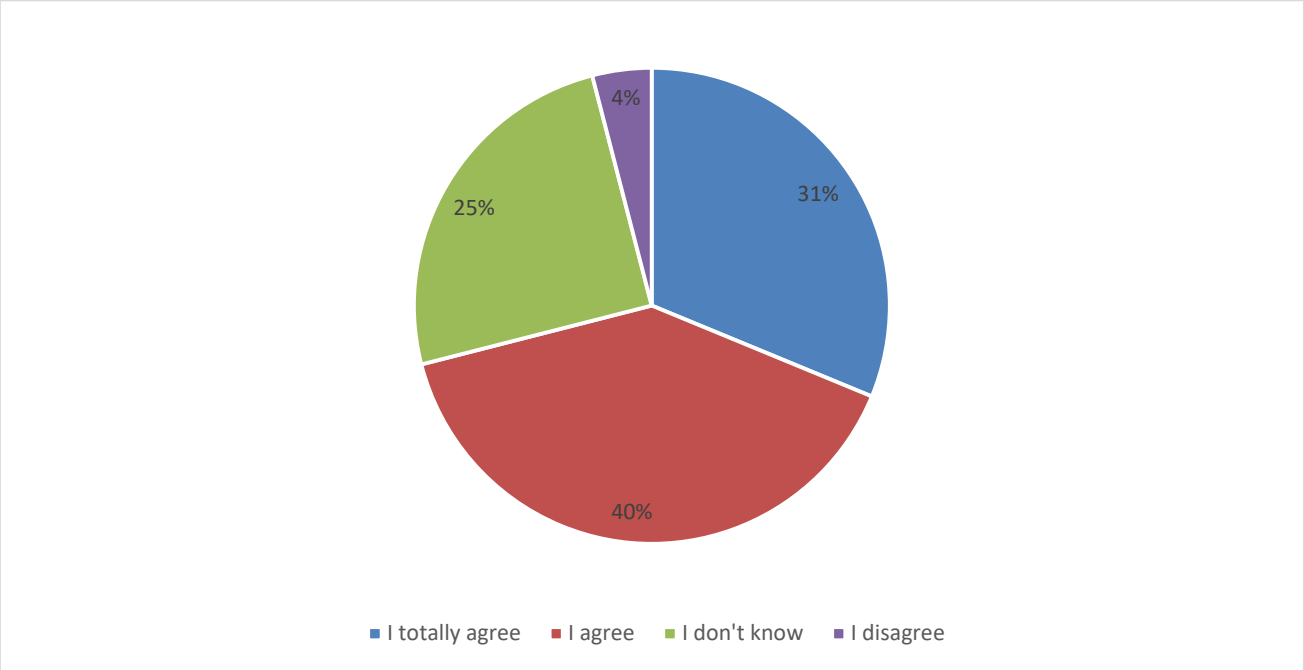

Table 2 presents data showing how a sample of 397 teachers are aware of and understand hypoglycemia management, shedding light upon their knowledge of what symptoms signal low blood sugar and what the consequences are. Almost all respondents without a child with diabetes (91.4%) are also not implying that these levels of awareness are being influenced by personal experience. Participants as a whole agree that carpal tunnel syndrome (88.5%), loss of consciousness (91.2%) are symptoms of low blood sugar but not paleness (54.3%) and cramps (51.1%), respectively.

Table (2): Parameters related to knowledge toward management of hypoglycemia among teachers (n=397).

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Parameter		***No.***	***Percent (%)***
Do you have a child with diabetes?	No	363	91.4
	Yes	34	8.6
Is paleness a symptom of low blood sugar?	I totally agree	84	21.2
	I agree	164	41.3
	I don't know	131	33.0
	I disagree	15	3.8
	I strongly disagree	3	.8
Is sweating a symptom of low blood sugar?	I totally agree	124	31.2
	I agree	158	39.8
	I don't know	99	24.9
	I disagree	16	4.0
Is tremor a symptom of low blood sugar?	I totally agree	186	46.9
	I agree	165	41.6
	I don't know	44	11.1
	I disagree	2	.5
Are stress and behavioural changes symptoms of hypoglycaemia?	I totally agree	133	33.5
	I agree	148	37.3
	I don't know	111	28.0
	I disagree	4	1.0
	I strongly disagree	1	.3
Is loss of consciousness a symptom of low blood sugar?	I totally agree	175	44.1
	I agree	187	47.1
	I don't know	30	7.6
	I disagree	2	.5
	I strongly disagree	3	.8
Are cramps a symptom of low blood sugar?	I agree	153	38.5
	I don't know	203	51.1
	I disagree	37	9.3
	I strongly disagree	4	1.0

As shown in figure (2), A total sample of 397 participants' timing preferences in measuring blood sugar levels after giving a conscious patient sugars is presented and the data reveals timing preferences made. Moreover, 178 subjects, representing approximately 44.8% of the sample, indicated that blood sugar levels should be taken after a quarter of an hour. Instead, a much smaller minority suggested measuring

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after half an hour (31 participants or about 7.8%) and 45 people (about 11.3%) suggested waiting until an hour after eating. Further, 36 per cent of respondents, or 143 people, also reported being unable to determine when it was 'appropriate'. This data suggests a strong consensus for the immediate assessment at these first 15 minutes, so further discussion on the rationale behind the choices for the latter groups is necessary.

Figure (2): Illustrates time of remeasuring blood sugar after giving sugar to a conscious patient among participants.

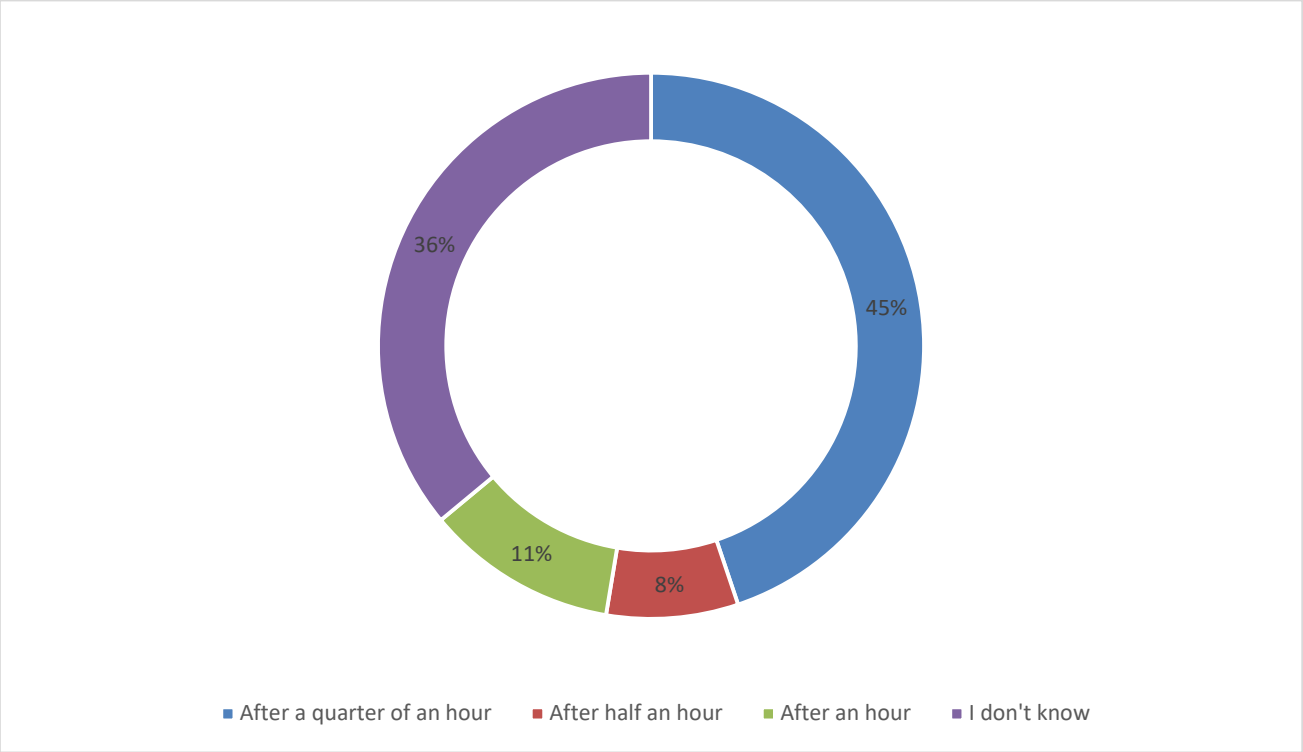

Table (3) shows that 397 participants responded to a concerning gap in teachers' knowledge and preparedness for hypoglycemia management. While most (72.5%) said they knew how to use a blood glucose meter, 87.7 percent didn't know the 'rule 15 15 15,' an essential guideline for preventing episodes of hypoglycemia. In addition, many participants expressed uncertainty across different situations, including giving 15 grams of carbohydrates when blood sugar reaches certain levels and 64.2% did not know when to give 15 grams of carbohydrates. However, 72.5% of them were unable to or did not know how to inject glucagon, a key intervention if an unconscious patient, and more than half (53.7%) didn't know what to do in an unconscious patient that loses consciousness.

Table (3): participants' attitude and practice toward management of hypoglycemia among teachers (n=397).

Parameter		***No.***	***Percent (%)***
Do you know how to use a blood glucose meter?	No	109	27.5

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	Yes	288	72.5
Does the patient's loss of consciousness or not affect the treatment method?	I totally agree	48	12.1
	I agree	80	20.2
	I don't know	152	38.3
	I disagree	86	21.7
	I strongly disagree	31	7.8
Do you know the rule 15 15 15?	No	348	87.7
	Yes	49	12.3
If the patient is conscious, he is given:	15 grams of slow-absorbing sugars	49	12.3
	15 grams of fast-absorbing sugars	151	38.0
	I don't know	197	49.6
Example of rapidly absorbed sugars:	3 tablespoons of sugar dissolved in a cup of water	98	24.7
	6 pieces of candy	17	4.3
	1 tablespoon of honey	69	17.4
	Half a cup of juice	84	21.2
	All of the above	57	14.4
	I don't know	72	18.1
After giving sugars to a conscious patient, when should the blood sugar level be measured?	After a quarter of an hour	178	44.8
	After half an hour	31	7.8
	After an hour	45	11.3
	I don't know	143	36.0
If the blood sugar level remains less than 70 mg 15 minutes after giving 15 grams of sugar to the patient, what is the correct action?	Repeat the steps from the beginning	47	11.8
	Re-measure your blood sugar level again after 15 minutes	63	15.9
	Call an ambulance	119	30.0
	I don't know	168	42.3
When is the patient given 15 grams of carbohydrates?	When blood sugar reaches 100	14	3.5
	When blood sugar reaches 70	92	23.2
	When blood sugar reaches 90	36	9.1
	I don't know	255	64.2
If the patient is unconscious, what will you do?	Wait 15 minutes	41	10.3

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	Glucagon injection	143	36.0
	I don't know	213	53.7
Do you know how to inject glucagon?	No	288	72.5
	Yes	109	27.5
When the patient's condition improves after the glucagon injection, what will you do?	Let the patient rest for an hour	33	8.3
	Correct the blood sugar level with a light meal	96	24.2
	Transfer the patient to the hospital	122	30.7
	I don't know	146	36.8
If glucagon is not available and the patient is unconscious, what will you do?	Trying to give the patient honey	74	18.6
	Trying to give the patient juice	86	21.7
	Transporting the patient to the hospital	125	31.5
	I don't know	112	28.2
Do you always carry fast-absorbing sugar with you?	No	268	67.5
	Yes	129	32.5

Data presented in Table 4 concerning participants task in management of hypoglycemia among teachers has important implications to the field of health education in educational setting. Undeniably, most respondents (64.0%) confirmed the existence of blood sugar meters at schools, and just as many (61.0%) confirmed the existing medical clinics, showing the basic infrastructure of dealing with hypoglycemic incidents. Most importantly, there is a very strong consensus regarding the need for teachers to know the symptoms of low blood sugar, with 99.3 percent reporting support for this knowledge. Additionally, a large 97.5% of respondents concurred with the need to train teachers in being able to properly use a blood glucose meter. What was most striking about it is that 98.5 percent recognized the value of campaigns designed to increase awareness of low blood sugar.

Table (4): participants' participation toward management of hypoglycemia among teachers (n=397).

Parameter		***No.***	***Percent (%)***
Is there a blood sugar meter at school?	No	143	36.0
	Yes	254	64.0
Is there a medical clinic at the school?	No	155	39.0
	Yes	242	61.0
Is it necessary for teachers to know the symptoms of low blood sugar?	I totally agree	296	74.6
	I agree	98	24.7
	I disagree	2	.5

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	I strongly disagree	1	.3
Is it necessary to train teachers on the use of a blood glucose meter?	I totally agree	280	70.5
	I agree	107	27.0
	I disagree	10	2.5
Is it necessary to conduct campaigns in schools to raise awareness about low blood sugar?	I totally agree	311	78.3
	I agree	80	20.2
	I disagree	4	1.0
	I strongly disagree	2	.5

Table 5 shows the deficiency in knowledge of teachers towards the management of hypoglycemia and outlines insightful trends in knowledge about the hypoglycemia management. What is notable, however, is that almost half of the respondents in the sample (48.6%) exhibit high knowledge, 50.1% moderate knowledge, while only 1.3% did not possess even the slightest knowledge. That shows educators are conscious of the health and safety of students, with individuals who come in with diabetes in particular. On the contrary, the reservation of 1.3 percent of the population with low knowledge, points to a sector that requires more work to improve.

Table (5): Shows knowledge toward management of hypoglycemia among teachers score results.

	Frequency	**Percent**
High knowledge level	193	48.6
Moderate knowledge level	199	50.1
Low knowledge level	5	1.3
Total	397	100.0

Table 6 presents the frequency distribution of attitude levels, and it shows a 'worrisome' trend regarding the attitude and practice with respect of hypoglycemia management by teachers. Only 6.0% of respondents percentage of respondents were aware about the practices and practiced it while 29.0% only had a moderate level of awareness. It was alarmingly 65.0% of participant fall in to low hypoglycemia coumunication category, which indicated huge gap of hyopglycemia management protocols.

Table (6): Shows attitude and practice toward management of hypoglycemia among teachers score results.

	Frequency	**Percent**
High attitude level	24	6.0
Moderate attitude level	115	29.0
Low attitude level	258	65.0
Total	397	100.0

The participation level of teachers in management of hypoglycemia is presented in Table 7 and a high trend in such involvement emerges. An impressive 83.9% of respondents showed high level of participation in ensuring the well being of those who are susceptible to hypoglycemic events. However

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compared to the relatively small moderate (9.1 per cent) and low (7.1 per cent) participation figures, this points to a sound base for proactive participation but there is still room for improvement in knowledge and training for a minority of teachers.

Table (7): Shows participation toward management of hypoglycemia among teachers score results.

	Frequency	**Percent**
High level of participation	333	83.9
Moderate participation	36	9.1
Low participation level	28	7.1
Total	397	100.0

Table (8) shows that knowledge toward management of hypoglycemia among teachers has statistically significant relation to gender (P value=0.033), and having a child diagnosed with diabetes (P value=0.007). It also shows statistically insignificant relation to age, residential area, marital status, place of work, speciality. Female gender of participants and having a child diagnosed with diabetes were found to have higher knowledge level than the others.

Table (8): Relation between knowledge toward management of hypoglycemia among teachers and sociodemographic characteristics.

Parameters		***Knowledge level***		***Total (N=397)***	***P value****
		High knowledge level	**Moderate to low knowledge level**		
Gender	Female	136	123	259	0.033
		70.5%	60.3%	65.2%	
	Male	57	81	138	
		29.5%	39.7%	34.8%	
Age	39 or less	42	44	86	0.151
		21.8%	21.6%	21.7%	
	40 to 45	56	56	112	
		29.0%	27.5%	28.2%	
	46 to 50	47	68	115	
		24.4%	33.3%	29.0%	
	51 or more	48	36	84	
		24.9%	17.6%	21.2%	
Residential area	Northern region	1	0	1	0.297
		0.5%	0.0%	0.3%	
	Southern region	63	53	116	
		32.6%	26.0%	29.2%	
	Central region	57	69	126	

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		29.5%	33.8%	31.7%	
	Eastern region	8	15	23	
		4.1%	7.4%	5.8%	
	Western region	64	67	131	
		33.2%	32.8%	33.0%	
Marital status	Single	22	15	37	0.463
		11.4%	7.4%	9.3%	
	Married	158	173	331	
		81.9%	84.8%	83.4%	
	Divorced	10	14	24	
		5.2%	6.9%	6.0%	
	Widowed	3	2	5	
		1.6%	1.0%	1.3%	
Place of work	Kindergarten	12	9	21	0.354
		6.2%	4.4%	5.3%	
	Elementary School	63	83	146	
		32.6%	40.7%	36.8%	
	Middle School	49	43	92	
		25.4%	21.1%	23.2%	
	High School	69	69	138	
		35.8%	33.8%	34.8%	
Speciality	Biology	12	7	19	0.162
		6.2%	3.4%	4.8%	
	Social Studies	27	18	45	
		14.0%	8.8%	11.3%	
	Mathematics	15	17	32	
		7.8%	8.3%	8.1%	
	Religious Studies	30	24	54	
		15.5%	11.8%	13.6%	
	Arabic Language	24	37	61	
		12.4%	18.1%	15.4%	
	Science	12	9	21	
		6.2%	4.4%	5.3%	
	Chemistry	4	10	14	
		2.1%	4.9%	3.5%	
	Other	69	82	151	
		35.8%	40.2%	38.0%	
Do you have a child with diabetes?	No	169	194	363	0.007
		87.6%	95.1%	91.4%	
	Yes	24	10	34	

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		12.4%	4.9%	8.6%	

P value was considered significant if ≤ 0.05.

Table (9) shows that attitude and practice toward management of hypoglycemia among teachers has statistically significant relation to residential area (P value=0.004), marital status (P value=0.001), speciality (P value=0.004) and having a child diagnosed with diabetes (P value=0.0001). It also shows statistically insignificant relation to gender, age, and place of work. Single participants, specialized in social studies and those having a child diagnosed with diabetes were found to have higher attitude and practice level than the others.

Table (9): Attitude and practice toward management of hypoglycemia among teachers in association with sociodemographic characteristics.

Parameters		***Attitude level***		***Total (N=397)***	***P value****
		High or moderate attitude	**Low attitude level**		
Gender	Female	93	166	259	0.609
		66.9%	64.3%	65.2%	
	Male	46	92	138	
		33.1%	35.7%	34.8%	
Age	39 or less	32	54	86	0.285
		23.0%	20.9%	21.7%	
	40 to 45	46	66	112	
		33.1%	25.6%	28.2%	
	46 to 50	34	81	115	
		24.5%	31.4%	29.0%	
	51 or more	27	57	84	
		19.4%	22.1%	21.2%	
Residential area	Northern region	0	1	1	0.004
		0.0%	0.4%	0.3%	
	Southern region	32	84	116	
		23.0%	32.6%	29.2%	
	Central region	45	81	126	
		32.4%	31.4%	31.7%	
	Eastern region	16	7	23	
		11.5%	2.7%	5.8%	
	Western region	46	85	131	
		33.1%	32.9%	33.0%	
Marital status	Single	22	15	37	0.001
		15.8%	5.8%	9.3%	
	Married	102	229	331	

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		73.4%	88.8%	83.4%	
	Divorced	13	11	24	
		9.4%	4.3%	6.0%	
	Widowed	2	3	5	
		1.4%	1.2%	1.3%	
Place of work	Kindergarten	10	11	21	0.138
		7.2%	4.3%	5.3%	
	Elementary School	49	97	146	
		35.3%	37.6%	36.8%	
	Middle School	39	53	92	
		28.1%	20.5%	23.2%	
	High School	41	97	138	
		29.5%	37.6%	34.8%	
Speciality	Biology	5	14	19	0.004
		3.6%	5.4%	4.8%	
	Social Studies	24	21	45	
		17.3%	8.1%	11.3%	
	Mathematics	16	16	32	
		11.5%	6.2%	8.1%	
	Religious Studies	14	40	54	
		10.1%	15.5%	13.6%	
	Arabic Language	22	39	61	
		15.8%	15.1%	15.4%	
	Science	12	9	21	
		8.6%	3.5%	5.3%	
	Chemistry	4	10	14	
		2.9%	3.9%	3.5%	
	Other	42	109	151	
		30.2%	42.2%	38.0%	
Do you have a child with diabetes?	No	115	248	363	0.0001
		82.7%	96.1%	91.4%	
	Yes	24	10	34	
		17.3%	3.9%	8.6%	

****P value was considered significant if ≤ 0.05.***

Table (10) shows that participation toward management of hypoglycemia among teachers has statistically significant relation to having a child diagnosed with diabetes (P value=0.008). It also shows statistically insignificant relation to gender, age, residential area, marital status, place of work, speciality.

Table (10): Participation toward management of hypoglycemia among teachers in association with

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sociodemographic characteristics.

Parameters		***Participation level***		***Total (N=397)***	***P value****
		High level of participation	**Moderate or low participation**		
Gender	Female	216	43	259	0.721
		64.9%	67.2%	65.2%	
	Male	117	21	138	
		35.1%	32.8%	34.8%	
Age	39 or less	69	17	86	0.400
		20.7%	26.6%	21.7%	
	40 to 45	99	13	112	
		29.7%	20.3%	28.2%	
	46 to 50	94	21	115	
		28.2%	32.8%	29.0%	
	51 or more	71	13	84	
		21.3%	20.3%	21.2%	
Residential area	Northern region	1	0	1	0.967
		0.3%	0.0%	0.3%	
	Southern region	96	20	116	
		28.8%	31.3%	29.2%	
	Central region	105	21	126	
		31.5%	32.8%	31.7%	
	Eastern region	20	3	23	
		6.0%	4.7%	5.8%	
	Western region	111	20	131	
		33.3%	31.3%	33.0%	
Marital status	Single	34	3	37	0.578
		10.2%	4.7%	9.3%	
	Married	275	56	331	
		82.6%	87.5%	83.4%	
	Divorced	20	4	24	
		6.0%	6.3%	6.0%	
	Widowed	4	1	5	
		1.2%	1.6%	1.3%	
Place of work	Kindergarten	18	3	21	0.602
		5.4%	4.7%	5.3%	
	Elementary School	125	21	146	
		37.5%	32.8%	36.8%	
	Middle School	73	19	92	
		21.9%	29.7%	23.2%	

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	High School	117	21	138	
		35.1%	32.8%	34.8%	
Speciality	Biology	18	1	19	0.196
		5.4%	1.6%	4.8%	
	Social Studies	37	8	45	
		11.1%	12.5%	11.3%	
	Mathematics	25	7	32	
		7.5%	10.9%	8.1%	
	Religious Studies	46	8	54	
		13.8%	12.5%	13.6%	
	Arabic Language	53	8	61	
		15.9%	12.5%	15.4%	
	Science	20	1	21	
		6.0%	1.6%	5.3%	
	Chemistry	14	0	14	
		4.2%	0.0%	3.5%	
	Other	120	31	151	
		36.0%	48.4%	38.0%	
Do you have a child with diabetes?	No	299	64	363	0.008
		89.8%	100.0%	91.4%	
	Yes	34	0	34	
		10.2%	0.0%	8.6%	

****P value was considered significant if ≤ 0.05.***

Discussion:

The present study aimed to evaluate the knowledge and practices regarding hypoglycemia management among school teachers in Saudi Arabia, a critical area given the rising incidence of Type 1 Diabetes Mellitus (DM1) among children in the region. With over 2500 new diagnoses annually, the need for educators to be equipped with the necessary knowledge and skills to manage hypoglycemic episodes is paramount. This discussion will compare the findings of our study with existing literature on the topic, highlighting similarities and discrepancies, while also addressing the limitations inherent in our research.

Our study found that a significant proportion of teachers exhibited varying levels of knowledge regarding hypoglycemia, with 48.6% demonstrating high knowledge and only 1.3% showing low knowledge. This aligns with findings from Alotaibi et al., who reported that primary school teachers in Riyadh had a similar distribution of knowledge levels, indicating a general awareness of hypoglycemia symptoms and management protocols among educators [12]. However, the concerning statistic that only 6.0% of our participants demonstrated adequate awareness and practice regarding hypoglycemia management echoes the concerns raised by Beverly et al., who noted that medical students often lack practical knowledge about hypoglycemia management despite theoretical understanding [13]. This suggests a potential gap in the translation of knowledge into practice, which is critical in emergency

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situations like hypoglycemia.

Moreover, our results indicated that 65.0% of teachers fell into the low hypoglycemia communication category, which is concerning given the necessity for effective communication in managing diabetic emergencies. This finding is consistent with the systematic review by Edwards et al., which highlighted that inadequate knowledge and communication among school staff can hinder optimal diabetes management in educational settings [14]. The need for improved communication protocols and training for teachers is further supported by the work of Gutzweiler et al., who emphasized the importance of regular exchanges among teachers, parents, and healthcare providers to ensure that children with diabetes receive appropriate care at school [15].

Interestingly, our study revealed that teachers with personal experience, such as having a child diagnosed with diabetes, exhibited higher knowledge levels (P=0.007). This finding resonates with the observations made by Junco and Hawrylak, who found that teachers' perceptions of care for students with Type 1 Diabetes were significantly influenced by their personal experiences and knowledge [16]. This underscores the importance of experiential learning in enhancing educators' understanding of diabetes management, suggesting that targeted training programs could benefit from including personal narratives and case studies to foster deeper engagement.

In terms of practical knowledge, our study found that 44.8% of respondents correctly identified the appropriate timing for blood sugar measurement after administering sugar to a conscious patient. This is a crucial aspect of hypoglycemia management, as timely intervention can prevent severe complications. However, the 36% of respondents who were unsure about when to check blood glucose levels indicates a significant knowledge gap that needs to be addressed. This finding aligns with the research conducted by Kadohiro, which highlighted the challenges school personnel face in managing hypoglycemia due to insufficient training and knowledge [17].

The infrastructure available in schools for managing hypoglycemic incidents was also assessed, with 64.0% of teachers confirming the presence of blood sugar meters and 61.0% acknowledging the existence of medical clinics. While these findings suggest a foundational level of preparedness, they also point to the need for comprehensive training programs to ensure that teachers are not only aware of the resources available but also competent in utilizing them effectively. This is supported by the recommendations from Zucchini, who advocated for standardized training protocols for school staff to enhance their ability to recognize and respond to hypoglycemic events [18].

Despite the positive indicators of participation in hypoglycemia management, with 83.9% of teachers actively involved, the moderate (9.1%) and low (7.1%) participation levels highlight areas for improvement. This discrepancy is reminiscent of the findings from Nannsen et al., who reported that while school staff recognized the importance of diabetes management, actual participation in care activities was often lacking due to insufficient training and support [19]. Therefore, it is imperative that educational institutions implement structured training programs that not only inform teachers about diabetes management but also empower them to take an active role in supporting students with diabetes.

The limitations of our study must also be acknowledged. The cross-sectional design restricts the ability to draw causal inferences regarding the relationship between knowledge and practice. Additionally, the reliance on self-reported data may introduce bias, as participants may overestimate their knowledge and practices. Furthermore, the geographical representation of our sample, while diverse, may not fully capture the experiences of teachers in more rural or underserved areas of Saudi Arabia, where access to

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training and resources may be limited. Future studies should consider longitudinal designs and include a broader range of participants to enhance the generalizability of findings.

Conclusion:
In conclusion, while our study indicates a commendable level of awareness and participation among Saudi teachers regarding hypoglycemia management, significant gaps in knowledge and practice remain. The findings underscore the urgent need for targeted educational interventions to equip teachers with the necessary skills to manage hypoglycemic episodes effectively. By fostering a culture of continuous learning and collaboration among educators, healthcare providers, and families, we can enhance the safety and well-being of students with diabetes in school settings.

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Ethical approval:
After fully explaining the study and emphasizing that participation is optional, each participant gave their informed consent. The information gathered was safely stored and utilized exclusively for study.

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The authors declare no conflict of interest.

Informed consent:
Written informed consent was acquired from each individual study participant.

Data and materials availability:
All data associated with this study are present in the paper.

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