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Knowledge, Attitudes, and Practices of School Teachers Regarding Type 1 Diabetes Mellitus: A Literature Review

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Abstract

This literature review examines school teachers' knowledge, attitudes, and practices in managing students with Type 1 Diabetes Mellitus (T1DM), synthesizing 26 studies from 11 countries published between 2017 and 2024. While many teachers are willing to support students with T1DM, their knowledge, confidence, and preparedness vary considerably. Factors such as gender, prior diabetes-related training, teaching experience, and personal or family exposure to diabetes were associated with differences in teachers' ability to provide effective support. Teachers who have received structured training or previous experience with students with T1DM generally report greater confidence in managing diabetes-related emergencies. The review also identifies persistent challenges, including misconceptions about T1DM, inadequate training opportunities, limited access to school healthcare resources, and the absence of clear institutional policies. These barriers may compromise teachers' confidence and the safety of students living with T1DM. Despite these challenges, most teachers express a strong interest in receiving additional education and training. The findings highlight the need for comprehensive teacher training programs and stronger school-based support systems to enhance diabetes care and ensure a safe and supportive educational environment for students with T1DM.

Categories: Medical Education, Pediatrics, Endocrinology/Diabetes/Metabolism
Keywords: diabetes mellitus management, knowledge attitude and practices, school health, school teachers, type 1 diabetes mellitus (t1d)

Introduction And Background

Type 1 diabetes mellitus (T1DM) is one of the most common chronic metabolic diseases affecting children worldwide [1]. It is an autoimmune endocrine disorder characterized by destruction of pancreatic beta cells and consequent absolute insulin deficiency. The resulting hyperglycemia may present with polyuria, polydipsia, weight loss, and other metabolic symptoms, and lifelong insulin replacement is required [2]. Its global burden is substantial and still rising: according to the International Diabetes Federation (IDF) Diabetes Atlas (11th edition) and T1D Index estimates, approximately 9.5 million people were living with T1DM worldwide in 2025 (up from 8.4 million in 2021), including about 1.0 million aged 0-14 years and 0.8 million aged 15-19 years. An estimated 513,000 new cases were diagnosed in 2025, of which 164,000 occurred in children aged 0-14 years and 58,000 in those aged 15-19 years, and the number of people living with T1DM is projected to reach 14.7 million by 2040 [3]. Contemporary T1DM management includes regular glucose monitoring, insulin administration, nutrition planning, physical activity, and rapid recognition and treatment of hypo- and hyperglycemia [4]. Besides hypoglycemia, hyperglycemic crises, principally diabetic ketoacidosis (DKA), are the main acute emergencies of T1DM; DKA may be the presenting feature of newly diagnosed disease or follow missed insulin doses or intercurrent illness, and it is life-threatening unless recognized and treated promptly [5].

Children and adolescents spend a substantial proportion of each weekday at school, where parents are not continuously available to supervise diabetes care. Consequently, school personnel may be required to recognize hypoglycemia and hyperglycemic crisis, permit glucose monitoring and food intake, facilitate insulin administration, respond to emergencies, and communicate with families and healthcare professionals. The school environment therefore has direct implications for the safety of students with T1DM, glycemic management, participation in learning and extracurricular activities, and psychosocial well-being [6,7]. In particular, adequate preparedness is important during acute events such as hypoglycemia and hyperglycemic crisis, when timely recognition and treatment may be critical to preventing serious complications.

Despite this responsibility, the literature repeatedly identifies gaps in teachers' diabetes knowledge, confidence, and practical preparedness. Reported barriers include limited access to structured training, inconsistent availability of school nurses or other trained personnel, uncertainty about emergency protocols, and misconceptions about the causes and day-to-day management of T1DM [6,7]. These findings are consistent with an integrative review by Parke et al., which identified substantial variation in diabetes-

related training among school staff and highlighted gaps in the availability of appropriately trained personnel [8]. At the same time, many teachers report positive attitudes toward students with diabetes and a strong willingness to receive additional education. Understanding this gap between willingness and practical capability is important for designing effective school-based interventions.

Existing reviews have mainly addressed school-based diabetes care or educational interventions in general terms, including an integrative review of T1DM in schools [8], recommendations and knowledge gaps in school-based management [9], and a systematic review of interventions, barriers, and facilitators in educational settings [10]. In contrast, the present review focuses specifically on teachers' knowledge, attitudes, and practices (KAP) and brings together the KAP evidence published since 2017, much of it from the Middle East and Europe, during a period in which the global burden of T1DM has continued to rise [3]. A focused synthesis is needed to show which teacher-level gaps are consistent across settings, which factors are associated with better preparedness, and where training and school-level support should be directed.

This literature review therefore synthesizes evidence on school teachers' knowledge, attitudes, and practices (KAP) regarding T1DM. It specifically examines factors associated with KAP, including demographic characteristics, teaching experience, prior exposure to diabetes, and formal training; compares findings across geographic settings; and evaluates evidence concerning emergency preparedness, institutional support, and routine diabetes management in schools.

Review

Methods

Review Design and Search Strategy

This study was conducted as a narrative literature review examining school teachers' knowledge, attitudes, and practices (KAP) regarding type 1 diabetes mellitus (T1DM). A structured literature search was conducted between February and March 2025 to identify relevant publications. The search was conducted using PubMed, CINAHL, Academic Search Ultimate (accessed through EBSCO), Europe PMC, and Google Scholar. Supplementary searches were also performed through selected journal and publisher websites, including Bahrain Medical Bulletin, International Journal of Medical Science in Clinical Research and Review, Cambridge University Press, Scientific Research Publishing (SCIRP), and SCIEPUB.

The search terms included "knowledge," "attitudes," "practices," "Type 1 Diabetes Mellitus," and "school teachers." These terms were used in various combinations to identify relevant publications. This review was conducted as a narrative literature review based on a structured literature search and was not designed as a systematic or scoping review. Therefore, it does not claim adherence to PRISMA or PRISMA-ScR reporting guidelines.

Eligibility Criteria

Articles were eligible for inclusion if they weData Extraction and Thematic Synthesisre published online between 2017 and 2024, were available in English or had an available English full-text translation, and examined school teachers' knowledge, attitudes, or practices regarding T1DM. Studies conducted in any geographical setting were considered. Studies focusing on type 2 diabetes mellitus, gestational diabetes, or other forms of diabetes were excluded. Studies involving populations other than school teachers, including parents and healthcare professionals, were also excluded.

Study Selection

A total of 57 records were identified, comprising 20 records from PubMed and 37 records from supplementary sources. Following the removal of 23 duplicates, 34 records remained for screening. Eight records were excluded following title screening, leaving 26 articles for further assessment. All 26 articles underwent full-text assessment and met the eligibility criteria; therefore, no articles were excluded at the full-text stage. A total of 26 studies were included in the final review, as illustrated in Figure *1*.

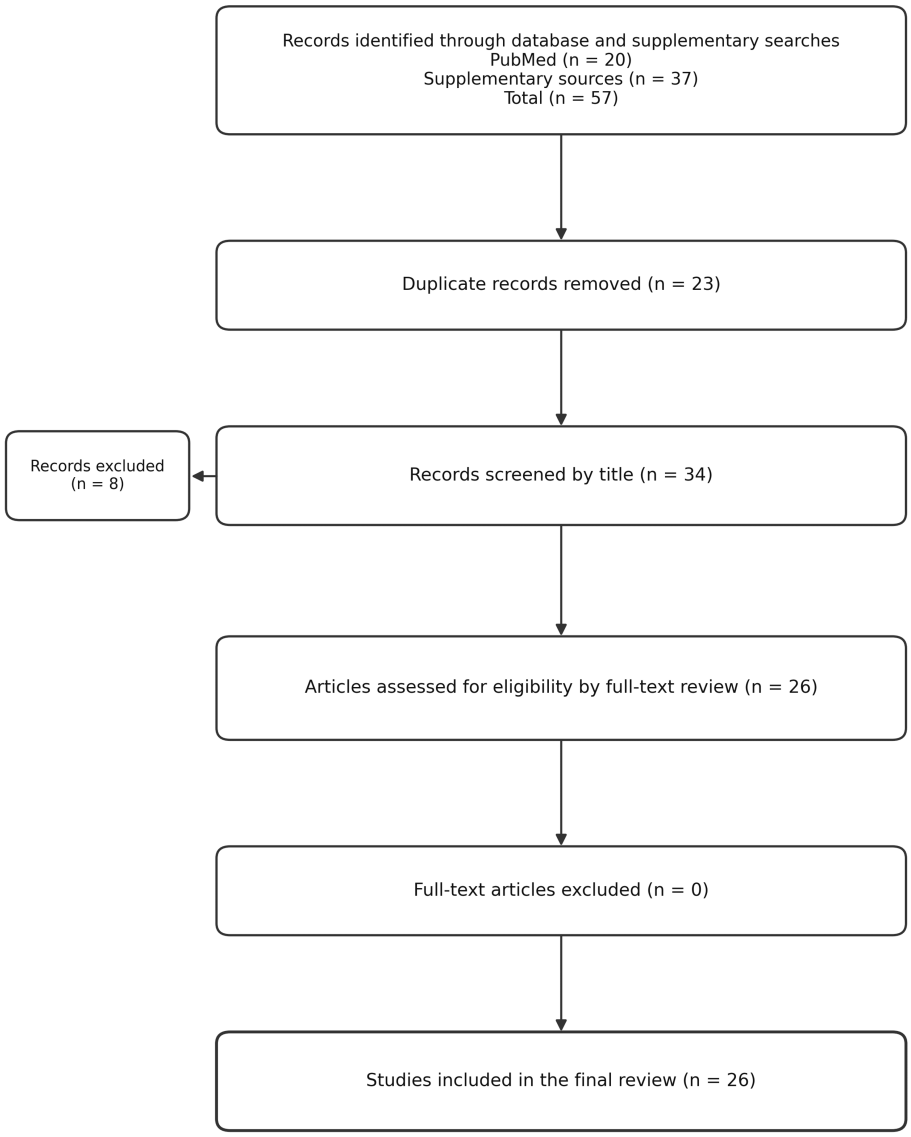


FIGURE 1: Study identification and selection process

The screening process was distributed among the seven authors, with each author assigned a separate group of articles to review. Each author assessed their assigned articles for relevance to the review objectives and identified findings related to teachers' knowledge, attitudes, and practices regarding T1DM.

Relevant information was extracted from the included articles and organized according to study characteristics and the three main KAP domains: knowledge, attitudes, and practices. Findings within each domain were compared across studies and grouped into recurring subthemes. These included teachers' knowledge of T1DM and its complications, attitudes toward students with T1DM, preparedness to manage diabetes-related emergencies, routine diabetes care practices, and the availability of training and institutional support. The findings were synthesized descriptively and narratively. Quantitative findings, including percentages and other reported statistical results, were presented as reported in the individual studies. No pooled statistical analysis was performed.

Findings

Knowledge

Gender differences: gender differences in teachers' knowledge of T1DM have been reported, although the direction and significance of these differences vary across studies. In Saudi Arabia, Aljefree et al. (2023) found that female teachers had significantly higher knowledge scores than male teachers, with mean scores of 4.6 and 4.2, respectively. Female teachers were also more likely to correctly identify the age of onset and symptoms of T1DM, such as fatigue and loss of concentration. Among male teachers, increasing age and longer teaching experience were positively associated with knowledge, while teachers with diabetes

themselves demonstrated the highest levels of knowledge [11].

In contrast, Statiri et al. (2023), studying primary school teachers in Greece, found significantly higher knowledge among male teachers (p=0.004). Notably, all three participants who demonstrated sufficient knowledge of T1DM were male, although the majority of participants had only basic knowledge overall [12]. Chatzistougianni et al. (2020), also conducted among Greek teachers, similarly reported a slightly higher mean knowledge score among males than females; however, this difference was not statistically significant (p=0.763) [13]. The findings from these studies do not demonstrate a consistent gender-based pattern in T1DM knowledge. The opposing results across settings suggest that factors such as educational background, teaching experience, and previous exposure to diabetes may also contribute to differences in knowledge.

Impact of teaching experience: teaching experience has been associated with differences in teachers' knowledge, attitudes, and practices regarding T1DM. In a cross-sectional study conducted in Riyadh, Saudi Arabia, Aldekhayel (2020) found that teachers with more than 20 years of experience had higher levels of diabetes-related knowledge and better practices compared with those with 1-5 years of experience [14]. Similarly, a study from Poland by Stefanowicz-Bielska et al. (2024) reported higher knowledge scores among teachers with more than 21 years of teaching experience, particularly among those who had direct exposure to students with diabetes [15]. Aljefree et al. (2023) also found that increasing years of teaching experience were positively associated with knowledge, attitudes, and practices related to T1DM [11].

In Upper Siang, India, Perme et al. (2022) reported that more experienced teachers were more confident in responding to diabetes-related emergencies, although overall awareness remained moderate [16]. In contrast, Alqahtani et al. (2023), studying teachers in the Aseer region of Saudi Arabia, found that older teachers were generally more knowledgeable, but did not demonstrate a strong statistical association between knowledge and years of teaching experience [17]. Overall, the findings suggest that greater teaching experience may be associated with better preparedness; however, experience alone may not be sufficient, and its effect appears to vary according to prior exposure to students with diabetes and formal training.

Influence of personal or family history: personal or family exposure to diabetes was associated with higher levels of T1DM knowledge in several studies. In an interventional study by Assarrar et al. (2025), teachers who personally knew someone with diabetes demonstrated better knowledge [18]. Similarly, Statiri et al. (2023) found that teachers with a family history of diabetes had significantly higher knowledge of T1DM (p=0.007) [12]. Aljefree et al. (2023) also reported higher knowledge among teachers with a family history of diabetes compared with those without such a history [11]. Overall, these studies suggest an association between previous personal or family exposure to diabetes and greater diabetes-related knowledge among school teachers.

Training and formal education: formal diabetes-related training was consistently associated with higher knowledge and confidence among school teachers. In an interventional study conducted in Normandy, Tournilhac et al. (2020) evaluated a Video Training Program (VTP) designed to improve teachers' confidence in managing children with T1DM. Following the intervention, participants demonstrated significant improvements in knowledge and confidence regarding diabetes-related emergencies, including both hypo- and hyperglycemia [19]. Similarly, Assarrar et al. (2025) reported that an educational intervention significantly improved teachers' knowledge of T1DM [18].

Comparable findings were reported by Bassi et al. (2024), who evaluated an online training program for school staff. Participants who received the training demonstrated significantly greater improvements in knowledge, confidence in managing diabetes-related emergencies, recognition of abnormal symptoms in students with T1DM, and management of hyperglycemia symptoms compared with the control group [20]. Cross-sectional studies also support an association between previous training and greater diabetes-related knowledge. Alshammari et al. (2021) and Al Humayed et al. (2020) both reported higher levels of knowledge among teachers who had previously received diabetes-related training [21,1].

However, the quality and adequacy of training may also influence its effectiveness. Stefanowicz-Bielska et al. (2024) reported that inadequate or incomplete educational preparation was associated with lower knowledge among teachers in the Pomeranian Voivodeship [15]. Overall, the reviewed studies consistently indicate that formal diabetes education is associated with improved knowledge and confidence, while inadequate training may leave important gaps in teachers' preparedness.

Common misconceptions: several studies identified misconceptions among school teachers regarding the etiology, treatment, and management of T1DM. In a Polish study by Stefanowicz-Bielska et al. (2024), questions concerning the causes of T1DM were among the most difficult for teachers, with some participants incorrectly attributing the disease to excessive sugar consumption or insufficient physical activity. Other misconceptions included the belief that T1DM is contagious, as well as gaps in understanding its treatment, the use of glucagon, management of severe hypoglycemia, and appropriate support for students during strenuous physical activity [15].

Similar misconceptions regarding the etiology of T1DM were reported among teachers in Saudi Arabia, where some participants incorrectly associated the disease with excessive sugar intake and lack of physical exercise [21]. Beliefs that T1DM is contagious were also reported, although less frequently than in the Polish study (19.8% compared with 97%) [21]. In Greece, Chatzistougianni et al. (2020) similarly identified a small proportion of teachers who believed that T1DM was contagious [13]. In India, teachers also demonstrated misconceptions regarding the etiology of T1DM, including an incorrect association between T1DM and obesity [22].

Knowledge gaps extended beyond the causes of T1DM to its management. In an interventional study conducted in Morocco involving 346 teachers, 84% recognized frequent urination and excessive thirst as symptoms of diabetes, while only 35.3% knew the definition of hypoglycemia and 65% identified hyperglycemia. Additionally, 40% believed that children with diabetes could not participate in physical exercise, and 55.5% believed that consuming sugar before exercise was mandatory. Following the educational intervention, teachers demonstrated a statistically significant improvement in their overall knowledge of T1DM (p= 0.0001) [18].

Demographic factors (age, geographic setting, and education level): several studies examined the relationship between teachers' age and their knowledge of T1DM. In a study conducted in Riyadh, Saudi Arabia, Aldekhayel (2020) found that 65.6% of teachers aged 51-60 years were knowledgeable about diabetes, compared with 44.9% of those aged 20-30 years [14]. Similarly, Al-Bunyan et al. (2021) reported that age significantly affected awareness among school staff in Al Ahsa, Saudi Arabia, with teachers aged ⩾50 years demonstrating the highest level of awareness [23]. However, findings were not consistent across all studies, with some reporting no significant association between age and KAP. Few studies examined the influence of geographic setting on teachers' knowledge. Stefanowicz-Bielska et al. (2024) reported higher knowledge scores among teachers working in rural areas compared with those working in urban areas [15]. Other studies either did not report geographic setting or did not examine its relationship with KAP outcomes. Educational level was also associated with differences in teachers' knowledge. In Greece, Chatzistougianni et al. (2020) found that teachers with tertiary education had the highest mean percentage of correct answers (81.78 ± 9.90%), while those with secondary education had the lowest (78.16 ± 15.47%), with a statistically significant difference between these groups (p = 0.021) [13]. Aljefree et al. (2023) also reported that the relatively high educational level of the participating Saudi public-school teachers may have contributed to their knowledge levels [11]. Overall, higher educational attainment was generally associated with better diabetes-related knowledge among teachers.

Knowledge of Hypoglycemia

Multiple cross-sectional studies have examined teachers' knowledge of hypoglycemia symptoms and their management. In Saudi Arabia, findings varied across regions. In Northern Saudi Arabia, 75.3% of female public-school teachers demonstrated sufficient knowledge of hypoglycemia as a complication of T1DM, while 82.1% knew how to manage it [21]. In this study, researchers considered a knowledge of 80% on the 20-point knowledge questionnaire as sufficient knowledge. Similarly, among primary and intermediate school teachers in Al Jouf, 87.9% were aware of hypoglycemia symptoms and 84.3% knew how to manage them [24]. In Abha City, 77.6% of participants recognized hypoglycemia symptoms and 90.4% knew how to manage them [1]. A nationwide Saudi study reported that 70.1% of participants were aware of hypoglycemia symptoms, 72.7% knew how to treat them, and 69.1% had previously performed diabetes management tasks [25]. However, other Saudi studies reported lower levels of knowledge. In Al Ahsa, teachers demonstrated gaps in their awareness of diabetic complications [23], while in the Hail region, approximately half of participants knew how to manage children with diabetes during hypoglycemia [26].

Findings from studies outside Saudi Arabia also varied. In southern Spain, 74.2% of teachers had good knowledge of hypoglycemia symptoms, and 85.9% knew how to manage them [27]. In the Pomeranian Voivodeship, Poland, 86.9% of participants demonstrated knowledge of T1DM complications and 94.3% had knowledge of its management [15]. In Greece, Statiri et al. reported that 52.7% of teachers knew how to manage hypoglycemia, while Chatzistougianni et al. reported a lower proportion of 27.33% [12,13]. In contrast, a study conducted in Oujda City, Morocco, reported that only 35.3% of teachers were aware of hypoglycemia symptoms [18]. Qualitative studies from Germany and Spain also identified concerns regarding teachers' preparedness for diabetes-related emergencies and the adequacy of school resources and support [28,29].

Overall, knowledge of hypoglycemia and its management was relatively high in several studies, particularly those conducted in Saudi Arabia, Spain, and Poland, although substantial gaps were reported in other settings. Comparative findings on the recognition and management of hypoglycemia across the included regions are summarized in Table *1*.

Study	Region	Knowledge of hypoglycemia (%)	Knowledge of management of hypoglycemia (%)
Alshammari and Haridi, 2021 [21]	Northern Saudi Arabia	75.3	82.1
Al Duraywish and Nail, 2017 [24]	Al Jouf, Saudi Arabia	87.9	84.3
Al Humayed, 2020 [1]	Abha City, Saudi Arabia	77.6	90.4
Al Khalifah et al., 2021 [25]	Saudi Arabia (Nationwide)	70.1	72.7
Al-Bunyan et al., 2021 [23]	Al Ahsa, Saudi Arabia	57.3	92.7
Alluhaybi et al., 2020 [26]	Hail region, Saudi Arabia	—	52.2
Gutiérrez-Manzanedo et al., 2018 [27]	Southern Spain	74.2	85.9
Stefanowicz-Bielska et al., 2024 [15]	Pomeranian Voivodeship, Poland	86.9	94.3
Statiri et al., 2023 [12]	Attica, Greece	—	52.7
Chatzistougianni et al., 2020 [13]	Greece	—	27.33
Assarrar et al., 2025 [18]	Oujda City, Morocco	35.3	—

TABLE 1: Teachers' knowledge of diabetic emergencies and their management in the included studies.

Percentages represent the proportion of respondents in each study who showed the stated knowledge. Definitions and measurement methods differed between studies, so the values are not directly comparable. —: data not reported.

Attitudes

Willingness to support students: many studies reported generally positive attitudes toward supporting students with T1DM in the school setting. In Saudi Arabia, Alluhaybi et al. (2020) found that 94.9% of teachers were willing to meet with parents of students with diabetes and maintain communication with them to ensure appropriate care. Many participants also expressed interest in attending diabetes-related educational events [26]. Similarly, Al Humayed et al. (2020) reported that 78% of teachers were willing to have students with diabetes in their classrooms [1]. In Greece, Statiri et al. (2023) found that teachers expressed willingness to accept students with chronic conditions, including T1DM, and provide them with the necessary support [12].

However, willingness to support students was not consistent across all studies. Detsis et al. (2023) reported a mean readiness score of 48.10 ± 13.22 among teachers regarding the management of students with T1DM [30]. Similarly, a study conducted in New Delhi reported a mean attitude score of 4.95 out of 8 among primary school teachers [22]. Overall, the reviewed studies indicate that teachers generally express willingness to support students with T1DM, although levels of readiness and supportive attitudes vary across study populations.

Demographic differences (age and gender): several studies examined differences in teachers' attitudes toward students with T1DM according to age and gender. In Riyadh, Aldekhayel (2020) reported more positive attitudes among older teachers [14]. Similarly, Issa (2022) found that older school staff members in Al-Madinah City showed greater concern regarding school preparedness for diabetes care and greater recognition of their responsibility toward students with T1DM [4]. In Abha, Al Humayed et al. (2020) also reported more supportive attitudes among older teachers [1]. In Greece, Statiri et al. (2023) found that older female teachers demonstrated greater awareness of the psychological impact of diabetes on students and were more comfortable taking preventive actions in school [12]. Chopra et al. (2017) reported that younger teachers were more willing to receive training, while older teachers demonstrated greater consistency and confidence in diabetes-related responsibilities [22].

Gender differences were also reported in several studies. Aljefree et al. (2023) found that female teachers had significantly higher attitude scores than male teachers and demonstrated greater willingness to participate in diabetes care and support [11]. Similarly, Al-Bunyan et al. (2021) reported more positive attitudes among female teachers in Al Ahsa, particularly regarding emotional support and classroom adaptations for students with diabetes [23]. In Melilla, Spain, Luque-Vara et al. (2021) found that female teachers were more likely to express concern about students' well-being and communicate with parents regarding diabetes-related needs [31]. In contrast, Horvath et al. (2023) reported that some male and younger teachers felt underprepared or anxious about managing diabetes-related emergencies in a qualitative study [7].

Overall, several studies reported more positive attitudes among older and female teachers, although findings were not entirely consistent across studies.

Impact of experience and exposure: several studies examined the relationship between teaching experience or previous exposure to diabetes and teachers' attitudes toward students with T1DM. In a study conducted in Saudi Arabia, Aldekhayel (2020) found that teachers with greater teaching experience or previous exposure to diabetes through a family member or student tended to have more positive attitudes [14]. In contrast, Luque-Vara et al. (2021), studying teachers in Melilla, Spain, reported less positive attitudes toward caring for students with diabetes among teachers with more than 10 years of experience compared with those with fewer years of experience [31]. In Greece, Statiri et al. (2023) found that teachers with less teaching experience expressed greater concern about caring for students with chronic illnesses and greater sympathy toward these students [12].

Previous direct exposure to diabetes was also examined in relation to perceptions of school preparedness. In a study of 765 public-school teachers in southern Spain, approximately half of those who had previously dealt with a hypoglycemic episode in a student reported that their school was not well prepared to manage such situations [6]. Overall, findings regarding the relationship between experience or previous exposure and teachers' attitudes were mixed across studies.

Institutional support and policies: several studies examined teachers' perceptions of institutional support for the management of students with T1DM in schools. In a study conducted in Saudi Arabia, Al Humayed et al. (2020) found that 99.4% of teachers supported the presence of a school nurse, while 80.2% expressed interest in participating in a training program for managing students with diabetes [1]. Similarly, Detsis et al. (2023) reported high mean scores for teachers' perceptions of the role of the school nurse (90.53 ± 9.39) and the role of students with T1DM (89.17 ± 11.42). However, the mean score for readiness of teachers and the educational system to manage students with T1DM was 48.10 ± 13.22, while the mean self-efficacy score was 30.71 ± 13.67 [30]. In that study, self-efficacy was defined as a person's belief that they can bring about change through their own actions and was measured with a generalized self-efficacy scale, with higher scores indicating greater perceived self-efficacy; self-efficacy scores correlated positively with the percentage of correct answers on the knowledge questionnaire (mean 86.00 ± 9.01% correct; $p = 0.05$) [30].

Practices

Emergency preparedness: in terms of teachers' preparedness to deal with diabetes-related emergencies, studies have reported variable findings. A 2017 study by Al-Duraywish et al. in the Al Jouf region of Saudi Arabia found that only 16% of participants reported having trained personnel at their school to manage diabetes-related emergencies [24]. In contrast, a nationwide cross-sectional study in Saudi Arabia conducted in 2020 reported that 69.1% of participants knew how to perform diabetes management tasks and had previously performed them [25]. Overall, the reviewed studies indicate variation in teachers' preparedness and access to trained personnel for managing diabetes-related emergencies in schools.

Gender differences: gender differences in diabetes-related practices were reported by Aljefree et al. (2023) among Saudi public-school teachers. Female teachers were more likely than male teachers to believe that T1DM was associated with increased student absenteeism (70% versus 54.8%). Among male teachers, older age and greater teaching experience were associated with higher attitude and practice scores, with teachers aged 55-62 years demonstrating significantly higher scores than younger male teachers. Among female teachers, greater teaching experience was significantly associated with higher practice scores. Teachers who reported never smoking also demonstrated higher practice scores regardless of gender [11].

Diabetes management: studies from several countries have reported gaps in the practical management of T1DM in schools, as summarized in Table *2*. In a nationwide Saudi study, only 6.5% of participants reported performing blood glucose testing, 3.0% reported administering insulin, and 11.1% reported managing hypoglycemia. Among students with diabetes, 39.3% had no assistance with glucose monitoring at school, 47.9% had skipped insulin injections because of a lack of assistance, and 38.9% had experienced untreated hypoglycemia [25].

Study	Region	Blood glucose monitoring (%)	Insulin-related practice (%)	Teacher support (%)	Trained personnel (%)
Al Khalifah et al., 2021 [25]	Saudi Arabia (Nationwide)	6.5	3.0	—	11.1
Al Duraywish and Nail, 2017 [24]	Al Jouf, Saudi Arabia	23.9	23.9	90.3	16.0
Al Humayed, 2020 [1]	Abha City, Saudi Arabia	21.2	21.2	95.2	18.4
Aljefree et al., 2023 [11]	Saudi Arabia	30.5/24.9	30.5/24.9	69.5/80.1	34.5/28.4
Stefanowicz-Bielska et al., 2024 [15]	Pomeranian Voivodeship, Poland	56.4	—	—	—
Gutzweiler et al., 2020 [28]	Germany	38.5	33.6	—	—
Mustafa et al., 2022 [32]	Baghdad, Iraq	58.8	45.4	—	—

TABLE 2: Diabetes care practices and support reported in the included studies.

Values are the percentage of respondents in each study reporting the stated practice or support. Definitions and measurement methods differed between studies, so the values are not directly comparable. For Aljefree et al. [11], values are shown as male/female. —: data not reported.

Similarly, in Al Jouf, Saudi Arabia, 90.3% of teachers reported providing support to students with diabetes, while 75.0% reported the absence of trained personnel capable of managing diabetes-related emergencies at their schools. Only 23.9% reported having a trained person at their school who could check blood glucose and administer insulin. In the same study, 93.1% of teachers expressed willingness to participate in diabetes training programs, and 89.4% supported the presence of school nurses [24].

In Abha, Saudi Arabia, 95.2% of teachers reported providing support to students with diabetes, while 47.1% reported that their schools had appointed someone to look after students with T1DM. However, only 21.2% reported having a person trained to check blood glucose and administer insulin, and 18.4% reported having a person trained to manage diabetes-related emergencies [1]. Aljefree et al. (2023) similarly reported that 30.5% of male and 24.9% of female teachers reported having a trained person in their school who could check blood glucose and administer insulin. The corresponding proportions for personnel trained to manage diabetes-related emergencies were 34.5% among male teachers and 28.4% among female teachers [11].

Findings from other countries also demonstrated gaps in practical diabetes management. In Poland, 56.4% of teachers reported knowing how to measure capillary blood glucose using a glucometer [15]. In Germany, 38.5% of teachers reported helping students with blood glucose monitoring and 33.6% reported helping with insulin administration [28]. In Baghdad, Iraq, 58.8% of teachers reported having tried to develop competency in using a glucometer and 45.4% had tried to develop competency in insulin injection. However, only 2.5% had helped a diabetic student with decision-making, and 5.9% had provided immediate emergency help to a diabetic student who had lost consciousness [32].

Overall, the reviewed studies demonstrate considerable variation in the practical management of T1DM in school settings, including differences in teacher involvement, availability of trained personnel, and capacity to perform diabetes-related tasks.

Support for Student Care

Several studies examined the support provided by schools and teachers to accommodate the needs of students with T1DM. In a nationwide Saudi study, 89.4% of teachers reported allowing students to use the bathroom during class, while 88.8% allowed students to eat or drink during class [25]. Similarly, in Baghdad, 78.2% of teachers reported allowing students to take bathroom breaks more than once during class, while 37.0% allowed students to eat meals and snacks anywhere, including in the classroom [32].

Provision of special meals was less frequently reported. In the Saudi nationwide study, 10.2% of male and 6.5% of female teachers reported providing special meals for students with diabetes [25]. Similarly, only 15.2% of schools in Abha and 5.9% of schools in Al Jouf reported providing special meals for students with diabetes [1,24].

Discussion

The literature reviewed demonstrates a consistent gap between teachers' willingness to support students with T1DM and their practical preparedness to provide diabetes-related care. Across Saudi Arabia, Greece, Spain, Germany, Poland, Morocco, India, Iraq, and other settings, teachers generally expressed supportive attitudes, whereas knowledge, confidence, and reported ability to perform specific diabetes-related tasks varied substantially [1,11-15,18,21-32]. This distinction is important because a positive attitude does not necessarily indicate adequate preparedness to recognize and respond to diabetes emergencies or assist with routine diabetes management. This finding is consistent with an integrative review by Parke et al., which identified substantial variation in the provision of T1DM education to school staff and reported that some schools had glucagon available without trained personnel able to administer it [8]. The findings therefore suggest that assessment of school preparedness should extend beyond general awareness of diabetes to include knowledge and practical preparedness for specific diabetes-related tasks.

The review also indicates that experience and personal exposure may be associated with differences in teachers' KAP regarding T1DM, although findings were inconsistent. Several studies reported higher knowledge or KAP scores among teachers with greater teaching experience, older age, previous contact with a student with T1DM, or a personal or family history of diabetes [11-15,21]. For example, Alshammari et al. found that previous contact with a student with T1DM, personal or family exposure to diabetes, and previous training were independently associated with better knowledge [21]. Similarly, Aljefree et al. reported associations between teaching experience and KAP, while Aldekhayel and Stefanowicz-Bielska et al. reported higher knowledge among teachers with greater teaching experience [11,14,15]. However, these findings were not consistent across studies. Statiri et al. reported differences in knowledge according to gender and family history, while Alqahtani et al. found no strong association between years of teaching experience and knowledge; Luque-Vara et al. also reported less positive attitudes among teachers with longer teaching experience [12,17,31]. These inconsistencies suggest that demographic characteristics and experience alone may not be reliable indicators of teachers' preparedness to manage T1DM.

Knowledge of hypoglycemia illustrates the variability in teachers' preparedness particularly well. As summarized in Table *1*, several studies reported relatively high levels of knowledge regarding hypoglycemia symptoms or management, including studies from Saudi Arabia, Spain, and Poland [1,15,21,24,27]. In contrast, substantial knowledge gaps were reported in other settings, including Morocco and parts of Saudi Arabia [18,22,26]. For example, although 74.2% of teachers in southern Spain recognized hypoglycemia symptoms and 85.9% knew how to manage it, only 35.3% of teachers in the Moroccan study correctly identified hypoglycemia [18,27]. These differences may reflect variation in study populations, assessment methods, previous exposure to students with T1DM, and access to diabetes-related training. Importantly, knowledge of hypoglycemia does not necessarily indicate the ability or confidence to intervene during an actual emergency, highlighting the need to distinguish theoretical knowledge from practical preparedness.

Training emerged as one of the most consistent modifiable factors associated with teachers' preparedness to manage T1DM. Teachers who had received diabetes-related education generally demonstrated better knowledge or greater confidence than those without previous training [19-21]. However, the availability of diabetes-related training for school staff remains inconsistent across settings. Parke et al. reported wide variation in the proportion of school staff who had received T1DM training, with substantial numbers of staff in several countries reporting no previous diabetes education [8]. Similarly, Smith et al. noted that only a small number of school-based intervention studies had been conducted, with most focusing on educational or structural approaches to improve diabetes care [9]. These findings are consistent with the variation identified in the present review, where previous training was associated with better knowledge and confidence, but access to formal education and trained personnel varied considerably between settings [1,15,21,24,25].

Evidence from intervention studies suggests that targeted education can improve aspects of teachers' preparedness. The online training study by Bassi et al. demonstrated greater improvements in theoretical knowledge and confidence in daily and emergency diabetes management among trained school staff, including recognition of hypoglycemia and confidence in supporting insulin administration and glucagon use, as well as the management of hyperglycemia [20]. Similarly, Tournilhac et al. reported increased teacher confidence following targeted video training on glucagon administration and insulin injection for hyperglycemia [19]. Edwards et al. also found that educational interventions aimed at children or school staff generally produced short-term improvements in knowledge or confidence, although longer-term follow-up was limited [10]. ISPAD recommends that school personnel receive diabetes education according to their level of involvement with the student, ranging from basic education for all school staff to more advanced, individualized training for personnel directly involved in diabetes care [33]. Taken together, these findings support structured, skills-oriented training rather than reliance on one-time or informal education. Training should therefore be matched to staff responsibilities and include recognition and treatment of hypoglycemia and hyperglycemia, glucose monitoring, physical activity considerations, appropriate escalation pathways, and, for personnel directly involved in diabetes care, skills such as insulin administration and glucagon use [33].

A second major theme is the gap between individual teacher support and institutional capacity. As shown in

Table 2, the proportion of teachers or school staff involved in glucose monitoring, insulin-related care, or other diabetes management tasks was frequently lower than the proportion expressing general support for students with T1DM. The Saudi nationwide study illustrates this gap, with substantial proportions of students reportedly lacking assistance with glucose monitoring, insulin administration, or hypoglycemia management at school [25]. Studies from Germany and Spain similarly identified limitations in school resources, communication, and preparedness for diabetes-related emergencies [6,28,29]. Smith et al. also identified gaps in school-based diabetes support, including the absence of written hypoglycemia action plans, lack of an assigned staff member responsible for diabetes care, and perceptions among parents and teachers that school personnel were inadequately trained [9]. The American Diabetes Association emphasizes that effective school diabetes care requires an individualized Diabetes Medical Management Plan (DMMP), developed by the student's health care provider and used to guide the care and accommodations provided at school [34]. The ADA also emphasizes coordination between families, schools, and diabetes health care professionals, together with appropriate education and training of school personnel [34]. Thus, safe diabetes care depends not only on individual teachers' willingness or knowledge, but also on school-level systems that provide individualized care plans, appropriately trained personnel, access to necessary supplies, clear communication pathways, and adequate support for diabetes management throughout the school day.

The findings should also be interpreted in light of limitations in the available evidence. Much of the literature is cross-sectional and relies on self-reported knowledge, attitudes, confidence, or practices, which may not accurately reflect teachers' performance during real emergencies. In addition, the included studies used different questionnaires, scoring systems, and thresholds for adequate knowledge, limiting direct comparison of findings across regions. Several studies were conducted in single cities or selected school sectors, which may restrict generalizability. The review itself also has methodological limitations. Supplementary searches conducted through Google Scholar and selected journal and publisher websites may have limited reproducibility, as detailed search records and source-specific record counts were not retained. Furthermore, searching selected journal and publisher websites rather than systematically searching all relevant sources may have introduced selection bias.

Geographic variation also remains insufficiently characterized; Parke et al. noted that many studies did not distinguish between metropolitan and rural settings [8]. The intervention literature has also provided limited information on the durability of improvements, with Edwards et al. reporting that most educational interventions demonstrated short-term improvements in knowledge or confidence but lacked longer-term follow-up [10]. The literature also gives relatively limited attention to the practical implications of newer diabetes technologies, such as continuous glucose monitoring and automated insulin-delivery systems in school settings. Future research should therefore use standardized and validated assessment tools, include larger and more geographically diverse school populations, evaluate observed practical skills rather than relying solely on self-report, and assess the long-term retention of training. Studies should also evaluate implementation of school-level diabetes care systems and determine whether these interventions improve student safety, participation, glycemic outcomes, and educational experiences.

Conclusions

This review shows that school teachers generally have positive attitudes toward supporting students with T1DM, but supportive attitudes do not necessarily translate into adequate knowledge, confidence, and practical preparedness. Knowledge is influenced by factors such as previous diabetes-related training, teaching experience, education level, age, and personal or family exposure to diabetes; however, these associations are not consistent across settings. Important misconceptions remain, particularly regarding the causes of T1DM, physical activity, and emergency management. Although many teachers can recognize common symptoms of hypoglycemia and are willing to accommodate students by allowing food, glucose checks, or bathroom breaks, substantially fewer report confidence or competence in tasks such as insulin administration, glucagon use, and blood-glucose monitoring. The evidence therefore highlights a persistent gap between supportive attitudes and the practical skills required for safe school-based diabetes care.

Closing this gap requires coordinated action at both the individual and institutional levels. Formal diabetes education represents an important modifiable factor associated with improved teachers' knowledge and confidence, and training should be appropriate to the level of involvement of school personnel. Schools must also be adequately prepared by ensuring clear protocols, individualized diabetes management plans, access to necessary supplies, trained personnel, and effective communication among teachers, families, school nurses, and diabetes care teams. The available intervention studies indicate that structured educational programs can improve teachers' knowledge and confidence, although evidence regarding long-term effects remains limited. Future research should prioritize standardized outcome measures, long-term evaluation of training, under-studied geographic and school settings, and student-centered outcomes.

Additional Information

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All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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