Evaluating factors affecting diabetes management among teachers and parents of children living with type 1 diabetes

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I, as a corresponding author of the following publication(s), declare that the authors have no conflict of interest, and Maria Dora Horvath Ph.D. candidate had a significant contribution to the jointly published research below:

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ABBREVIATIONS

CGM = Continuous Glucose Monitoring

CSII = Continuos Subcutaneous Insulin Insertion

DAS = Diabetes Attitude Survey

DD = Diabetes Distress

DKT = Diabetes Knowledge Test

FOH = Fear of Hypoglycemia

HbA1c = Hemoglobin A1C

IDF = International Diabetes Federation

LPA = Latent Profile Analysis

MDI = Multiple Daily Injections

PAID = Problem Areas in Diabetes

SMBG = Self-Monitoring Blood Glucose

T1D = Type 1 Diabetes

1. Introduction

Children with chronic illness and their families besides having to bring up, must manage their disease and its treatment. A lifetime of unanticipated medical concerns, potential cognitive disabilities, and/or the financial burden of long-term disease can affect the direction of a child's life and the development of a family in subtle and profound ways. Subjective factors (for example, what the patient and family perceive about the illness and its management) are generally more powerful predictors of disease outcomes than the "objective" measures of the patient's condition. Families, as well as other relevant developmental contexts (for example kindergartens and schools), are viewed as essential and inseparable from children living with a chronic disease in understanding illness and adaptation. The health-related concerns in addition to affecting the child, will also affect parents, siblings, extended family members, classmates, school personnel and the healthcare team. These groups or subsystems engage in mutual interactions with one another, and all of them both influence and are influenced by the child (Roberts & Steele, 2009).

As reported by Engel (1979) understanding illness requires an understanding of the interactions between biology (e.g. genes, viruses), psychology (e.g. mood, behavior) and social factors (e.g. family, society). The level of compatibility between people and their social context is an important predictor of physical and mental well-being (Stokols, 1996). The psychosocial research on the environment of people living with diabetes has shown that the social context is of great importance to clinical, behavioral and psychological outcomes (de Wit et al., 2020). Interpersonal factors such as stigma and discrimination negatively impact self-care, self-esteem and emotional well-being and social support and resilience are beneficial for it (Brakel, 2006; Cohen & Wills, 1985). A systems-oriented framework in psychology assumes a mutual influence between an individual's behavior and the behavior of other participants of the system (Hobbs, 1966). It has been applied to understand the functioning of the child in the family and the school and healthcare network (Power, 2003; Power & Bartholomew, 1987). Kazak and colleagues (1995) describe social ecology as a valuable paradigm for conceptualizing the complex ways in which systems related to the lives of pediatric patients and their families interact to determine growth and adaptability.

The social environment is further nuanced by the social ecology map systems developed by Urie Bronfenbrenner (1979), which provides a framework for understanding the

relationships among the systems surrounding the child (Roberts & Steele, 2009). At the most fundamental level are the immediate settings (or "microsystems") in which a child directly engages, such as the family, school, and healthcare system, as well as subsystems of these settings, such as the parent-child connection or siblings. Multiple microsystems interact to influence a child's development and adaptability at the next level of influence. This "mesosystem" includes family-healthcare team contacts and family-school interactions. While macrosystem factors relate to broader societal influences such as stigma and cultural attitudes. The exosystem pertains to cultural norms, economic policies, societal values, laws and regulations. Therefore, the illness experience of the child is affected by the complex interaction of micro-, meso-, exo-, and macrosystems (Bronfenbrenner, 1979; Roberts & Steele, 2009).

Diabetes affects the whole family and family affects diabetes, since diabetes management-related tasks involve family members, especially parents (Helgeson et al., 2012). Hence it may strongly depend on family functioning (Wysocki et al., 2009). This may be particularly true for younger children, who need to rely on adults or older siblings around them to care for their illness. Family dynamics can affect diabetes outcomes in many ways (de Wit et al., 2020; Eilander et al., 2017; Patterson & Garwick, 1994; Martin et al., 1998). It predicts treatment adherence in children and adolescents with T1D, which predicts metabolic control (Lewin et al., 2006). de Wit and colleagues (2020) found that parental wellbeing also affects diabetes outcomes. The relationship between parental wellbeing and diabetes management is reciprocal. Having a child who lives with a chronic illness, or a disability is related to psychological distress among parents (Patterson & Garwick, 1994). Diabetes management-related psychological factors, as fear of the child having hypoglycemia and distress about diabetes care affect the mental health and wellbeing of parents which will also affect the child's wellbeing and diabetes outcomes (such as HbA1c levels) (Eilander et al., 2017).

Besides their home, children spend most of their time in educational institutions such as kindergartens and schools. These are places for the development and evolvement of academic skills and social, emotional and behavioral functioning. Schools are important settings of peer-peer, teacher-student and parent-teacher relationships, which all may contribute to the mental health, psychological adjustment, and the engagement in education of children (Runions et al., 2020). Teachers are important contributors to the socio-ecology of the school (Farmer et al., 2011). Studies conducted with children have suggested that the quality of the teacher-student interaction may affect psychological adjustment and, more specifically, the lives of students who are marginalized or at risk (Troop-Gordon, 2015). Diabetes management can be most effective by maintaining a partnership among students, parents, school nurses (if they are

available), healthcare providers, teachers and other related school personnel (transportation, food service employees and administrators) (National Association of School Nurses, 2016).

The present dissertation is about two groups of the microenvironment of children living with T1D aged between 5-14 years, parents and teachers, who are present in children's upbringing and are mostly involved in their development. Parents make decisions about diabetes management and provide diabetes care. Regarding them, we investigate psychological factors related specifically to diabetes care. We explore diabetes-related anxiety-like phenomena as fear of hypoglycemia and diabetes distress. To explore these, we use Latent Profile Analysis to create parental profiles of fear of hypoglycemia and see the differences these profiles show regarding diabetes care-related factors. Concerning teachers, we explore the attitudes they show towards diabetes and its management in a qualitative study. Furthermore, we investigate the effect of a short diabetes education on teachers' diabetes knowledge, attitudes towards diabetes, and confidence in managing the condition.

1.1. Theoretical Background

1.1.1. T1D and its management

According to the Hungarian Central Statistical Office's data, in 2019, more than 5,000 children in Hungary were living with type 1 diabetes mellitus, which is one of the most common chronic childhood diseases in Hungary (KSH, 2019). It can develop at any age, but its onset is cumulative before school age and during adolescence, and then decreases steadily with age (Gerő, 2010; Lukács et al., 2021). As Gerő (2010) states the symptoms of the disease are typically acute, with the most common being excessive urination and constant thirst, dehydration, weakness, weight loss and skin itching, but younger children may also experience abdominal pain and vomiting. It is caused by the immune system attacking the insulin-producing beta cells in the pancreas, which destroy these cells completely and permanently deprive the patient's body of its natural insulin supply, which, in its absence, prevents the body's cells from absorbing glucose as their energy source (Gerő, 2010).

Consequently, in the absence of blood glucose regulation, blood glucose levels in the body increase, resulting in hyperglycemia. In the absence of insulin, life cannot be sustained, hence the symptomatic treatment of the disease is necessary (Gerő, 2010; Zóka et al., 2012). The proper management of children's T1D requires basic level of specific knowledge and skills, as it is rather complex and involves invasive procedures (Bechara et al., 2018). It involves a variety

of tasks: regular blood glucose monitoring, insulin intake (the latter two involve learning to use the necessary tools, their ongoing calibration, and maintenance), exercise, and management of hypoglycemia and hyperglycemia, as well as close monitoring of carbohydrate intake (American Diabetes Association, 2004). Several solutions are available to control and monitor blood glucose levels and to administer insulin (Dovc & Battelino, 2020).

The current methods for monitoring blood glucose levels are Self-Monitoring of Blood Glucose (SBGM) and Continuous Glucose Monitoring (CGM) (Snaith & Holmes-Walker, 2021). In the case of CGM, a small body-mounted device takes continuous measurements (every 5-15 minutes), and the associated disposable sensor measures the sugar content of the interstitial fluid and transmits the value to other devices such as insulin pumps and smartphones (Beck et al., 2019; Chen et al., 2020; Olczuk & Priefer, 2018). Insulin delivery can be done by manual injection, injecting insulin into the subcutaneous fat layer (Frid et al., 2016), or by a specially designed pen-shaped delivery device requiring (Multiple Daily Injections - MDI) that is pre-filled with the appropriate amount of insulin. The internal cartridge of the insulin pen can be disposable and refillable (Kesavadev et al., 2020). Its use is much simpler than injections because it is easy and quick to learn (Pearson, 2010). The other method of insulin delivery is Continuous Subcutaneous Insulin Insertion (CSII), which automatically delivers basal insulin at the right rhythm and in the right amount. This requires a needle to be inserted continuously under the skin, an insulin pump to be worn by the patient, and the proper calibration of the device (Dovc & Battelino, 2020; Nimri et al., 2020).

1.1.2. T1D management and parents' mental health

Tasks of diabetes management are challenging for children, especially when it comes to modern insulin regimens (Driscoll et al., 2015). Parents usually primarily take care of diabetes management tasks for them. The management poses several unique challenges for parents concerning their everyday responsibilities, continuous supervision, and caregiving (Iversen et al., 2018). These difficulties include physical growth and blood glucose monitoring, adjustments in insulin administration, changes in food preferences, unpredictable physical activities, and the constant need for supervision and care (Streisand & Monaghan, 2014). Taking care of diabetes management tasks for their children living with T1D may also be psychologically challenging for parents (Helgeson et al., 2012). The International Society for Pediatric and Adolescent Diabetes (ISPAD) stated that diabetes management could mostly be affected by psychosocial factors (Amiri et al., 2018; Delamater, 2009; ISPAD,2000).

Parents often experience severe concerns about their child's health (Amer, 2008; Ginsburg et al., 2005), with feelings of guilt and worry potentially leading to depression and anxiety (Frank, 2005; Kovacs et al., 1985). One-fourth of mothers and fathers meet DSM-IV criteria for posttraumatic stress disorder six weeks after the diabetes diagnosis of their child (Landolt et al., 2002). Parents struggle to maintain optimal blood glucose levels and often feel like failures if targets are not met (Wennick & Hallström, 2006). Moreover, regularly causing pain while administering insulin adds to their experience of stress (Hatton et al., 1995; Marshall et al., 2009). Mealtimes and nighttime blood glucose monitoring seem to be more stressful for them than other parts of the day (Mullins et al., 2004; Powers et al., 2002). The responsibility for their child's life, constant monitoring, and worries about health and developmental transitions further contribute to stress (Bowes et al., 2009). As a result, parents often experience isolation and burnout (Hilliard et al., 2015). These aspects must be addressed because parental stress and burnout serve to obstruct the proper family management of type 1 diabetes in children (Streisand et al., 2005; Thompson et al., 2001). The psychological distress is associated with higher stress and more depressive symptoms in children (Chaney et al., 1997; Mullins et al., 2004), problematic child behavior (Hilliard et al., 2011), and lower quality of life (Jaser et al., 2008).

1.1.3. Parental diabetes distress

Diabetes distress (DD) is a normal emotional response to diabetes and its consequences (Berry et al., 2015; Fisher et al., 2014). DD is a continuum rather than a strictly defined concept. It encompasses a wide range of emotions: concerns, doubts, fears about the chronic disease and its complications (Fisher et al., 2010), as well as the burden of self-care, interpersonal difficulties and relationships with health professionals (Polonsky et al., 2005). DD has been associated with less than optimal glycemic control, affecting patients' self-care, adherence and is associated with elevated hemoglobin A1c (Fisher et al., 2012). These may increase the likelihood of complications and healthcare costs (Lawrence et al., 2006; Leichter & See, 2005; Yi et al., 2008). The association may also occur reversed, as glycemic control deteriorates, the likelihood of psychological problems increases even more (Hassan et al., 2006). Distress can also be influenced by environmental factors such as the family environment and, in children, the emotional attitude of parents towards the disease (Hessler et al., 2016; Jaser et al., 2008; Markowitz et al., 2012).

Some amount of stress may benefit diabetes management as it can facilitate the motivation of parents (Stallwood, 2005). However too much stress might be overwhelming and may result

in demotivation and feeling helpless (Streisand et al., 2005). According to Whittemore and colleagues (2012) anxiety in parents contributes to increased maternal control, overprotectiveness, lower self-efficacy and it might reduce parent's capacity to learn management tasks. Parental anxiety and depression have differential effects on family communication, conflict, adaptability, and parental involvement in T1D management, all of which are important for proper diabetes management and family functioning. Some parents find ways to manage their stress (for example by developing routines or finding support) but if they cannot, they might develop significantly high psychological symptoms, like depression, anxiety, posttraumatic stress (Whittemore et al., 2012).

1.1.4. Parental fear of hypoglycemia

Parents might feel the need to constantly pay attention to determine the meaning of child behavior that could be indicative of hypoglycemia or hyperglycemia (Sullivan-Bolyai et al., 2003). The fear of hypoglycemia (FOH) is the anxiety and concern in both patients with diabetes and their family members caused by the discomfort of hypoglycemia, the possibility of long-term complications, and the unpredictability of such episodes (Driscoll et al., 2016; L. Gonder-Frederick et al., 2011; Tully et al., 2022). The construct of FOH includes conditioned fear responses to perceived or real signs of hypoglycemia, and corrective or preventive behaviors that in more severe cases may result in phobic avoidance (Green et al., 2000; Przezak et al., 2022). Given that, at times, hypoglycemia may be a necessary condition of treatment, the level of fear can be considered adaptive up to the point where it stimulates appropriate corrective action (Cardinali et al., 2021). Excessively low level of fear is not optimal either, as it can lead to underestimation or ignoring of symptoms. It is also likely that parents who are actively involved in their child's treatment may experience severe hypoglycemic episodes as traumatic and may develop FOH (Anderbro et al., 2015).

Higher levels of fear may lead to disadvantageous coping strategies (Patton et al., 2007). Parents may take steps to manage their child's illness to reduce their own anxiety which might be harmful (Wild et al., 2007). Fear can lead to over compensatory behaviors in parents, such as overfeeding or administering less insulin to keep their child's blood glucose levels higher than recommended. These actions are detrimental to the child's body, as they result in poorer blood glucose control, increasing the likelihood of diabetes-related health complications and may also lead to obesity (Marrero et al., 1997). In addition, less effective blood glucose control makes the development of another hypoglycemic episode more likely, so a parent's fear and desire to protect their child can lead to a vicious circle (Wild et al., 2007). It is common for

parents to be overly fearful and not allow their child to physically move away from them, which can also hinder their child's healthy psychosocial development (Clarke et al., 1998). FOH is significantly associated with pediatric parenting stress and higher level of parenting pressure (Amiri et al., 2018; Viaene et al., 2017; Youngkin et al., 2021; Zhang et al., 2022).

Parents' FOH is assessed using the most common questionnaire, the Hypoglycemia Fear Survey-Parents (HFS-P). The HFS-P is a 25-item questionnaire adapted from the original HFS questionnaire for parents of children and adolescents aged 8 and over. Like the HFS, the HFS-P also consists of two subscales. The worry subscale scores reflect parents' concerns about hypoglycemia, and the Behaviour subscale measures adaptive and maladaptive behaviours that parents use to avoid their child's hypoglycemic episode (Clarke et al., 1998; Cox et al., 1987; L. A. Gonder-Frederick et al., 2006; O'Donnell et al., 2022; Shepard et al., 2014).

The following two studies created subgroups within a population of people living with T1D using FOH as one of the grouping variables. Anderbro and colleagues (2015) aimed to investigate the relationship between fear of hypoglycemia (FOH), psychological symptoms (anxiety and depression), and diabetes related factors (severe hypoglycemia history, HbA1c) in adults with type 1 diabetes. They included 764 patients who completed the HFS and other psychological measures like the Perceived Stress Scale and the Hospital Anxiety and Depression Scale. They categorized patients into subgroups based on FOH and severe hypoglycemia risk (SHR) levels. The groups included (1) High FOH, High SH Risk, characterized by frequent hypoglycemia and high anxiety; (2) High FOH, Low SHR, marked by high anxiety despite low hypoglycemia risk; (3) Low FOH, Low SHR, with higher A1c levels and lower hypoglycemia frequency; and (4) Low FOH, High SHR, showing lower anxiety and depression scores but higher SHR. Subgroups showed differences in non-diabetes-related anxiety and hypoglycemia history among other factors.

Maclean and colleagues (2022) involved 178 individuals with type 1 diabetes (49 % of which had risk for severe hypoglycemia) in their study. They used the Hypoglycemia Fear Survey-II (HFS-II), the Hyperglycemia Avoidance Scale (HAS), Problem Areas in Diabetes (PAID), Attitudes to Awareness of Hypoglycemia (A2A), which measures the cognitive barriers to hypoglycemia avoidance and The Single-Item Gold Score of Hypoglycemia Awareness to compute k-means clustering analysis. They found four distinct clusters. Cluster 1 included individuals with preserved hypoglycemia awareness and low fear and low cognitive barriers. Cluster 2 including those with preserved awareness but high fear, distress, and increased Ran High behaviors. Cluster 3 consisted of individuals with impaired hypoglycemia awareness, low fear and high cognitive barriers. Cluster 4 featured impaired awareness with

high fear, low cognitive barriers. They also identified four HFS-II factors based on reactions shown to hypoglycemia with exploratory factor analysis. These include "Sought Safety," which is associated with actions taken to ensure help available during hypoglycemia, and "Restricted Activity," which is linked to avoiding normal activities due to hypoglycemia risk. While the "Ran High" cluster includes behaviors aimed at maintaining higher blood sugar to avoid hypoglycemia, the "Worry" cluster focuses on concerns about social embarrassment related to hypoglycemia. They found that Sought Safety, Restricted Activity and Worry increased with recurrent severe hypoglycemia.

In the study we conducted among parents we use a different method (latent profile analysis (LPA)) for identifying subpopulations within our sample with the involvement of the worry and behaviour subscales of HFS-P.

1.1.5. Factors influencing the level of FOH

Parents' and children's age and frequency and severity of hypoglycemic episodes

As the following studies show, parental FOH may be influenced by both parents' and children's ages, and the frequency and severity of hypoglycemic episodes. Aalders et al. (2018) found that older parents exhibit less FOH. While some studies suggest that parents of older children take more preventive actions against hypoglycemia (Haugstvedt et al., 2015; Herbert et al., 2015; Pate et al., 2019; Shepard et al., 2014). Other research indicated that parents of younger children experience higher FOH (Herbert et al., 2015; Patton et al., 2017). However, several studies found no age-related differences in parental FOH (Aalders et al., 2018; Abitbol & Palmert, 2021; Haugstvedt et al., 2015; Van Gampelaere et al., 2019; Van Name et al., 2018; Viaene et al., 2017; Youngkin et al., 2021). Gonder-Frederick and colleagues (2011) noted higher FOH behavior scores in mothers of younger children, hypothesizing that increased child maturity and involvement in diabetes management reduces parental fear. Anderson and colleagues (1990) confirmed that as children age and take more responsibility for their diabetes, parental fear decreases.

There are contradictions in the literature about the associations between parental FOH and the frequency and severity of hypoglycemic episodes. Some studies found no association between the frequency of children's hypoglycemic episodes and parental FOH (Amiri et al., 2018; Haugstvedt et al., 2015; Hawkes et al., 2014; Shepard et al., 2014; Van Name et al., 2018) and some found that frequency of hypoglycemia is positively correlated with the total score of HFS-P and the worry subscale (Abitbol & Palmert, 2021; Haugstvedt et al., 2010). As for the severity of hypoglycemic episodes the results in the literature are similarly contradictive. Some

studies showed no associations (Aalders et al., 2018; Haugstvedt et al., 2010; Hawkes et al., 2014; Muradoğlu et al., 2021; Van Name et al., 2018), whereas others showed positive correlations between severity of episodes and parental FOH (Abitbol & Palmert, 2021; S. R. Johnson et al., 2013; Pate et al., 2019).

Self-efficacy of parents

Self-efficacy refers to beliefs about the ability to perform the actions required to achieve a given performance, goal, or behavior change (Bandura, 1977, 1986). According to Urban (2017) people who have higher perceived self-efficacy devote more attention and more effort to performing an action than people with low-level of self-efficacy. Within the field of health psychology the concept is usually defined in relation to specific health behaviours (Urban, 2017). Parental self-efficacy related to diabetes management can be defined as parent's beliefs about their ability to take care of their child's diabetes (Streisand et al., 2005). According to Amiri and colleagues (2018) research on self-efficacy related to diabetes management is limited (McMahon et al., 2005; Mitchell et al., 2009; Streisand et al., 2005). Low level parental self-efficacy is related to high level of FOH (Herbert et al., 2015; Pate et al., 2019). Clarke and colleagues (1998) found no correlation between maternal FOH and mothers' confidence in their ability to recognize their child's symptoms and act appropriately during a hypoglycemic episode.

Among parents of children with T1D, we examine psychological factors specifically related to diabetes management. We investigate diabetes-related anxiety phenomena, such as fear of hypoglycemia and diabetes distress. Using LPA, we identify parental profiles based on their fear of hypoglycemia and analyze how these profiles differ in relation to diabetes distress, self-efficacy, perceived diabetes management problems, demographical and diabetes management related data (e.g.: time spent in diagnosis, number of hypoglycemic episodes**)**.

1.1.6. Diabetes management in schools and kindergartens

According to Pansier and Schulz (2015) children with T1D and their parents might often need help from school staff or teachers. They face challenges and difficulties in school and kindergarten, which mostly come from the lack of informed and trained staff, the absence of nurses or the lack of diabetes care policies in schools. Deficient diabetes management in schools may cause several troublesome consequences, such as absenteeism, stress or depression, poor performance and low quality of life (Pansier & Schulz, 2015). While some schools have professional medical support, such as school nurses, the availability varies. For example, the MOCHA project found that Norway and Estonia have around 1.4 school nurses per 1000 pupils,

Finland 1.2, and Iceland 0.9 (van der Pol et al., 2020). Many schools lack adequate support for children with T1D. The Dawn Youth Study found that the availability of nurses and diabetes training was inadequate in most schools across 24 countries (Lange et al., 2009).

Children with T1D who make negative attributions of teachers' reactions regarding self-care efforts have more difficulties related to adherence in school situations and they experience more stress (Hains et al., 2009). They may feel unconfident about their condition in the school setting and avoid performing management tasks to evade undesirable attention and notions of feeling "different" from peers (Wang et al., 2013). Therefore, teachers are important contributors to the appropriate socialization of children and might support them in the tasks related to diabetes management and in the psychological processes related to living with the disease (acceptance of the disease, peer education and sensitization).

1.1.7. Teachers' attitudes towards diabetes and its management

Teachers play a crucial role in managing diabetes in schools and kindergartens, assisting with specific aspects of management for younger children and influencing the effectiveness of self-management through their approach and attitude for older, self-managed children (Pansier & Schulz, 2015; Tolbert, 2009). Several studies have investigated teachers' perceptions and attitudes towards diabetes care (Alzahrani, 2019; Boden et al., 2012; Carral San Laureano et al., 2018; Gökçe et al., 2021). These studies used quantitative tools and got divergent results (e.g. for willingness to participate in management) which calls for further investigation of the subject.

Allport (1935) defines attitude as a mental and neural state of readiness, organised along experience, which has a dynamic or directive effect on an individual's response to objects and situations. According to Rosenberg and Hovland (1960), attitude is composed of three main components: cognitive, affective and behavioral. An individual's attitude can be described in terms of the knowledge acquired by a person, the approaches and emotions associated with it, and the patterns of his or her behavior (Allport, 1935; Fabrigar et al., 2005; Hovland & Rosenberg, 1960). To process new knowledge and to form a related attitude, we draw on previous experiences and established attitudes (Fabrigar et al., 2005).

Holmström et al. (2018) investigated school personnel's experiences caring for youth with T1D through interviews with 24 staff members working with children aged 6 to 18. They characterized their experience as "being facilitators in a challenging context" (p. 116), feeling uncertain and overwhelmed by the never-ending, unclear responsibilities. The teachers had to find their own way to cope with these difficulties and challenges. They found strategies to

support self-care and established trusting relationships with the youth and their parents. This study also highlighted the need for educating school personnel and nurse specialists. Luque-Vara and colleagues (2021) used questionnaires to investigate perceptions and attitudes towards diabetes care among 441 teachers. Half of those surveyed stated that their educational institution was unprepared to handle diabetes related situations. 4.8% of the participants stated that they had attended a diabetes education program before, 29.9% had seen a hypoglycemic episode at their institution and 44.6% said they would be willing to administer glucagon to student if it was needed. In conclusion, the authors also state that there has been little research on this topic.

Among non-diabetic people, higher levels of diabetes knowledge and higher level of education are associated with positive attitudes towards diabetes (Alemayehu & Sisay, 2021; Alzahrani, 2019). In a study of Tannous and colleagues (2012) teachers showed a moderate level of diabetes knowledge (mean was 0.66 out of 1.00) together with favorable attitudes (with higher than average mean of 4.05 out of 6) towards students with diabetes. These findings suggest that attitudes towards diabetes can be modified by increasing diabetes knowledge. Positive attitudes can promote effective diabetes management, hence, attitude change through education may contribute to ensuring that children with diabetes receive appropriate care in schools (Alemayehu & Sisay, 2021; Alzahrani, 2019). As Dunn (1988) quotes: „Education is a form of treatment for diabetes!" (p. 493). The quote is about patient education; however, it can also be extended to the education of the social environment of patients. From the perspective of teachers, a diabetes education program may help to improve the health management of children with T1D and increase the efficiency of their care.

1.1.8. Diabetes knowledge of teachers

A Spanish study showed that while 43% of teachers had taught children with diabetes, only 0.8% had received specific training (Carral San Laureano et al., 2018). Many teachers are unaware of the distinctions between type 1 and type 2 diabetes, are unable to detect typical symptoms such as nausea and have a variety of misconceptions about diabetes (Bechara et al., 2018). Jarrett and colleagues (1993) also found that teachers have inadequate knowledge about the condition. Tolbert (2009) after reviewing 11 articles focusing on the improvement of diabetes management in schools noted the need for improvements in communication, after-school support, staff and peer education, school nurse availability, and lunch choices. The American Diabetes Association (2011) recommends training school personnel in diabetes care and allowing students to monitor and treat blood glucose levels in the classroom.

1.1.9. Diabetes education of teachers

There are several intervention studies in the literature using diabetes education among teachers each utilizing different methodologies, these are described in the following paragraphs.

Gesteland and colleagues (1989) compared three groups: one received an educational session, a 13-minute video, and handouts; another group learned independently using an 8-10 week curriculum; and a control group received no education. The first two groups completed a 22-item diabetes knowledge questionnaire before and 8-10 weeks after the intervention, and the control group completed the questionnaire once. The results showed that both educated groups performed better than the control group at the second measurement, but their improvements after the intervention were not statistically significant. These findings suggest that mass education alone may not be an effective method for improving diabetes knowledge among primary school teachers.

Other studies have explored more interactive and tailored educational approaches. Jarret and colleagues (1993) organized a parent-led training session for teachers. Parents received a two-hour training about what knowledge to pass on to teachers and teachers received a 20-30 minute session from parents with informational materials. The teachers' diabetes knowledge was tested immediately before and 6-8 weeks after the training, showing significant improvements post-education. Siminerio and Koerbel (2000) provided 1-1.5 hour lectures to 156 school staff members, measuring diabetes knowledge with a 10-question test before and after the education. The lectures taught about the causes of onset, grouping, complications (acute and chronic), management, and treatments. The post-education scores were significantly higher, indicating the effectiveness of the lectures. Similarly, Dixe and colleagues (2020) conducted a study with 131 school staff who met children with T1D in their daily work, using two 3-hour sessions with face-to face attendance to cover theoretical and practical modules. Post-training, there were significant increases in both knowledge and confidence scores.

The KiDS and Diabetes in Schools program (IDF, 2014) is another significant intervention tool designed to improve diabetes understanding and management in schools. The curriculum addresses numerous issues that children with diabetes experience at school and aims to promote general diabetes understanding. The part of the program on type 1 diabetes focuses on the needs of pupils at school and includes a simple diabetes management plan. Bechara and colleagues (2018) evaluated its effectiveness, involving training sessions for 9944 students, 236 staff members, and 32 parents, followed by interviews with 42 adults. The study found that 56% of school staff had not previously heard of diabetes in a school context, but after the training, 82%

reported changed attitudes, 32% felt more willing to be involved in diabetes care, and 38% felt confident to approach families about diabetes care. The KiDS program has also been successful in diabetes education according to another qualitative study (Chinnici et al., 2019).

Interactive eLearning programs have shown promise as well. Taha and colleagues (2018) assessed an online program with 124 public school employees, using a diabetes knowledge questionnaire before and after the program, and then at 6 and 12 months post-education, adding confidence measurements at these later points. Their program was based on three modules: knowledge, skills, and recommendations. Following the post-test, participants attended a workshop to develop skills for diabetes management. The program significantly improved both knowledge and confidence, with sustained improvements over time. Gutierrez and colleagues (2020) analyzed the impact of the "Diabetes Care at School: Bridging the Gap" program, which included 12 online modules. They assessed knowledge and self-efficacy among 132 participants (nurses, teachers, principals, bus drivers and food service staff, 31 % had diabetes training the past year and 69 % did not). The program contained of diabetes awareness training for general staff, non-medical personnel training, and advanced training for school nurses. They found significant improvements in knowledge and confidence, especially among non-medical personnel. Furthermore, the post-test scores of those with no prior diabetes training were almost equivalent to those with prior diabetes training.

Zimmermann and colleagues (2022) evaluated a virtual diabetes education program with 67 school personnel, measuring feasibility, acceptability, and efficacy through pre- and post-training assessments. 71 % of participants were school nurses and 29 % were teachers, clinic assistants, or other school staff. Post-test scores demonstrated mean improvement on the diabetes technology subscale, the basic management subscale, and the ketone management subscale. 92% of the participants reported they benefitted from the training. This study found that virtual training is feasible for delivering diabetes technology education to school staff. Husband and colleagues (2000) investigated the impact of a commercially available educational material on teachers' diabetes knowledge, "Type 1 Diabetes in Children: A Passport to Knowledge", available on CD-ROM. They studied teachers who taught students with diabetes. They assessed participants' diabetes knowledge before and after the education using a 17-question, self-developed test-like questionnaire. No significant differences in the subjects' diabetes knowledge were found. They explained their findings with the training being less interactive and not specifically designed for teachers.

These studies underscore the necessity for tailored, interactive, and comprehensive diabetes education programs for school staff to effectively manage diabetes in educational

settings. Structured education programs, whether in-person or online, have been shown to significantly improve diabetes knowledge and confidence among school personnel, emphasizing the importance of such initiatives in supporting children with diabetes.

2. Aims

As a framework this dissertation investigates diabetes care-related psychological factors which are examined among two types of stakeholders within the microenvironment of children living with T1D: parents and teachers. As the primary caregivers and educators, parents and teachers are the groups most frequently interacting with and nurturing children with diabetes. Three studies were conducted: the first study was conducted among parents, while the second and third studies focused on teachers. We examined the experiences and attitudes of parents and teachers towards diabetes management. The following aims were set for the studies:

Aim 1:

In the first study we investigate psychological factors related to diabetes care among parents. We aim to identify profiles related to the behavioral and anxiety-related reactions to hypoglycemia, since preventing hypoglycemia is one of the key elements of diabetes care. Furthermore, we analyze the differences the profiles show regarding additional diabetes-care related factors, such as diabetes distress, self-efficacy, perceived diabetes management problems, demographical and diabetes management related data (e.g.: time spent in diagnosis, number of hypoglycemic episodes**)**.

Aim 2:

In the second study, we use a qualitative interview method to explore teachers' attitudes towards diabetes care and their interpretations of their roles in supporting children living with T1D in schools and kindergartens. We included teachers of kindergartens, primary schools and high schools and assistant teachers as well.

The following research questions guided the study:

1) How can teachers' attitudes towards diabetes care be described within the framework of the three components of attitude?
2) How do teachers perceive their own role in the support of children living with T1D?

Aim 3:

The aim of the third study is to investigate the effects of a short, standardized education program on teachers' diabetes knowledge and attitudes and their confidence in diabetes care. We created the education in two forms: in-person and online. We measure the differences in the efficiency of the program between the two platforms. We hypothesize that a short diabetes education program increases diabetes knowledge and has positive effects on diabetes attitude and on confidence in diabetes care. Furthermore, we expect the effects to be stronger and more positive in person than online.

3. Methods

3.1. Parental fear of hypoglycemia, diabetes distress and self-efficacy related to diabetes management

3.1.1 Participants

A total of 403 parents who primarily took care of diabetes management in their family completed the questionnaire. Key demographic and diabetes-related data of our sample are shown in Table 1.

Gender of parent	***N***	**%**
Male	22	5.5 %
Female	381	94.5 %
Gender of child living with T1D		
Male	222	55.1 %
Female	181	44.9 %
Highest level of education		
Primary school	5	1.2 %
High school	96	23.8 %
Technical qualification	50	12.4 %
Advanced qualification	53	13.2 %
College or university degree	195	48.4 %
PhD	4	1.0 %
Family status		
Single	10	2.5 %
Divorced	29	7.2 %
Married	287	71.2 %
In a relationship	73	18.1 %
Widow	4	1 %
Tool used for insulin administration		
MDI	257	63.8 %
CSII	146	36.2 %
Tool used for measuring blood glucose levels		
SMBG	89	22.1 %
CGM	313	77,8 %
	Mean (SD)	**Range**
Age of parent in years	41.5 (5.7)	25-57
Age of child living with T1D in years	9.83 (2.74)	5-14
Years spent in diagnosis of T1D	3.25 (2.71)	0.08-13
HbA1c based on self-report	7.09 (0.961)	4.4-11.7

Table 1. Key demographic and diabetes-related data of our sample

3.1.2 Study measurements

Hypoglycemia Fear Survey- Parent version (HFS-P)

The first part of the Hypoglycemia Fear Survey measures the fear of hypoglycemia that parents of children living with T1D experience. All items are rated on a 5-point Likert scale (0 . "never" to 4 . "almost always"). It has three subscales. The Maintain High Blood Glucose subscale assesses the extent to which an individual engages in behaviors to prevent hypoglycemia by purposefully maintaining blood glucose levels higher than medically recommended. The Helplessness/Worry About Low Blood Glucose subscale assesses worry about hypoglycemia and related feelings of helplessness such as having a low blood glucose while asleep. The Worry About Negative Social Consequences subscale assesses worry about social consequences of hypoglycemia such as the child doing something embarrassing. Items are summed to create an overall hypoglycemia fear score. The Cronbach alfa of all the items on our sample was 0.892. The second part of the survey contains questions regarding the history of hypoglycemic episodes (severe hypoglycemic episodes in the past 12 months, moderate episodes in the past month and mild episodes in the past week) and how upsetting parents found these episodes. For all of these, respondents marked their answers on a scale of 0-9. Furthermore, parents also report the last HbA1c value and the target range of blood sugar level of the child (Cox et al., 1987; Gonder-Frederick et al., 2006; O'Donnell et al., 2022; Shepard et al., 2014). The questionnaire was used with the author's consent (Shepard et al., 2014). The translation of the questionnaire was carried out according to the method specified by the author: three independent experts translated the questionnaire, and the translations were then reconciled. The reconciled version was back-translated and approved by the original author.

The Problem Areas in Diabetes-Parent (PAID-P)

The PAID-P measures diabetes-specific emotional distress related to the daily care demands parent with children living with T1D face. It is scored using a 6-point Likert scale (1.Not a Problem, 6.Big/Serious Problem). Responses target how much each diabetes-related experience bothers/upsets the individual respondent over the past month. It has two subscales: emotional burden and child regimen specific distress. Items are summed to create an overall distress score, with higher scores indicating greater emotional distress (Evans et al., 2019). Cronbach alfa on our sample was 0.935. We used the questionnaire with the author's consent. The translation of the questionnaire was carried out according to the method specified by the author: three independent experts translated the questionnaire, and the translations were then reconciled. The reconciled version was back-translated and approved by the original author.

Self-efficacy related to diabetes management and perceived diabetes management problems

Parents rated their level of knowledge about diabetes management to indicate subjective diabetes management competence. This is a self-developed custom-designed questionnaire that we used in a previous study conducted with parents of children with T1D (Buzas et al., 2023). Five statements about self-efficacy related to diabetes management probed the commitment levels of the respondents to the treatments they used and the extent of their trust in their abilities to manage these tools (example of a statement: "I can effectively treat my child's diabetes"). Cronbach-alfa of the scale in our sample was 0.806. The perceived diabetes management problems were determined via participant ratings of how problematic they considered the following three issues within three items: controlling the blood glucose level, managing insulin delivery devices, and adapting to lifestyle changes precipitated by diabetes (example of a statement: „Controlling blood sugar levels by night."). Cronbach alfa in our sample was 0.732. Each of these factors are quired by five statements that required participants to evaluate the extent to which they agree with each statement on a five-point Likert scale (Buzás et al., 2023).

3.1.3. Data Collection

The questionnaire was completed by parents of children with type 1 diabetes aged 5-14 years. Recruitment was done online and by contacting diabetes clinics. Sampling was completed by both online and paper-based methods. Data were collected by psychology students and the author of the doctoral dissertation. Completion was entirely voluntary, respondents were informed of the purpose of the study and assured that completion would be anonymous and data would be kept confidential. By accepting the information and completing the form, participants gave their consent to participate in the research. Respondents did not receive any monetary or other compensation for completing the survey. The completion of the survey took on average 30 minutes. The study was approved by the Scientific and Research Ethics Committee of the Health Sciences Council (IV/9901-1/2021/EKU).

3.1.4. Data Analysis

The data were processed using the statistical software Jamovi (Version 2.5) (Jamovi, 2024). A p-value of <0.05 was accepted as a statistically significant difference. Confirmatory factor analysis was used to confirm the factor structure of the HFS-P questionnaire. The degree of goodness of fit of the factor structure of the test was indicated by the CFI, TLI, and RMSEA indicators. We then examined the psychometric properties of the full scale as well as the subscales, e.g., the internal reliability using Cronbach's α. After checking the sample for

multivariate outliers, we used the factor scores as indicator variables for Latent Profile Analysis (LPA). LPA focuses on identifying latent subpopulations within a population based on a set of variables. It assumes that people can be classified with different degrees of probability into categories that have different configural profiles of personal and/or environmental characteristics. It identifies and compares profiles of individuals with similar variable patterns with other profiles (Spurk et al., 2020). LPA was conducted using the freeware statistical software Jamovi with the module snowRMM (Seol, 2020/2024) that utilizes tidyLPA R-package (Rosenberg et al., 2019). The different solutions were compared based on multiple statistical fit indices. Better model fit was indicated by lower levels of the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), and a non-significant bootstrap likelihood ratio test (BLRT) in the successive model. We considered BIC and BLRT the most applicable indices in identifying model fit (Tein et al., 2013). We interpreted latent profiles based on their characteristic means on the indicator variables (factor scores).

3.2. Exploring Teachers' Attitudes and Roles in Supporting Children with T1D: A Qualitative Analysis

3.2.1. Participants

A convenience sampling method was employed to approach the 30 teachers who were included in the study. The participants were reached with the help of school and kindergarten psychologists and a diabetes educator. Other participants were reached through advertisements. Approximately 110 teachers were reached and 30 of them agreed to participate in an interview, hence the response rate was 27 %. The participants did not receive any compensation. The research has been approved by the Human Investigation Review Board at the University of Szeged Albert Szent-Gyorgyi Clinical Center (Ethics Opinion 199/2019-SZTE).

See participants characteristics in table 2. Working directly with a child with diabetes during the course of their work meant that it was in their class or was sometimes under their supervision. Experience with managing diabetes meant that the participant had diabetes (T1D or T2D) or had a spouse living with T2D or child living with T1D. In terms of educational attainment, all participants held advanced degrees (university or college degrees). We continued to conduct the interviews until data saturation was reached (Wu et al., 2016).

Gender	*N*	%
Male	4	13.3 %
Female	26	86.7 %
Age they work with		
Kindergarten	15	50%
Primary or high school	15	50%
Working directly with child with T1D		
Yes	19	63.3 %
No	11	36.7 %
Experience with manageing diabetes		
Yes	7	29.2 %
No	17	70.8 %
Received diabetes education		
Yes	15	50%
No	15	50%
	Mean (SD)	**Range**
Age in years	42.9 (20)	23-63

Table 2. Participant characteristics

3.2.2. Study measurements and data collection

Interview questions and procedure

We started to collect data by conducting focus group interviews. These interviews were led by the doctoral candidate and one of the supervisors (a health psychologist researcher) and with the use of a semi-structured questionnaire guide. Firstly, we aimed to explore the participants' shared and specific experiences and opinions of the subject. We also used these interviews to format the interview guide of the individual interviews. We conducted three focus group interviews: one with six participants and two with two participants. In addition, to get more depth and detail on the topics that appeared in the group interviews 20 individual interviews were conducted. The participants were provided with detailed information about the topic of the interview, the method of transcription, data analysis, and anonymization. Subsequently, they gave written consent to participate. Audio-recording was used to record the interviews, for which consent was also obtained verbally from participants.

Interview guide

The interview guide consisted of questions within five subjects. We asked the participants about their experiences with diabetes: these questions were about having had people with diabetes in their environment or during their jobs. Within the subject of diabetes-related knowledge they had to rate their diabetes knowledge from 1-10 and we asked them about facts regarding diabetes and where they got their knowledge from. The third subject was about how teachers perceive the options for diabetes care within the institution they work in. We inquired

how the care of children with diabetes is managed in the institution and which diabetes management tasks are teachers involved in. Furthermore, we questioned them about the attitudes the peers show towards children with diabetes. The fourth subject focused on the solutions teachers think would be suitable for the problem of the management of diabetes in the institution. Finally, to conclude the interview we asked them if they wanted to add something to the subjects and how they felt during the interview. See table 3 for the interview guide used in the interviews.

The individual interviews were led by a PhD student psychologist (first author) and a diabetes educator (third author).

I. Experiences with diabetes:
• Do you have/have you ever had diabetes in your close or distant environment?
• What is your idea of what everyday life is like for someone with diabetes?
• Is there a child with diabetes in your current or previous work environment?
II. Diabetes-related knowledge:
• What do you know about diabetes?
• What types of diabetes do you know?
• What are the symptoms of diabetes?
• In kindergarten/school, what are some of the behaviors that can manifest symptoms of diabetes?
• What causes diabetes?
• How does diabetes develop?
• How can diabetes be managed/treated?
• What treatment tools do you know?
• Who is involved in the care? (usually for someone with diabetes, not just in school)
• Where did you get your knowledge about diabetes from (friends, media, education, internet...)
III. Options for diabetes care within school/kindergarten:
• How is diabetes managed in the kindergarten/school?
• What daily activities are important in relation to diabetes care in school?
• How do you see peers relating to a child with diabetes?
• What specific knowledge/skills does the teacher need if there is a child with diabetes in the group/class?
• What are the difficulties/barriers to diabetes care within the school? What could be a solution or help to overcome these difficulties?
• Would you participate in a diabetes education session?
• Who within the school staff can be affected by diabetes?
• How are parents contacted about diabetes?
• What can parents do to facilitate diabetes care for teachers?
IV. Possible solutions to the issue of T1D in schools/kindergartens:
• What do you think would be an ideal solution to the situation of children living with T1D in school/kindergarten?
• What realistic/potential/achievable solution do you see?
• How do you see what you can do to help diabetes management in the school/kindergarten?

Table 3. The interview guide

3.2.3. Data Management and Analysis – Thematic Analysis

Each of the interviews were transcribed by the researcher who conducted it. The interviews have been typed verbatim, and anonymously (excluding identifiable data). Details about the participants behaviors were also indicated in transcriptions.

In the present study, a thematic analysis (Braun & Clarke, 2006; Joffe, 2012) for narrative interviews (Riessman, 2008) was applied to the dataset of the interviews. Thematic analysis allows a hybrid analytic approach, i.e. the combination of inductive and deductive reasoning, which we used throughout the entire process of analysis.

Procedures for qualitative analysis outlined by Braun and Clarke (Braun & Clarke, 2006) and Wu et al. (Wu et al., 2016) include the following steps:

1. The authors executing data analysis familiarize themselves with the data by reading and re-reading all of the transcribed interviews.
2. They then analyze by:
    a) generating initial codes
    b) searching for themes – in our case both inductively and deductively
    c) reviewing themes and
    d) defining and naming themes.

In our study the first interview was coded together with one of the supervisors of the thesis who is a health psychologist to create an initial set of codes. Further in the coding process 10% of the interviews were independently coded by the first two authors. The occurring differences in coding were discussed until consensus was reached.

We used the theory of the three components of attitude as theoretical framework for the coding templates (King, 2012), namely cognitive component, affective component and behavioral component (Allport, 1935; Fabrigar et al., 2005; Hovland & Rosenberg, 1960). An additional theme for the coding of these theoretical groups was the feasibility of diabetes management in schools and kindergartens. Codes and definitions were recorded in a codebook to help the process of analyzing. The first author coded all of the remaining interviews using the codebook. The first two authors held meetings to review codes and generate new emerging ones if it was necessary. The authors agreed on all codes of the transcripts. During the finalization the investigators organized the codes by relevance to themes aligned with the three components of attitude. All of the codes within the feasibility of diabetes management considering the behaviors of teachers were categorized into the three themes of the components

of attitude. See table 4. for an example of the codes transformed into the final themes and subthemes applied to a short segment of our data.

Data extract	Coded for	Final main themes and subthemes
So I have to say that this little girl has such self-discipline in this whole situation that she really sets an example for us. So maybe from a very young age she is obviously involved in this (living with type 1 diabetes) and gets all the support she needs, but I can really only mention her as an example, that this is not a problem for her, but a natural thing and she is so present in everyday life. (II7)	Attitude, affection — empathy – Towards child living with T1D	Attitude - Affective component – towards child living with T1D

Table 4. An example of the coding process

3.3. Evaluating the impact of a short diabetes education intervention on teachers' diabetes knowledge, attitudes and confidence in diabetes care

3.3.1. Participants

60 participants (from 5 schools and 2 kindergartens) were included in the study, 24 received the education in person and 36 received it online. See participants' detailed characteristics in table 5.

	All participants (n=60)	*In-person group (n=24)*	*Online group (n=36)*
Gender			
Male	4	21	35
Female	56	3	1
Age they work with			
Kindergarten (children aged 3-5 years)	37	10	27
Primary school (children aged 6-13 years)	23	14	9
Taking part of managing diabetes in school			
Yes, handling management tasks	39	13	26
Being attentive of symptoms and notifying parents	11	2	9
No	10	9	1
Age in years	43.72 (9.48)	44.6 (9.93)	43.1 (11.4)
Years spent working as a teacher	16.9 (11.5)	20.6 (11.4)	14.5 (11.1)

Table 5. Participants characteristics (Age and years spent working as a teacher are shown in mean values together with the standard deviations)

3.3.2. Study measurements

Diabetes education

We used two materials to create the diabetes education: the "KiDS and Diabetes In Schools (KiDS - Children with Diabetes in Schools)" package (IDF, 2014), compiled by the International Diabetes Federation (IDF) and the one titled "What is type 1 diabetes? A guide for parents of newly diagnosed children" created by Novo Nordisk (Novo Nordisk, 2018). The themes of diabetes education can be seen in Figure 1.

1. Introduction
2. What is diabetes?
3. Type 1 diabetes
4. Symptoms
5. Treatment – presentation of treatment tools
6. Nutrition
7. Hypoglycaemia
8. Hyperglycemia
9. Diabetes management in sick children
10. What are diabetes emergencies?
11. What do I need to know as a teacher?
12. Type 2 diabetes
13. Useful websites in English and in Hungarian

Figure 1. Main themes of the diabetes education

The education was held by a professional diabetes educator. In-person it was presented using a PowerPoint presentation. The presentation included a physical demonstration of the treatment devices (blood glucose meter, sensor, pen, insulin pump) and a brief explanation of their operation. The presentation lasted for one hour. After it the participants had the chance to ask any questions they had about the subject. Participants were asked to fill out the questionnaire right before the education and right after it.

The online training was presented in a video on an online platform. In the video, the PowerPoint presentation was shown with the narration of the diabetes educator. The video could be watched by the participants in their own time, they were asked to fill out the questionnaire right before watching the video and to fill it out again right after watching it. A step-by-step guide for the education and the filling of the questionnaires was provided. The group of online participants was offered the opportunity to have an online video chat meeting with the diabetes educator in a group format to ask their questions if they had any. This opportunity was rarely used by participants (only 4 of them raised questions).

Questionnaires (see appendices)

The first part of the questionnaire contained questions about demographical data, work history and teachers' experiences with diabetes care. The knowledge and attitude questionnaires were validated English-language measures, that three independent translators translated into Hungarian, then an agreed version of the translations was used. Cronbach alpha was calculated for each scale of the pretest questionnaires.

Diabetes Knowledge Test 2

To assess diabetes knowledge, a modified version of the Hungarian Diabetes Knowledge Test (DKT 2) (Fitzgerald et al., 2016; Papp-Zipernovszky et al., 2021) was used. The questionnaire measures general knowledge about diabetes, about the nutritional content of food and the causes of changes in blood sugar levels and insulin administration. Items were reformulated to be applicable to teachers: items numbered 2, 3, 11 and 12 in the original version were omitted, and additional questions were added based on the findings of Al Duraywish and Nail (2017). The final version contained 26 items, each of which required participants to select the one they considered to be correct from 3 or 4 predefined response options (e.g. 7. What effect does exercise have on blood glucose levels in a child in good health - a. Decreases, b. Increases, c. No effect). Cronbach-α in our sample was 0.733.

Diabetes Attitude Survey

Diabetes attitudes were measured using three different instruments.

1) DAS3: The items of the Diabetes Attitude Scale (DAS 3) is a general measure of diabetes-related attitudes (Anderson et al., 1998). We adapted some of the items for teachers about type 1 diabetes: 20 items were relevant for diabetes care in schools, hence 13 items were omitted from the 33 items. The instrument contained statements that are formulated as a continuation of the sentence "In general, I think that..." (e.g. (...) …teachers should be taught how everyday diabetes care affects the patient's life). Participants are asked to indicate on a five-point Likert scale the extent to which they agree with the statements (1- Strongly agree, 2 - Agree, 3 - Neutral, 4 - Disagree, 5 - Strongly disagree). See the Cronbach alfa values of the subscales used in our study in the results section.

2) School personnel diabetes attitude scale: Based on the publication by Tannous et al. (2012), we used 13 items to create a list of items measuring diabetes attitudes of school personnel. The items were statements about diabetes and people living with diabetes (e.g. "Children with diabetes should be taught in traditional classes."). Participants indicated the extent to which they agreed with the statements on a six-point Likert scale (1 - Strongly disagree

- 6 - Strongly agree). See the Cronbach alfa values of the subscales used in our study in the results section.

3) Semantic differential: In addition, we used a semantic differential method (Kiviniemi et al., 2007) to examine participants' feelings about three aspects of diabetes care. Three diabetes care-related tasks (blood glucose monitoring, insulin administration, treating hypoglycaemia) were rated by participants on six aspects along five-point Likert scale, with the low endpoint indicating a conflicting feeling (see Table 6). The mean of the items served as an overall measure of attitudes. Cronbach-α for all of the items in our sample was 0.931.

Involves uncertainty	1	2	3	4	5	Safe
Repulsive	1	2	3	4	5	Attractive
Frightening	1	2	3	4	5	Reassuring
Indifferent	1	2	3	4	5	Important
Burdensome	1	2	3	4	5	Easy
Useless	1	2	3	4	5	Useful

Table 6. Response options for the semantic differential measure

Confidence in diabetes care

For the assessment of confidence in diabetes care, we used 6 statements from the attitude scale developed by Van der Ven and colleagues (2003) (e.g., I know the difference between type 1 and type 2 diabetes), for each of which participants indicated their level of agreement on a 5-point Likert scale (1 - strongly disagree - 5 - strongly agree). Cronbach-α in our sample was 0.879.

3.3.3. Data collection

Participants completed the pretest and participated on the education (24 participated online and 36 in person). Directly after the education they completed the test for the first time and finally after 30 days they completed the retest (see the process of the intervention in Figure 2.). For all of the test sessions, we asked participants to provide a code name, which was used to link each completion to the next.

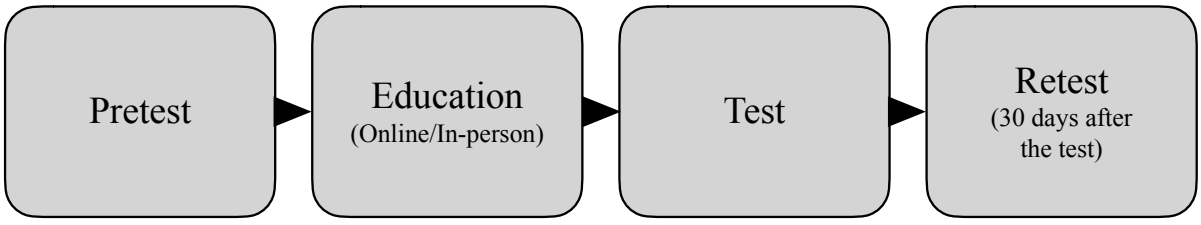

Figure 2. The process of the intervention

3.3.4. Data analysis

Statistical analyses were conducted using SPSS software (Version 23.0) (IBM, 2015). We conducted a Principal Components analysis to determine the underlying content of the compiled attitude scales on our sample (DAS3; School personnel diabetes attitude scale). To examine the effect of the education, a mixed ANOVA test was performed for each scale. Post-hoc testing with Bonferroni correction was used to compare means across the three measurement occasions.

4. Results

4.1. Parental fear of hypoglycemia, diabetes distress and self-efficacy related to diabetes management

4.1.1. Confirmatory Factor Analysis of the HFS-P Scale

First, we examined the four-factor structure (25 items) of the HFS-P questionnaire recommended by Shepard et al. (2014). These include the following subscales: (1) Behavior; (2) Maintain High Blood Glucose (3) Avoidance; (3) Helplessness and (4) Social Consequences. Model fit was considered adequate when the Comparative Fit Index (CFI) > 0.90, the Tucker Lewis' Fit Index (TLI) > 0.90 and the Root-Mean-Square Error of Approximation (RMSEA) ≤ 0.08 (Hu & Bentler, 1999). The result of the Chi-square (χ2) test supports the model if the test result is not significant and the obtained value is less than twice the degree of freedom. The χ^2-test is sensitive to the normality of the sample and therefore its results are less informative (Bentler & Bonett, 1980; Jöreskog & Sörbom, 1993; McIntosh, 2007; Ropovik, 2015).

The fit indices of the first model were below the optimum (χ^2 (116) = 287; *CFI* = 0.894; *TLI* = 0.882; *RMSEA* = 0.0600). To improve the fit, the Modification Indices, Residual Covariances were considered, item A7 (seventh item from the Worry about negative social consequences subscale) "Child appearing to be “stupid” or clumsy." showed, therefore it was removed. The fit of our model improved the most after removing this item (χ^2 (116) = 287; *CFI* = 0.932; *TLI* = 0.924; *RMSEA* = 0.0490).

We then examined the three-factor structure (18 items) of the HFS-P questionnaire recommended by O’Donnell and colleagues (2022). Which uses the following subscales: (1) Maintain High Blood Glucose; (2) Helplessness/Worry About Low Blood Glucose; (3) Worry About Negative Social Consequences. The fit indicators of the first model of the three-factor (18-item) solution (M1 (3F) fell short of the expected (χ^2 (132) = 458; *CFI* = 0.906; *TLI* = 0.891; *RMSEA* = 0.0783). The results of the modification indicators showed that, similarly to the four-factor model, removing item A7 improved the fit indicators to the greatest extent. Overall, the CFA thus confirmed the existence of a three-factor structure in our sample, with

the three-factor model finally having stronger fit indicators than the four-factor solution after removing item 7 (χ^2 (116) = 287; *CFI* = 0.948; *TLI* =0.939; *RMSEA* = 0.0605) (see Table 7).

Modell	χ2	df	*p*	CFI	TLI	RMSEA
M1(4F)	659	269	*p <0,001*	0,894	0,882	0,0542
M2(4F)	484	246	*p <0,001*	0,932	0,924	0,0490
M1(3F)	458	132	*p <0,001*	0,906	0,891	0,0783
M2(3F)	287	116	*p <0,001*	0,948	0,939	0,0605

Table 7. Fit indicators of the HFS-P on our sample:M1(4F): the original four-factor (25 items) solution, M2(4F): the four-factor (24 items) solution after removing item A7, M1(3F): the three-factor (18 items) solution, M2(3F): the three-factor (17 items) solution after removing item A7.

Internal Consistency of the HFS-P Scale and its subscales:

The full scale of seventeen items showed a high internal consistency. For the subscales, Cronbach's alpha values ranged from 0.658 to 0.893. Reliability is high for both the "Helplessness/Worry about Low Blood Glucose" and "Maintain High Blood Glucose" subscales, while the reliability of the "Worry About Negative Social Consequences" subscale is acceptable (see Table 8).

Scale	Cronbach-α
HFS-P	0,892
1. Maintain High Blood Glucose	0,854
2. Helplessness / Worry About Low Blood Glucose	0,893
3. Worry About Negative Social Consequences	0,658

Table 8. Internal consistency of HFS-P and its subscales for the three-factor model

4.1.2. Parental profiles of fear of hypoglycemia

The main aim of our study was to determine the patterns of fear of hypoglycemia among parents of children living with type 1 diabetes. To this end, we used the scores of the three factors (Maintaining High Blood Glucose Levels, Helplessness/Worry About Low Blood Glucose and Worry About Negative Social Consequences) as indicator variables for latent profile analysis. The method can identify subgroups with distinct profiles of parental fear of hypoglycemia. We applied 4 possible constraints provided by the tidyLPA package (Rosenberg et al., 2019) on the local distributions (variance) and covariances of the distinct latent profiles:

equal variances and 0 covariances (Model 1), varying variances and 0 covariances (Model 2), equal variances and varying covariances (Model 3), and varying variances and varying covariances (Model 4). Latent Profile Analyses with 2 to 8 solutions for the 4 models and fit indices for the consecutive profile numbers are presented in Table 9.

	Model 1				Model 2				Model 3				Model 4			
	AIC	**BIC**	**entropy**	**BLRT/p**	**AIC**	**BIC**	**entropy**	**BLRT/p**	**AIC**	**BIC**	**entropy**	**BLRT/p**	**AIC**	**BIC**	**entropy**	**BLRT/p**
2	2913	2965	0.83	508.4 (<.01)	2879	2954	0.70	266.7 (<.01)	3058	3098	0.89	357.383 (<.01)	3095	3146	0.71	38.7 (<.01)
3	2876	2956	0.80	50.5 (<.01)	2802	2918	0.78	96.2 (<.01)	2981	3037	0.89	84.314 (<.01)	2986	3054	0.90	116.9 (<.01)
4	2840	2947	0.86	50.8 (<.01)	2789	2945	0.84	32.9 (0.049)	2989	3061	0.58	-0.004 (1.0)	2994	3077	0.55	-0.006 (0.97)
5	**2771**	**2906**	0.84	83.0 (<.01)	2740	2935	0.85	69.4 (<.01)	2997	3085	0.48	0.036 (0.772)	3002	3102	0.45	-0.2 (1.0)
6	2769	2933	0.80	**15.1 (0.13)**	2739	2974	0.81	20.9 (0.257)	3002	3106	0.65	3.2 (0.822)	2965	3081	0.66	45.021 (<.01)
7	*	*	*	*	2724	2999	0.82	35.5 (0.029)	3010	3130	0.60	-0.0000771 (0.376)	2973	3105	0.60	-0.03 (0.97)
8	*	*	*	*	*	*	*	*	3018	3154	0.58	-0.003 (0.564)	2981	3128	0.57	-0.009 (0.79)

note: bold values represent local minima for AIC and BIC and the first non-significant BLRT value
Model 1: equal variances and 0 covariances, Model 2: varying variances and 0 covariances, Model 3: equal variances and varying covariances, and Model 4: varying variances and varying covariances
* Model 1 with seven and eight latent profiles and Model 2 with eight latent profiles did not converge
Table 9. Fit indices of the LPA models

Local minima of BIC were achieved in Model 1 with 5 and 6 latent profiles and Model 2 with 3 latent profiles. Confirmed by non-significant BLRT test in the 6 profile solutions of Model 1.

A non-significant ($p > 0.05$) result from the BLRT test for a given model with k number of latent profiles indicates that it is more appropriate to retain the model with k-1 latent profiles since the k-profile solution does not provide a significant increase in model fit. Comparing the results, we chose the five-profile solution of Model 1, since this was the first, most parsimonious solution, which also had very similar and low BIC values compared to the three-profile of Model 2 solution. Therefore, we retained the profile membership classifications of five groups for further analysis. Table 10 and Figure 3 present the subgroup profiles using the group means on the initial standardized factor scores.

		Maintaining High Blood Glucose Levels		Helplessness/Worry About Low Blood Glucose		Worry About Negative Social Consequences	
	N (%)	**m (SD)**	**95 % CI**	**m (SD)**	**95 % CI**	**m (SD)**	**95 % CI**
LP1	52	-1.197 (0.16)	0.02	-0.67 (0.45)	0.06	-0.89 (0.15)	0.02
LP2	130	0.38 (1.13)	0.098	1.17 (0.84)	0.07	1.07 (0.08)	0.08
LP3	124	-0.09 (0.84)	0.08	-0.40 (0.4)	0.04	-0.09 (0.03)	0.03
LP4	40	-0.41 (0.19)	0.03	-0.64 (0.34)	0.05	-0.87 (0.02)	0.02
LP5	53	0.77 (0.497)	0.07	-0.79 (0.28)	0.04	-0.88 (0.02)	0.02
F(overall)		301		146		242	
p		<0.001		<0.001		<0.001	
eta2		0.332		0.676		0.658	
post hoc		LP5 > LP2 > LP3,LP4 > LP1		LP2 > LP3,LP4,LP1,LP5; LP3 > LP5		LP2 > LP3 > LP4,LP5,LP1	

note: LP1 = inactives; LP2 = worriers; LP3 = balanced; LP4 = confidents; LP5 = over-insurers

Table 10. Comparison of the latent profile groups along the HFS-P subscale scores

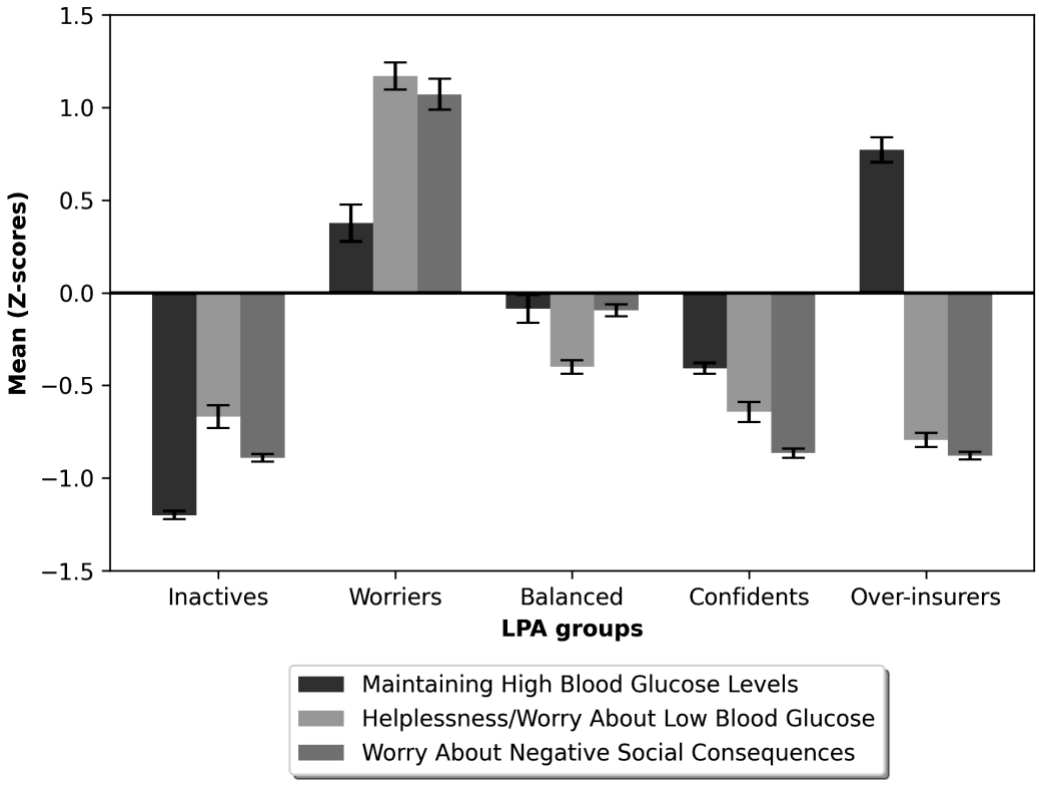

Figure 3. Profiles of the latent profile groups.
Note: dimension scores are standardized factor scores with positive and negative SE Error bars

The groups LP1, LP4, and LP5 all show relatively low worry scores (Helplessness and Social consequences). LP1 has the lowest score in Maintain High whereas LP4 and LP5 show average scores (between 0 and -0,5) on this dimension. Group LP1 is not showing an active behavior trying to keep blood glucose levels higher than the normal rate and their anxiety level considering low blood glucose levels and negative social consequences are also low. This group may be called “Inactives” (N = 52, 13 %). The largest subgroup is LP2 (N=130, 32.6%), they show the highest scores in worries, and the second highest (after group LP5) in maintaining higher blood glucose levels. We may call this group showing this type of reaction of fear of hypoglycemia “Worriers”. The second largest group is LP3 (N = 124, 31.1 %) for they showed average scores in all three of the subscales, they have higher scores in maintaining BG than group LP2 and they show almost the same scores in actively trying to keep BG high than on being afraid of negative social consequences, out of their scores, helplessness is the lowest, we may call them “Balanced”. Group LP4 (N = 40, 10 %) is the smallest group, they show similarly low scores in the worry-related factors. Their maintaining high score is in the average range. They may be called “Confidents”. Group LP5 shows the highest scores in maintaining higher blood glucose levels and the lowest scores on both of the worry subscales, they might experience anxiety less since they can feel more control. This group may represent the “over-insurers”.

4.1.3. Profile groups compared across various demographical and diabetes care related factors

Latent profile groups were compared across parents’ age, children’s age, child independency in diabetes management, time spent in diagnosis and psychological factors related to diabetes management (diabetes distress, self-efficacy, diabetes management competence and perceived problems) and factors related to hypoglycemic episodes.

Parent’s age

The overall F test indicated a significant effect considering parent’s age (F (4,391) = 2.70; p = 0.031). Post Hoc tests with Tukey correction indicated that in the “Balanced” group (M = 42.4, SD = 4.87) parent’s age was significantly higher than in the Over-insurers group (M = 39.2, SD = 7.86). The Post Hoc tests did not indicate any more significant differences between the rest of the groups: “Inactives” (M = 41.5, SD = 6.87), “Worriers” (M = 41.1, SD = 6.55) and “Confidents” (M = 40.6, SD = 6.19).

Age of child living with T1D

The overall F test indicated a significant effect concerning child age also (F (4,136) = 2.92; p = 0.023). Post Hoc tests with Games-Howell correction indicated that in the Worriers group child age was significantly lower (M = 9.22, SD = 2.94) than in the "Balanced" group (M = 10.30, SD = 2.48). There were no significant differences amongst the rest of the groups: "Inactives", "Confidents" and "Over-insurers" (M = 9.98, SD = 3.14; M = 9.76, SD = 3.13 and M = 9.30, SD = 2.71).

Child independency in T1D management and time spent in diagnosis

No significant difference could be detected between the groups concerning child independency in T1D management measured by a single item (F (4,138) = 2.24; p = 0.068) and time spent in diagnosis (F (4,390) = 1.47; p = 0.21).

Diabetes distress

We found significant differences between groups considering diabetes distress (F (4,394) = 14.1; p <0.001). Post Hoc tests with Tukey correction indicated significant differences between "Inactives" (M = 43.8, SD = 17.9) and "Worriers" (M = 62.9, SD = 18.1), "Worriers" also showed significant differences from groups "Balanced" (M = 52.6, SD = 20.1), "Confidents" (M = 44.3, SD = 18.5) and "Over-insurers" (M = 52.2, SD = 17.5). Among all of the groups, the "Worriers" showed the highest level of distress.

Self-efficacy

A significant difference was also shown between groups considering self-efficacy (F (4,394) = 3.31; p = 0.011). Post Hoc tests with Tukey correction indicated significant differences between groups "Worriers" (M = 4.30, SD = 0.604) and "Confidents" (M = 4.58, SD = 0.448). There were no significant differences between the rest of the groups: "Inactives" (M = 4.53, SD = 0.547), "Balanced" (M = 4.41, SD = 0.5) and "Over-insurers" (M = 4.47, SD = 0.522). The "Confidents" showed the highest levels of self-efficacy among all of the groups.

Perceived problems in diabetes management

There were significant differences between groups considering perceived diabetes management problems (F (4,147) = 8.63; p <0.001). Post Hoc tests with Games-Howell correction indicated significant differences between groups. The "Worriers" (M = 3.04, SD = 1.008) perceived problems higher than the "Inactives" (M = 2.21, SD = 0.9), the "Balanced" (M = 2.72, SD = 0.879) had higher perception of problems higher than the "Inactives". "Worriers" experienced problems higher than the "Confidents" (M = 2.51, SD = 0.627) and the "Over-insurers" (M = 2.59, SD = 0.789).

Factors considering hypoglycemia, hypoglycemic episodes and HbA1c

Latent profile groups were compared across the child's most recent hemoglobin A1c reading and the target range for the child's blood glucose level (the minimum and maximum levels between which parents try to keep blood glucose levels). None of these variables were related to group membership: F_{HbA1c} (4,126) = 1.25; p = 0.292; $F_{\text{minimum level of blood glucose}}$ (4,135) = 0.693; p = 0.598; $F_{\text{maximum level of blood glucose}}$ (4,136) = 0.632; p = 0.641.

Latent profile membership was cross tabulated with the number of episodes of hypoglycemia (severe, moderate and mild) and how upsetting these were for parents. The answers were marked on a scale of 0-9. For the calculations we grouped the answers the following way: the number of severe hypoglycemic episodes were grouped into two categories: 0-1 episodes and 2-9 episodes. Moderate hypoglycemic episodes were grouped into four categories: 0; 1-3; 4-6; 7-9. Mild episodes were grouped into three categories: 0; 1-5; 6-9. The number of severe episodes and their upsetting nature were not related to group membership: Chi-square$_{\text{Severe episodes}}$ = 4.61 (df = 4), p = 0.330; Chi-square$_{\text{Severe episodes upset}}$ = 12.8 (df = 16), p = 0.688. The number of moderate episodes were not related to group membership (Chi-square$_{\text{Moderate episodes}}$ = 7.04 (df = 12), p = 0.855), however the upsetting nature of them were significantly related (Chi-square$_{\text{Moderate episodes upset}}$ = 39.7 (df = 16), p <0.001) (see table 11).

	Upsetting nature of moderate hypoglicemic episodes					
Group membership	**0**	**1**	**2**	**3**	**4**	**Total (n)**
"Inactives"	35	11	5	1	0	52
"Worriers"	61	14	30	17	8	130
"Balanced"	67	20	18	6	12	123
"Confidents"	26	3	7	3	1	40
"Over-insurers"	41	5	4	2	1	53
Total (n)	230	53	64	29	22	398

Table 11. Contingency tables of the upsetting nature of moderate hypoglycemic episodes

Finally, the number of mild episodes was not related to group membership (Chi-square$_{\text{Mild episodes}}$ = 14.0 (df = 8), p = 0.082), however the upsetting nature of them was significantly related (Chi-square$_{\text{Mild episodes upset}}$ = 33.7 (df = 16), p = 0.006). In comparison to the entire sample, the "Worriers" and the "Balanced" found mild hypoglycemia episodes to be the most upsetting, while the "Confidents" found them to be the least disconcerting (see table 12.).

	Upsetting nature of mild hypoglycemic episodes					
Group membership	**0**	**1**	**2**	**3**	**4**	**Total (n)**
"Inactives"	40	8	2	1	1	52
"Worriers"	53	32	28	9	8	130
"Balanced"	57	30	18	7	11	123
"Confidents"	26	8	3	2	1	40
"Over-insurers"	35	8	7	1	2	53
Total (n)	211	86	58	20	23	398

Table 12. Contingency tables of the upsetting nature of mild hypoglycemic episodes

4.1.4. Discussion of results

The current study investigated fear of hypoglycemia, diabetes distress, and self-efficacy related to diabetes management among parents. The aim was to identify profiles associated with behavioral and anxiety-related reactions to hypoglycemia and to analyze the differences among these profiles regarding additional diabetes care-related factors. The LPA revealed five distinct parental profiles, each exhibiting unique characteristics and levels of concern.

The "Inactives" group (13% of the sample) showed low engagement in maintaining high blood glucose levels and low anxiety about hypoglycemia and its social consequences. This group reflected low anxiety and they did not actively attempt to keep blood glucose levels higher than normal. The "Worriers" group (32.6%) exhibited the highest levels of worry in the sample and the second highest scores in behaviors to maintaining higher blood glucose levels. The "Balanced" group (31.1%) demonstrated average scores across all subscales, indicating moderate levels of anxiety and proactive behaviors. This group managed to balance their concerns and actions, showing almost equal scores in maintaining high blood glucose and worrying about negative social consequences. The "Confidents" group (10%) had low scores in worry-related factors but maintained average ratings of keeping high blood glucose levels. They showed confidence in managing their child's diabetes without excessive anxiety, worries about social consequences and actively maintaining high levels of blood glucose. The "Over-Insurers" group had the highest scores in maintaining high blood glucose levels compared to the other groups. Whereas they showed low scores on both worry subscales. This group likely experienced less anxiety due to a sense of control over their child's diabetes management.

Some significant differences were observed among these profiles regarding demographic and T1D management related factors. Our results showed significant differences in parental age

between the profiles, with the “Balanced” group having older parents compared to the “Over-Insurers” group. Additionally, the “Worriers” group had younger children compared to the “Balanced” group. We found significant differences in DD levels across the profiles, with the “Worriers” group showing the highest levels of distress. Significant differences were observed in self-efficacy between the profiles, between the “Worriers” and “Confidents” groups, with the Worriers group reporting lower self-efficacy. No significant differences were found in HbA1c levels or the number of severe and mild hypoglycemic episodes across the profiles. However, the upsetting nature of moderate and mild hypoglycemic episodes was significantly related to profile membership. With the “Worriers” and the “Balanced” perceiving the nature of mild hypoglycemic episodes the most upsetting and the “Confidents” perceiving them the least upsetting compared to the whole sample.

4.2. Exploring Teachers' Attitudes and Roles in Supporting Children with T1D: A Qualitative Analysis

4.2.1. Subthemes of the components of attitude towards diabetes and its management

We analyzed the transcriptions of the interviews using thematic analysis (Braun & Clarke, 2006; Joffe, 2012) for narrative interviews (Riessman, 2008). A combination of inductive and deductive reasoning was used throughout the entire process of analysis. An overview of the subthemes of the components of attitude towards diabetes and its management is provided in Figure 4.

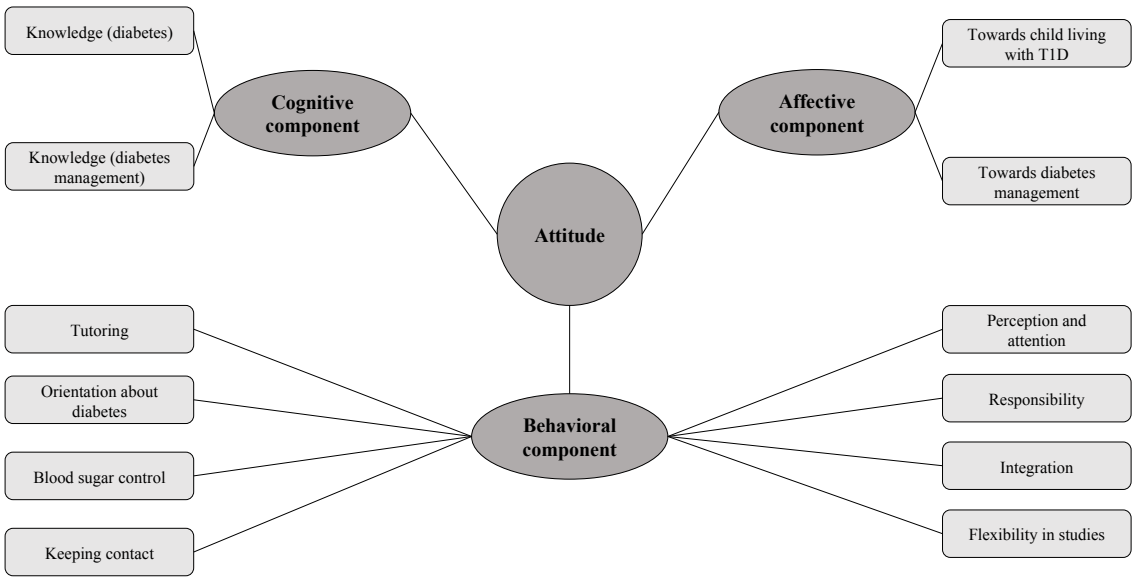

Figure 4. Overview of the subthemes of the components of attitude towards diabetes and its management. (circle: main themes, square: subthemes)

Cognitive component of attitude towards diabetes and its management

The cognitive component included knowledge about diabetes and its management. Knowledge about diabetes contained both correct and incorrect information about the biological background. Teachers reported the behavioral and psychological signs they observed in children living with T1D (for example difficulties in concentration during low blood glucose levels). Knowledge about diabetes management included information about the medical treatment of diabetes. The methods of blood sugar control and alternative treatments as additional treatment options in diabetes were mentioned by participants. The majority of teachers in the sample rated their knowledge about diabetes and its' management over 4 (out of 10). See the quotations from each subtheme in table 13.

The affective component of attitude towards diabetes and its management

The affective component included approach, opinions and emotions shown towards the child with T1D and its management. We identified cognitive and affective reactions of empathy (Davis, 1980, 1983; Deutsch & Madle, 1975). Cognitive reactions included identifying with the mental perspective of the child with T1D or the parent, affective reactions included expressing vicarious sharing of emotions of the child living with T1D (Smith, 2006). Most of our participants thought that children with T1D should not be left out of any activities and they should be fully integrated into any community. However, some participants expressed a segregating approach, meaning that children with T1D should go to a separate institution or should do some activities (e.g. sports) separately from their peers. Most of the participants represented the integrating approach and thought that teachers are obliged to learn about diabetes and its management if they must supervise a child with T1D and they must undertake tasks related to diabetes management.

Some participants expressed that they consider the tasks related to diabetes management as a burden. Others felt that these tasks are not burdensome and easily manageable. The analysis revealed that teachers often experience distress when taking care of a child with T1D. Most commonly they reported being afraid of the disease itself, of needles or pricking the child with a needle and of the child falling into a coma. On the other hand, some of the participants reported that they would undertake caring for a child with T1D without any particular anxiety or distress. See the quotations from each subtheme in table 13.

Behavioral component of attitude towards diabetes and its management

The behavioral component consisted of behaviors teachers exhibit or could be exhibiting for the feasibility of diabetes management in schools and kindergartens. In this case the sub-themes are the specific behaviors, that teachers reported performing to support the children living with T1D.

The participants pay attention to and perceive different types of diabetes-related changes in the child's behavior with T1D either actively or passively. They actively pay attention and identify symptoms of blood sugar changes. Moreover, they passively let the child with T1D take care of a task related to diabetes management.

Participants expressed that they take responsibility for monitoring the child with T1D or for taking care of diabetes management related tasks. They may contribute to the integration of the child with T1D by letting them come to extracurricular activities, by informing the child's peers about the disease (explaining diabetes and its treatment), and sensitizing the peers of the child (encouraging them to be more empathic). They also contribute to the integration by guiding peers, and modeling how they should treat the child with T1D. Treating the children with T1D in the same way as their peers is also a significant part of their contribution to the integration process. School teachers may help children with T1D by being less pressing in their studies. For example, when it comes to physical education, teachers may give easier tasks to them if they have problems with their blood glucose control.

In order to manage diabetes in the institution properly, the participants must keep in touch with the parents of the child with T1D. They also keep in contact with their colleagues. Moreover, one participant mentioned that she would even keep contact with the medical staff who treats the child with T1D.

Teachers who participated in diabetes care reported that they perform tasks related to blood sugar control or encourage the child to do so (e.g.: help with setting the management tool or eating if blood sugar is low and doing some exercise when blood sugar is high). We asked the participants if they would use a glucagon injection in case of an emergency. Most of them said they would, but neither of them had to use it so far.

The participants often look up information about diabetes (mostly on the internet or participate in a training course about diabetes) when they find out that a child with T1D will join their group. They may also gain knowledge about diabetes through experience (personal experience, experience with relatives or former students with T1D).

The participants also contribute to the children with T1D accepting their disease and being self-sufficient when it comes to diabetes care. They may also increase health awareness in

children with T1D and their peers by tutoring them. They consider this as their duty, as they think the nature of their profession requires that they also contribute to the upbringing of the children. See the quotations from each subtheme in Table 13.

Themes	Subthemes	Quotations from focus group and individual interviews
Cognitive component	**Knowledge about diabetes**	'...the pancreas doesn't produce enough insulin, which is needed by the body, so blood sugar levels rise. Well...the symptoms...um...can be drinking a lot, going to the toilet a lot, mouth...breath changes, urine becomes acetous.' (II21)
	Knowledge about diabetes management	Considering type 1 [diabetes], I understand that insulin needs to be replaced. This can be done via a pen or a pump. .'(II11)
Affective component	**Towards child living with T1D**	'I can see her, poor thing, with the pump and the sensor. Her trousers slip down a little bit and I can see the little red dots on her, and it tugs at my heartstrings that God lets a little 5-year-old face these kind of obstacles.' (II4)
	Towards diabetes management	I'll tell you that it bothers us quite often. When we're here at work we're studying and concentrating, an P's (the child with T1D) device starts beeping... So, unfortunately we often feel that. 1: It's difficult 2: Tiring 1: A burden!' (FG2)
Behavioral component	**Perception and Attention**	'Here at school, if I see that R's eyes [the child with T1D] become a bit dizzy, I ask him immediately. (FG1)
	Responsibility	'This child is brought to the school, she spends her time between 8am till 5pm here, so during that time I'm responsible for her. And if I'm responsible for her, then my job is to learn the things that are necessary for her.' (FG2)
	Integration	'So that it's very important to talk about it with the other children. Using tales, puppets, we can strengthen the connection [between the child with T1D and his peers]' (II3)
	Flexibility in studies	'It turned out that he had diabetes and he 'slipped' [failed one academic year]. And the question was how we are going to manage to get him to graduation. So, in this case we handled it differently. There wasn't a date for the exam, he could take the exam when he was ready for it.' (FG1)
	Keeping contact	'We were in touch with the parents every single day. They told us how long the child sleeps, how we have to wake him/her up, what size of portions he should eat etc.' (FG1)
	Blood sugar control	'It happens that when their blood sugar level drops, we give them some cookies, some grape glucose tablets so that they don't start to fall into hypo [hypoglycemia].' (II4)
	Orientation about diabetes	When I found out that we were going to have [in the group] a little girl like that, I went to the XY [name of the foundation] Foundation's lecture before she joined the group, so that I could have some theoretical and practical experience of what it entailed.' (II4)
	Tutoring	'Let's think about the situation with glasses. Let's draw a parallel. If a child starts wearing glasses, a smart teacher says: "Wow, you've got such cool glasses" and "Wow it is so good!". And we prepare the child for this, right? We might even say that the glasses are very fragile, so we have to take good care of them...So, it won't draw too much attention if you introduce it properly.' (II5)

Table 13. Quotations of the subthemes

(Abbreviations: focus groups 1,2,3 = FG1, FG2, FG3; individual interviews 1-20= II 1-20)

4.2.2. Discussion of results

The aim of the present study was to understand diabetes care in schools and kindergartens from teachers' point of view. We conducted a qualitative study with semi-structured interviews and performed a thematic analysis. The qualitative design allowed the exploration of the underlying mechanisms of teachers' attitudes toward diabetes care. Furthermore, the use of the theoretical framework of the three components of attitude was found suitable for exploring the subject: teachers' attitudes toward diabetes care can be described in terms of knowledge about diabetes and its care, emotions toward diabetes, and behavioral patterns (Allport, 1935; Hovland & Rosenberg, 1960; Fabrigar et al., 2005).

The cognitive component consisted of two main categories: knowledge about diabetes and knowledge about diabetes management. Considering diabetes management, teachers talked about medical treatments, blood sugar control, and alternative treatments. Identifying the behavioral symptoms associated with diabetes is especially important considering the work of teachers, even if they do not specifically help in management. The psychological aspect of diabetes was separated from the behavioral symptoms, as teachers were talking about the psychological traits of children with diabetes. Within the affective component of attitude (including approach and opinions), we explored categories related to being more open and positive and representing a more integrative approach. Empathy as a positive approach has emerged as a category. Teachers expressed both emotional and cognitive empathy toward children with T1D (Davis, 1980; Davis 1983; Deutsch & Madle, 1975). Teachers working in kindergartens expressed empathy even toward the parents of the children. As for the negative affections, one of the most frequently mentioned affective components of attitude turned out to be distress. Teachers expressed that they feel uncertain about management tasks (such as blood glucose monitoring and insulin dosing), and they often worry about possible emergency situations (e.g., the pupil falling into a coma) under their supervision. Some teachers also expressed that they consider tasks related to diabetes management as a burden.

The behavioral component consisted of ways teachers contribute to the feasibility of diabetes management in the institution. These behaviors can be categorized into three groups: behavior related to diabetes management tasks, interpersonal relations, and behavior related to the pedagogical profession. Behavior related to management tasks is important, especially in cases where professional support is not available in the institution, as it was mentioned by most of our participants. Teachers also make a significant contribution to the psychosocial development and integration of the child with T1D by tutoring the children about acceptance

(both the child with T1D and their peers) and being self-reliant. We found that both informing and sensitizing peers were notable categories, which also highlights the significance and complexity of how teachers can support the integration of children with T1D into their community.

4.2. Evaluating the impact of a short diabetes education intervention on teachers' diabetes knowledge, attitudes and confidence in diabetes care

4.2.1.Effect of education on the mean scores of diabetes knowledge

The third study aimed to investigate the effects of a short, standardized diabetes education program on teachers' knowledge, attitudes, and confidence in diabetes care, comparing the effectiveness of in-person and online delivery methods.

One participant's data were excluded from the present analysis, due to too many missing values. The analysis revealed a main effect of DKT2 in the predicted direction: it showed a significant knowledge gain when comparing the score of DKT 2 pretest, test and retest scores ($F(1,1.65) = 36.009$, $p < 0.001$). Participants scored higher in the test phase ($M = 20.315$, $SE = 0.494$) than in the pretest phase ($M = 16.641$, $SE = 0.538$) ($p < 0.001$). They also scored higher on the retest ($M = 20.138$, $SE = 0.449$) than on the pretest ($p < 0.001$) (see Figure 5.). The main effect of the form of education was tendentious ($F(1,57) = 3.96$, $p = 0.051$). Contrasts revealed that those who took the education in person scored higher ($M = 19.841$, $SE = 0.635$) on the DKT 2 test than those who took it online ($M = 18.222$, $SE = 0.508$) (see figure 6.).

No significant interaction effect was observed between the DKT 2 score and the form of education ($F(1,1.65) = 2.811$, $p = 0.075$).

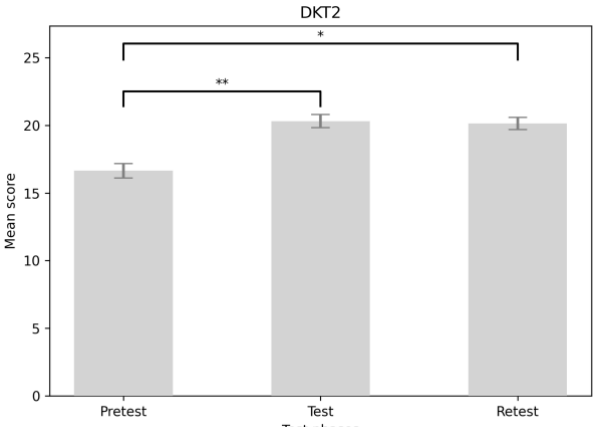

Figure 5. Main effect of DKT2 considering the test phases

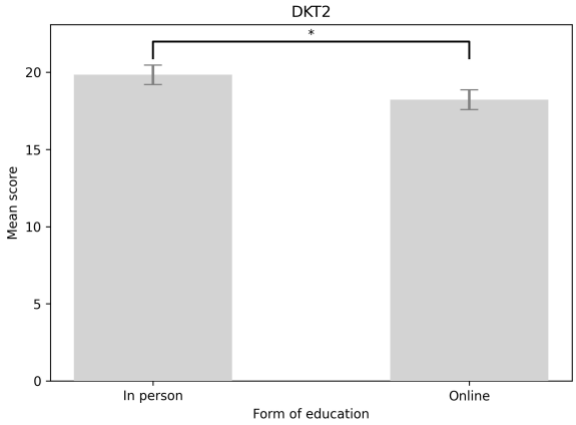

Figure 6. Main effect of the form of education considering DKT2 scores

4.2.2. Principal component analysis of two attitude scales: the Diabetes Attitude Scale (DAS 3) and the School Personnel Diabetes Attitude Scale

We conducted a principal component analysis on the 20 items that were chosen and adapted for diabetes care in schools from the original DAS3 (Anderson et al., 1998). According to the *KMO-test* (0.714) the data was suitable for factor analysis. The variables with less than 0.4 extraction communalities were excluded, therefore the final analysis was performed including eight items. We identified two components with eigenvalues of 3.087 and 2.425, respectively (all the other emerging components having eigenvalues less than 1). The two components accounted for 68.903 percent of the variability. Two subscales were found. As the items belonging to the subscales differed from the ones of the original scale, we named the subscales as following: Social support subscale: items 4,6,18,19, 20 (Cronbach-α: 0,825), and Emotional effects of diabetes care subscale: items 14,15,16 (Cronbach-α: 0.831). According to the Bartlett sphericity test ($\chi^2(28) = 212.825$, $p < .001$), these eight items were related to each other. Further analysis of the two subscales were done by using factor scores.

Regarding the School Personnel Diabetes Attitude Scale we conducted a principal component analysis on 13 items. According to the *KMO-test* (0.759) the data is suitable for factor analysis. The variables with less than 0.4 extraction communalities were excluded, therefore the final analysis was performed including seven items. We identified two components with eigenvalues of 2.888 and 1.654, respectively (all the other emerging components having eigenvalues less than 1). The two components accounted for 68.903 percent of the variability. Two subscales were found: The integration subscale with items 2,3,4 and 5 (Cronbach-α: 0,825), and the Distinction subscale: with items 10,11 and 13 (Cronbach-α: 0.663). Further analysis of the two subscales was done by using factor scores. According to the Bartlett sphericity test ($\chi^2(21) = 123.387$, $p < .001$), these seven items were related to each other.

4.2.3. Effects of the education on diabetes attitudes

Effect of the education on DAS3 subscale scores

Social support subscale

The main effect of the Social support subscale was not significant, indicating no differences between the scores on this subscale at different measurement occasions ($F(2,116) = 0.23$, $p = 0.795$). The main effect of the form of education was significant ($F(1,58) = 4.091$, $p = 0.048$): those who took the education in person scored higher ($M = 0.276$, $SE = 0.176$) on the Social support subscale than those who took it online ($M = -0.184$, $SE = 0.144$) (see figure 7.).

A significant interaction effect was observed between the subscale's score and the platform of the education ($F(2,116) = 0.004$, $p = 0.004$). This indicates that the scores of the subscale differed between participants who received education in person and online. To break down the differences, post hoc tests were performed that compared each test occasion across each type of education. The test session in person ($M = 0.335$, $SE = 0.177$) was significantly higher than the test session online ($M = -0.223$, $SE = 0.172$) ($p = 0.033$). The retest scores of the in-person education ($M = 0.447$, $SE = 0.167$) were also higher than the retest scores online ($M = -0.298$, $SE = 0.168$) ($p = 0.004$) (see figure 8.). According to these findings, the scores increased after the education in the group of participants who received the education in person, whereas compared to these values, the scores decreased among participants who received the education online.

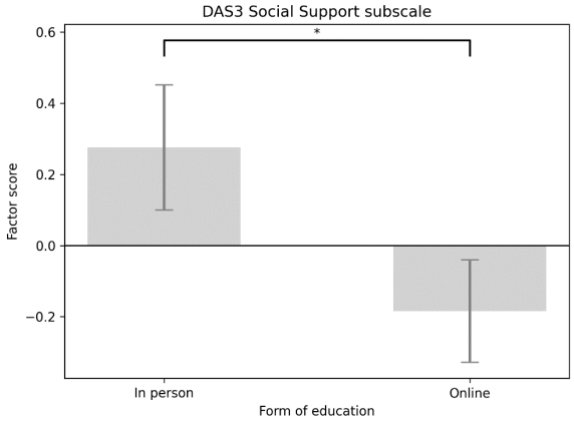

Figure 7. Main effect of the form of education considering DAS3 Social Support subscale factor scores

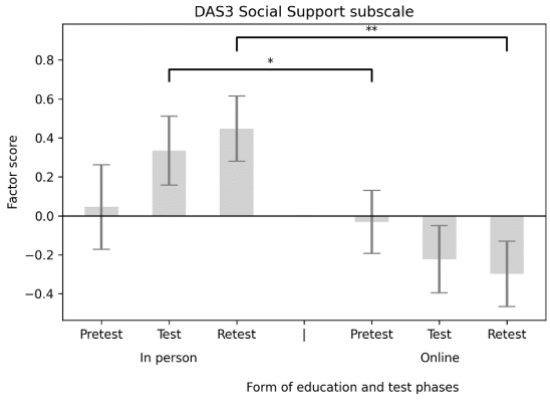

Figure 8. Interaction effect of DAS3 Social Support scale and the form of education

Emotional effects of diabetes care subscale

Regarding the Emotional effects of diabetes care subscale, no significant effects were found. The main effect of the Emotional effects of diabetes subscale was not significant ($F(2,116) = 0.058$, $p = 0.943$), neither was the main effect of the form of education ($F(1,58) = 1.963$, $p = 0.167$). Finally, the interaction effect of the subscale and the form of education was not significant either ($F(2,116) = 1.46$, $p = 0.236$). These results suggest that the means of subscales' scores were not significantly affected by education.

Effect of education on school personnel diabetes attitude scale subscale scores

Integration subscale

Two participants data were excluded from the present analysis, due to too many missing values. There was no significant main effect considering the Integration subscale scores ($F(2,116) = 0.249$, $p = 0.78$). The main effect of the form of education was significant in this

case (F (1,58) = 5.913, p = 0.018). Those who took the education in person (M = 0.323, SE = 0.172) scored higher on the Integration subscale than those who took it online (M = -0215, SE = 0.140). (see figure 9.)

A significant interaction effect was observed between the Integration subscale score and the platform of education (F(2,116) = 6.22, p = 0.003). To break down the differences, post hoc tests compared each test occasion across each type of education. The first retest session in person (M = 0.429, SE = 0.193) was significantly higher than the first retest online (M = -0.286, SE = 0.157) (p = 0.006). The second retest scores of the in-person education (M = 0.475, SE = 0.190) were also higher than the second retest scores online (M = -0.316, SE = 0.155) (p = 0.002). (see figure 10.). According to these findings, scores of the Integration subscale increased after the education in the group of participants who received the education in person, whereas compared to these values, the scores decreased among participants who received the education online.

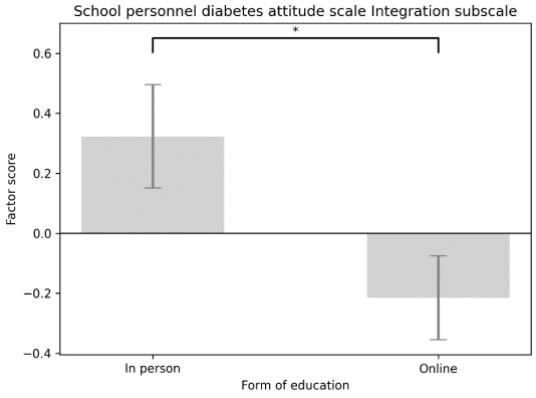

Figure 9. Main effect of the form of education considering School personnel diabetes attitude scale Integration subscale factor scores

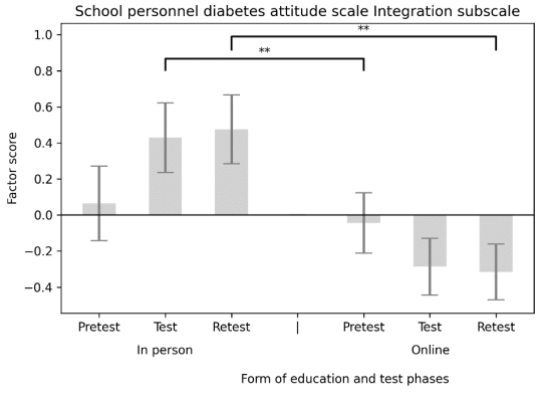

Figure 10. Interaction effect of School personnel diabetes attitude scale Integration subscale and the form of education

Distinction subscale

There was no significant main effect considering the Distinction subscale scores (F(2,116) = 0.092, p = 0.912). The main effect of the platform of education was significant in this case (F (1,58) = 4.131, p = 0.047). Those who took the education in person (M = 0.252, SE = 0.160) scored higher on the Distinction subscale than those who took it online (M = -0.168, SE = 0.131) (see Figure 11.).

No significant interaction effect was observed between the Distinction subscale score and the platform of the education ($F(2,116) = 2.297$, $p = 0.105$).

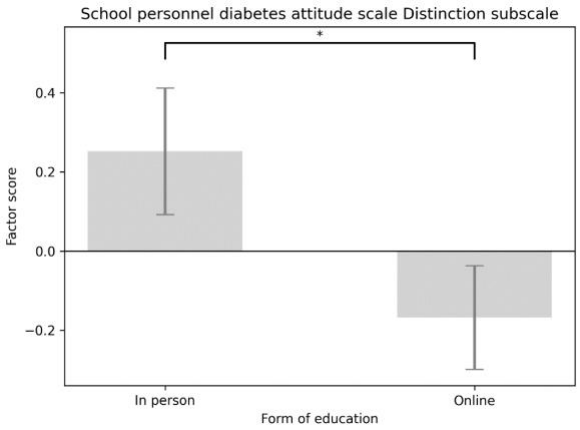

Figure 11. Main effect of the form of education cosidering School personnel diabetes attitude scale Distinction subscale factore scores

Effect of education on the mean scores of the Semantic differential

We correlated each item of the Semantic differential measuring participants' feeling about blood glucose monitoring, insulin administration and treating hypoglycemia using Pearson correlation. 72 out of the 90 correlations were significant (all correlations significancy levels were between $p < 0.001$ and $p = 0.044$ and r values were between 0.260 and 0.833), consequently we combined the final scores of each scale to analyze the effects of the education.

The analysis revealed a main effect of the Semantic differential in the predicted direction, there was a significant increase in the scores from comparing the score of the pretest, the test and the retest ($F(1.773,102.85) = 13.345$, $p < 0.001$). Participants scored higher on the test ($M = 3.633$, $SE = 0.89$) than on the pretest ($M = 3.277$, $SE = 0.98$) ($p < 0.001$). They also scored higher on the retest ($M = 3.524$, $SE = 0.82$) than on the pretest ($p = 0.004$) (see Figure 12.) indicating more positive feelings and evaluations toward diabetes care-related tasks. The main effect of the form of education was not significant (F (1,58) = 3.118, $p = 0.083$). A significant interaction effect was observed between the semantic differential scores and the platform of education ($F(1.773,102.853) = 6.490$, $p = 0.003$). This indicates that the scores of the scale differed between participants who received education in person and online. To break down the differences, post hoc tests were performed that compared each test occasion across each type of education. The test session in person ($M = 3.824$, $SE = 0.138$) was significantly higher than the test session online ($M = 3.443$, $SE = 0.113$) ($p = 0.037$). The retest scores of the in-person education ($M = 3.762$, $SE = 0.127$) were also higher than the retest scores online ($M = 3.285$, $SE = 0.104$) ($p = 0.005$) (see figure 13.). According to these findings, participants who received

the education in-person scored higher after the education than participants who received it online. Furthermore, the scores decreased between the tests and retests both online and in-person.

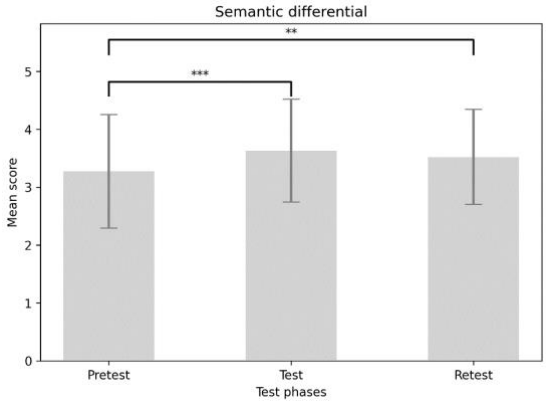

Figure 12. Main effect of Semantic differential considering the test phases

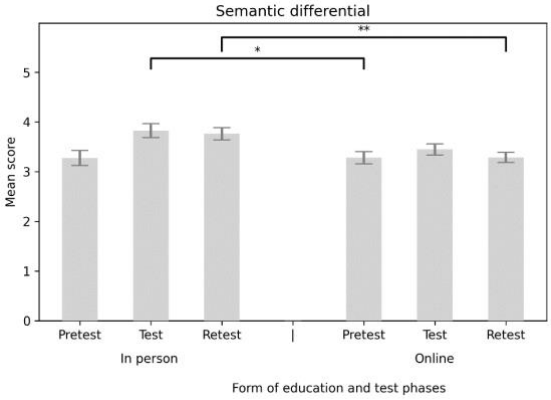

Figure 13. Interaction effect of the Semantic differential and the form of education

4.2.4. Effect of the education on the Confidence in diabetes care scale

The analysis revealed a main effect of Confidence in diabetes care scale in the predicted direction: there was a significant increase in diabetes confidence scores from comparing the score of the pretest, the test and the retest scores ($F(2,116)= 131.441$, $p < 0.001$). Participants scored higher on the test ($M = 3.698$, $SE = 0.094$) than on the pretest ($M = 2.186$, $SE = 0.118$) ($p < 0.001$). They also scored higher on the test, than on the retest ($M = 3.398$, $SE = 0.098$) ($p = 0.005$). Furthermore, they scored higher on the retest ($M = 3.398$, $SE = 0.098$) than on the pretest ($p < 0.001$) (see Figure 14.).

The main effect of the form of education was significant ($F(1,58) = 7.597$, $p = 0.008$). Contrasts revealed that those who took the education in person scored higher ($M =3.333$, $SE = 0.134$) on the Diabetes care confidence scale than those who took it online ($M = 2.855$, $SE = 0.11$) (see figure 15.). No significant interaction effect was observed between the scale score and the platform of the education ($F(2,116) = 1.525$, $p = 0.222$).

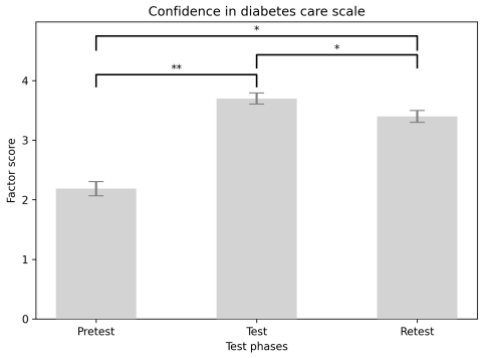

Figure 14. Main effect of Confidence in diabetes care scale considering the test phases

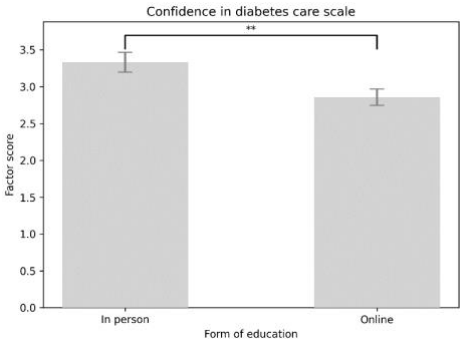

Figure 15. Main effect of the form of education cosidering Confidence in diabetes care scale scores

4.2.5. Discussion of results

In this study, we investigated whether a short, standardized diabetes education lecture could increase diabetes knowledge and improve attitudes and confidence in diabetes care. We also explored if the effects of the education could be different in-person than online. We hypothesized an increase in diabetes attitudes and confidence in diabetes care together with diabetes knowledge. There was a significant increase in knowledge and confidence levels, but no significant difference in most of the attitude scores after the education.

The results of the intervention showed a significant increase in diabetes knowledge from the pretest to the test and from the pretest to the retest. These findings suggest that the intervention effectively enhanced the diabetes knowledge of the participants. There was no significant difference between the test and retest sessions, hence the gained knowledge of participants was retained for 30 days.

Considering diabetes attitudes, uniquely, the scores of the Semantic difference showed a significant rise after education. Regarding the scores of the semantic differential the results of the intervention showed a significant increase from the pretest to the test and from the pretest to the retest sessions. The scores showed an upward trend after the education. The Emotional Effects and Social Support subscales of the DAS3 showed no significant improvement in scores after either in-person or online education, with in-person education showing upward trends and online education showing downward trends in later assessments. Similarly, the Integration and Distinction subscales of the School Personnel Diabetes Attitude Scale showed no significant post-education improvement, with in-person education showing upward trends and online education showing downward trends, but online participants exhibited less discrimination than in-person participants.

As for the Confidence in diabetes care we measure diabetes competence and recognition of hypoglycemia and hyperglycemia and the ability to provide appropriate diabetes care. The results showed significant improvements in these across all three measurement sessions. Participants scored higher on the test session compared to the pretest, and they scored higher on the test session compared to the retest session. Additionally, participants scored higher on the retest compared to the pretest.

For most of the phenomena measured, the in-person form of the education was found to be more effective, and led to higher levels of change. A significant increase in knowledge scores was observed in the online and the in-person training as well. However, teachers who participated in person had slightly higher knowledge scores than the ones who participated online. On the semantic differential scale, measuring attitudes, participants who received the education in-person scored higher after the education than participants who received it online. Those who attended the education in person had higher mean scores on the Confidence scale than those who participated online. This suggests that in-person education may be more effective in enhancing knowledge, building confidence, and changing attitudes towards diabetes care compared to online education.

5. Discussion

In our research we investigated diabetes care-related psychological factors among two groups of the microenvironment of children living with T1D: parents and teachers. The research incorporated three studies including the examination of diabetes care-related psychological factors (like self-efficacy and anxiety-like symptoms) related to diabetes management among parents and diabetes knowledge, experiences with diabetes care and attitudes towards it among teachers. The first study aimed to identify profiles related to the behavioral and anxiety-related reactions to hypoglycemia among parents. This study also analyzed differences among these profiles regarding demographical and diabetes care-related factors, such as parent's and children's age, child independence in T1D management and factors related to hypoglycemic episodes. The aim of the second study was to explore teachers' attitudes towards diabetes care using qualitative interviews, seeking to describe these attitudes within the cognitive, affective, and behavioral components framework and to understand their perceptions of their role in supporting children with T1D. Additionally, the third study aimed to investigate the effects of a short, standardized diabetes education program on teachers' diabetes knowledge, attitudes, and confidence in diabetes care. This education was delivered in both in-person and online formats, with a hypothesis that the program would enhance diabetes knowledge, positively influence attitudes, and increase confidence in diabetes care, with stronger effects expected from the in-person education.

In the first study, we identified five distinct profiles of parental FOH. The strength of our study is that we used LPA for the creation of subgroups. LPA is a person-oriented approach to analysis, hence providing more information about the individuals compared to other quantitative methods (Bergman et al., 2002). Our profiles show parallels with the subgroups identified by Anderbro and colleagues (2015), particularly with our "Worriers" group, which aligns with their high fear groups, as well as Maclean and colleagues' (2022) high fear and distress subgroup (cluster two). However, our study extends both findings by identifying a distinct Over-Insurers group, characterized by efforts to maintain high blood glucose levels and low worry scores, suggesting a unique coping strategy. It seems to be a novel identified category however the previously mentioned two studies used more variables for the subgrouping of their samples than us in our study, which should be noted when comparing these results.

Our results showed significant differences in parental age between the profiles, with the “Balanced” group having older parents compared to the “Over-Insurers” group. Additionally, the “Worriers” group had younger children compared to the “Balanced” group. This aligns with previous findings that parental FOH and involvement in management tasks tend to decrease as children grow older and gain more independence in their diabetes management (Anderson et al., 1990; L. Gonder-Frederick et al., 2011), and contradicts those studies reported no significant age-related differences in parental FOH (Aalders et al., 2018; Abitbol & Palmert, 2021; Haugstvedt et al., 2015; Van Gampelaere et al., 2019; Van Name et al., 2018; Viaene et al., 2017; Youngkin et al., 2021).

We found significant differences in diabetes distress levels across the profiles, with the “Worriers” group showing the highest levels of distress. This is consistent with previous research indicating that higher diabetes-related stress correlates with more intensive parental involvement and anxiety (Whittemore et al., 2012). The high distress levels in the “Worriers” group suggest a potential need for targeted, specific psychological interventions to help parents manage their stress and improve their coping mechanisms, as recommended by Fisher and colleagues (2010) in their observational study. Significant differences were observed in self-efficacy between the profiles, particularly between the “Worriers” and “Confidents” groups. The Worriers group reported lower self-efficacy, which aligns with the finding that low self-efficacy is associated with higher FOH (Herbert et al., 2015; Pate et al., 2019). This highlights the importance of enhancing self-efficacy in parents who show high FOH. Perceived problems in diabetes management varied significantly across profiles, with the “Worriers” group again showing the highest level. This finding is consistent with the notion that higher anxiety and stress can lead to greater perceived challenges in managing diabetes (Johnson, 1995; Streisand et al., 2005). Interventions aimed at reducing anxiety and improving problem-solving skills could also be beneficial for this group.

No significant differences were found in HbA1c levels or the number of severe and mild hypoglycemic episodes across the profiles. This contrasts with findings that there is a link between the two (Driscoll et al., 2016; Haugstvedt et al., 2010; S. R. Johnson et al., 2013; Patton et al., 2007). However, the upsetting nature of moderate and mild hypoglycemic episodes was significantly related to profile membership. The "Worriers" and the "Balanced" groups found mild hypoglycemic episodes to be the most upsetting, while the "Confidents" perceived these episodes as the least upsetting compared to the entire sample. The "Worriers" finding the episodes upsetting seems reasonable; however, the "Balanced" also finding them upsetting requires further explanation: their concern might specifically relate to experienced

hypoglycemic episodes and does not extend to other aspects of hypoglycemia, thus not permeating their daily lives as much. These results show that parental emotional responses to hypoglycemia can be more variable than the actual frequency of the episodes.

Building upon the insights gained from our second study, which utilized a qualitative methodology to explore teachers' perspectives of diabetes care, we found that unlike in previous studies (Amillategui et al., 2009; Olson et al., 2004; Pinelli et al., 2011), in general, teachers did not report negative attitudes towards diabetes. Teachers mentioned fear and expressed distress, specifically about the management of diabetes and about taking responsibility for the child's state. However, they were characterized by a sense of empathy, expressed through an integrative approach toward the child with diabetes and peers. Teachers expressed different experiences of the burden of the management of the disease; however, the child's autonomy in the management of diabetes had a positive impact on the experience of the burden. Being open about asking for help may also contribute to positive attitudes toward diabetes care, as teachers who had an open attitude toward diabetes felt that having specific knowledge was not a prerequisite for participating in care. This may refer to the findings of Olson and colleagues (2004), who found that teachers who were less likely to have sufficient knowledge about the disease were less "threatened" by the presence of children with diabetes in their classrooms.

When reviewing the literature on teaching children with chronic conditions, Hinton and Kirk (2015) also found that teachers are afraid of the risks involved with teaching children living with long-term conditions. These fears may originate from insufficient knowledge of diabetes and its management or from the feeling of being incapable to facilitate its management (Gormanous et al., 2002; Jarrett et al., 1993). In the qualitative study of Boden and colleagues (2012), the consequences of a lack of regulation within schools are reflected within teachers' perceptions of the care of children with diabetes. According to their results, the fear of diabetes care originates from a feeling of incompetence and the high sense of responsibility associated with it. In several other studies, teachers expressed a sense of uncertainty about caring for a child with diabetes due to their inability to deal with an emergency adequately and their concern about possible consequences (Amillategui et al., 2009; Olson et al., 2004; Pinelli et al., 2011).

According to our results teachers witness diabetes care in different ways; some find it scary, stressful, and burdensome, and others might find it easy. Furthermore, the presence of a child with diabetes may bring positive changes in the lives of children in the class, as several teachers have reported that through diabetes, the emphasis on healthy living and acceptance became a regular theme. This aspect may be a novel finding as previous studies (Amillategui et al., 2009;

Boden et al., 2012; Hinton & Kirk, 2015; Olson et al., 2004; Pinelli et al., 2011) did not report on such positive changes. Further research should be conducted to investigate the impact of the presence of a child with T1D on other children.

Considering the results of our third study. Results from studies with a similar design also showed an increase in knowledge for both in-person education (Bechara et al., 2018; Jarrett et al., 1993; Siminerio & Koerbel, 2000) and online education (Gutierrez, 2020; Taha et al., 2018; Zimmerman et al., 2022). Our study, however measured the effectiveness of a short, one-hour diabetes education and suggest that such a rapid education can have a significant impact on diabetes knowledge levels as well. In our research, the in-person form of education was found to be more effective than the online form, leading to higher levels of change for most of the measured phenomena. This result is in line with the findings of Husband and colleagues (2000) who found that a less interactive tool for education is not effective for increasing diabetes knowledge. It is also in line with the results of Gesteland et al. (1989) found that mass education is not an effective method of diabetes education for primary school teachers. In addition, this result confirms the importance of interactivity and the use of multimedia tools in online education (Gutierrez, 2020). However, contrary to our study the results of these studies are mostly about diabetes knowledge and not about diabetes attitudes.

Education had a positive impact on knowledge and confidence, increasing both. This was not the case for attitude, where differences were mainly between online and in-person measurements, with the online group showing a decreasing trend compared to the in-person group. In order to change attitudes, we propose interventions that are more interactive, with an emphasis on sensitization, and that provide a deeper insight into the daily lives and routines of the people involved in T1D. We might recommend the involvement of parents in the diabetes education of teachers just as in the study conducted by Jarret and colleagues (1993). It may also be advisable to introduce longer and/or repeated sessions to increase effectiveness. Future research should explore the relationship between diabetes knowledge and diabetes attitudes in more depth. Overall, face-to-face education was found to be more effective in our research. Our findings provide valuable insights for healthcare professionals and diabetes educators in designing effective interventions for teachers and guiding future research using diabetes education.

The care of children living with T1D necessitates a comprehensive approach that considers the interplay of biological, psychological, and social factors (Engel, 1979). Our findings emphasize the crucial role of the microenvironment, including parents and teachers, in supporting children with T1D (Bronfenbrenner, 1979; Roberts & Steele, 2009). The

identification of distinct parental profiles of fear of hypoglycemia (FOH) and the significant differences in diabetes distress and self-efficacy underscore the need for tailored psychological support to enhance diabetes management and overall family well-being (de Wit et al., 2020; Helgeson et al., 2012). Furthermore, teachers' attitudes towards diabetes care, characterized by empathy but also distress, highlights the importance of comprehensive diabetes education to alleviate fears and enhance their support for children's psychosocial development and integration (Farmer et al., 2011; National Association of School Nurses, 2016; Runions et al., 2020). Our intervention study demonstrates the effectiveness of in-person diabetes education in improving knowledge and confidence, underscoring the need for interactive and comprehensive training programs to better equip school personnel in managing diabetes-related tasks just as it was recommended by the American Diabetes Association (2011). These results illustrate that addressing the support needs of both parents and teachers is vital for improving the diabetes management and the overall well-being of children with T1D, aligning with the systems-oriented framework that considers the mutual influence of children living with T1D and their social context (Hobbs, 1966; Kazak et al., 1995; Power, 2003).

Limitations of the present studies

Our first study has limitations that should be considered when interpreting the results. First, the cross-sectional design does not allow for causal inferences of the relationships between the measured variables. Second, the use of self-report methods in our survey might introduce the potential bias of social desirability. Some important confounders, like general mental health status, were not assessed, and these might be useful for distinguishing between mental health issues and diabetes care-related anxiety-like symptoms.

Considering the qualitative research conducted with teachers we could not understand the perspectives of other parties who are involved in diabetes management in the school and kindergarten settings. Much could be gained from studying the experiences of children, parents, and teachers together. A limitation of our study involving diabetes education for teachers is that our sample size was relatively small and to perform group comparisons we could only include 24 and 36 participants. However, according to Cohen (2007) and Gall (1996), a minimum of 15 participants is needed to make comparisons between groups. Furthermore, in the case of online participants it was not possible to track the process of watching the video. We provided a step-by-step guide for the education and asked participants to follow the steps however we could not make sure whether steps were followed or not. In the case of the education in-person this issue was monitored. Furthermore, participants in online education would have been more

difficult to involve in the study if we have made attendance at the consultation after the education mandatory. Therefore, it was optional and only a few participants asked for this opportunity. Hence the comparison of the two groups in this regard is not sufficiently objective. Finally, most of the questionnaires used in our study were originally not validated for our target population. We adapted the original versions of the questionnaires for teachers ourselves. However, we verified the questionnaires statistically, which we found is not the case regarding other studies using interventions of diabetes education for school personnel.

6. Conclusions

In conclusion, our study extends the understanding of parental FOH by identifying distinct profiles that capture a range of behavioral and emotional responses to managing their child's T1D. Our findings emphasize that parents' anxiety-like symptoms can be categorized into specific profiles, which could be used in clinical practice. If the questionnaires utilized in our study for the measurement of some diabetes-related symptoms (FOH, DD) were used to screen parents in clinical settings, healthcare professionals could more easily identify parents who require targeted support. Furthermore, based on which profile they belong to, parents could receive specific interventions tailored to their unique needs. Regarding the reduction of anxiety-like symptoms related to T1D management, the ability to regulate emotions might create a sense of control for parents which could be beneficial for them to cope with the difficulties of T1D management. Based on this, effective support for parents may involve enhancing these emotional regulation skills. Addressing the diabetes-specific anxiety-related factors is an important part of supporting parents and improving the overall management of T1D in children.

Moreover, children living with T1D may face difficulties in the school environment. The role of teachers in facilitating children’s integration into the community is significant. Teachers may provide diabetes education to the child’s peers, and they may also help children to accept their condition and manage it more efficiently. Teachers’ general empathic approach means that they try to pay attention to the health management of the children, provide some flexibility in the daily routine, communicate with the parent about the child’s condition, and carry out tasks around blood glucose control with some help from the parents.

A short diabetes education can have a positive impact on diabetes knowledge and confidence, increasing both. However, this is not the case for diabetes attitude. In order to change attitudes, we propose interventions that are more interactive, with an emphasis on sensitization, and that provide a deeper insight into the daily lives and routines of the people involved in T1D. It may also be advisable to introduce longer and/or repeated sessions to increase effectiveness. Future research should explore the relationship between diabetes knowledge and diabetes attitudes in more depth. Regarding the online and in-person comparisons overall, face-to-face education was found to be more effective in our research. Our findings provide valuable insights for healthcare professionals and diabetes educators in

designing effective interventions for teachers and guiding future research using diabetes education.

The findings of the last two studies may guide more detailed examinations of associations between psychological, motivational, and environmental factors in the subject of diabetes management in schools and kindergartens. Professionals training teachers about diabetes management may benefit from our study. Based on our results, more emphasis should be placed on issues that cause distress and burden for teachers (e.g., what to do in case of extremely low blood glucose levels, managing blood glucose control) and the role of teachers in providing emotional support to children with diabetes (e.g., acceptance of T1D, peer sensitization, and education).

Addressing the support needs of the microenvironment surrounding children with diabetes is just as important as supporting the children themselves. As practical implications of our work, we provide recommendations on how to effectively support two key groups of the microenvironment of children living with T1D. For parents, it is suggested to focus on handling anxiety-related symptoms linked to diabetes care and supporting their coping mechanisms for handling these challenges. For teachers, it is essential to enhance their diabetes-related knowledge and to clarify any fear-inducing phenomena they encounter related to diabetes and its management. Acknowledging that teachers play a significant role not only in managing diabetes-related tasks but also in helping children cope with the psychological difficulties associated with the condition. These forms of support could contribute to the mental health and well-being of the microenvironment's members, thereby facilitating diabetes management and improving the health of children.

7. References

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9. Appendices

Questionnaires used in the first study: Parental fear of hypoglycemia, diabetes distress and self-efficacy related to diabetes management

Please fill in or underline the appropriate answer for the following questions:

I. Demographic Data:

1. How old are you? _____
2. Your gender: Male / Female
3. What is your highest level of education?
   1. Elementary school
   2. Vocational qualification
   3. High school diploma
   4. Higher education qualification
   5. College or university degree
   6. Other

3.1. If you selected "other," please describe your highest level of education: _____

4. What is your employment status?
   1. Student
   2. Unemployed/job seeker
   3. On maternity/paternity/childcare leave (GYES/GYED/GYOD - Nursing fee)
   4. Employee
   5. Entrepreneur
   6. Retired/disability pensioner
5. What is your marital status?
   1. Single
   2. Divorced
   3. Widowed
   4. Married
   5. In a relationship
6. What is your household's average monthly net total income?
   1. Less than 200,000 HUF
   2. 200,001-300,000 HUF
   3. 300,001-400,000 HUF
   4. 400,001-600,000 HUF
   5. 600,001-1,000,000 HUF
   6. More than 1,000,000 HUF

II. Diabetes-Related Data:

1. How old is your child living with type 1 diabetes? _____
2. The gender of your child living with diabetes: Boy / Girl
3. Besides your child with diabetes, how many other children do you have? _____
4. Please provide the ages of your non-diabetic children, separated by commas: _____
5. How much time has passed since your child was diagnosed with diabetes?

(Please round up your answer, e.g., if they were diagnosed one and a half months ago, enter 2 months):

_____

6. What device do you use for blood glucose monitoring? (Please mark the appropriate answer with an X)

	Only BGM

	CGM
	Primarily BGM but sometimes CGM during special periods (e.g.:illness, camp…)

6.1. If you use the CGM only during special periods (e.g., illness, camp), how many times per year does this occur? _____
6.2. If you use the sensor continuously, since when have you been using it? _____
7. What device do you use for insulin delivery? (Please mark the appropriate answer with an X!)

	Pen
	CSII

8. Since when have you been using the insulin delivery device indicated in the previous answer (pen/CSII) _____
9. How independent do you consider your child in diabetes management? (Please mark the appropriate answer with an X!)

	Not at all
	Partially independent
	Completely independent

III. **Self-efficacy related to diabetes management and perceived diabetes management problems** (Buzás et al., 2023)
To what extent do you agree with the following statements regarding your child's diabetes management?
Please indicate your answer on a scale of 1-5:
1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree
1. I am well aware of the possible treatments for my child's diabetes. 1 2 3 4 5
2. I am well aware of the devices suitable for treating my child's diabetes. 1 2 3 4 5
3. I understand what HbA1c is and why we monitor its value. 1 2 3 4 5
4. I use the devices chosen for my child's diabetes treatment effectively. 1 2 3 4 5
5. I am capable of effectively managing my child's diabetes. 1 2 3 4 5

How problematic do you find the following aspects of managing your child's diabetes?
Please indicate your answer on a scale of 1-5:
1 - Not at all problematic; 2 - Slightly problematic; 3 - Moderately problematic; 4 - Quite problematic; 5 - Very problematic

1. Controlling fluctuating blood sugar levels during the day 1 2 3 4 5
2. Controlling blood sugar levels at night 1 2 3 4 5
3. Adapting to the changed lifestyle 1 2 3 4 5

IV. Hypoglycemia Fear Survey- Parent version (HFSP) (Shepard et al., 2014)
This survey is intended to find out more about how low blood sugar makes people feel and behave.Please answer the following questions as frankly as possible.

I. Below is a list of things parents of children with diabetes sometimes DO IN ORDER TO AVOID LOW BLOOD SUGAR and related problems in their children. Read each item carefully. Circle one of the numbers that best describes YOU.
0 = NEVER 1 = RARELY 2 = SOMETIMES 3 = OFTEN 4 = ALMOST ALWAYS
1. Have my child eat large snacks at bedtime. 0 1 2 3 4
2. Avoid having my child being alone when his/her sugar is likely to be low. 0 1 2 3 4
3. Allow my child’s blood sugar to be a little high to be on the safe side. 0 1 2 3 4
4. Keep my child’s sugar higher when he/she will be alone for awhile. 0 1 2 3 4
5. Have my child eat something as soon as he/she feels the first sign of low blood sugar. 0 1 2 3 4

6. Reduce my child's insulin when I think his/her sugar is too low. 0 1 2 3 4
7. Keep my child's blood sugar higher when he/she plans to be away from me for awhile. 0 1 2 3 4
8. Have my child carry fast-acting sugar. 0 1 2 3 4
9. Have my child avoid a lot of exercise when I think his/her sugar is low. 0 1 2 3 4
10. Check my child's sugar often when he/she plans to go on an outing. 0 1 2 3 4
11. Get up in the middle of the night to check on my child or check my child's blood sugar levels. 0 1 2 3 4

II Worry: Below is a list of concerns parents of children with diabetes sometimes have. Read each item carefully. Circle one of the numbers that best describes HOW OFTEN YOU WORRY ABOUT EACH ITEM.

0 = NEVER 1 = RARELY 2 = SOMETIMES 3 = OFTEN 4 = ALMOST ALWAYS
12. Child not recognizing/realizing that he/she is having a low. 0 1 2 3 4
13. Child not having food, fruit, or juice with him/her. 0 1 2 3 4
14. Child feeling dizzy or passing out in public. 0 1 2 3 4
15. Child having a low while asleep. 0 1 2 3 4
16. Child embarrassing self or friends/family in a social situation. 0 1 2 3 4
17. Child having a low while alone. 0 1 2 3 4
18. Child appearing to be "stupid" or clumsy. 0 1 2 3 4
19. Child losing control of behavior due to low blood sugar. 0 1 2 3 4
20. No one being around to help my child during a low. 0 1 2 3 4
21. Child making a mistake or having an accident at school. 0 1 2 3 4
22. Child getting a bad evaluation at school because of something that happens when his/her sugar is low. 0 1 2 3 4
23. Child having seizures or convulsions. 0 1 2 3 4
24. Child developing long term complications from frequent low blood sugar. 0 1 2 3 4
25. Child feeling light-headed or faint. 0 1 2 3 4
26. Child having a low. 0 1 2 3 4

Parent HFS-II Part 2
Today's Date: _____
1a. In the PAST 12 MONTHS, how many times has your child experienced episodes of SEVERE HYPOGLYCEMIA? (Hypoglycemic episodes when your child's blood sugar was so low that he/she was unable to recognize symptoms, ask for help, or treat him/herself due to mental confusion or unconsciousness.)

Please put a check mark below by the number of episodes of severe hypoglycemia your child has had in the past 12 months.
__ 0 __ 1 __ 2 __ 3 __ 4 __ 5 __ 6 __ 7 __ 8 __ 9 or more

1b. In the PAST 12 MONTHS, how upsetting was your child's worst episode of SEVERE HYPOGLYCEMIA? Please circle the number below that best describes your child's worst episode of severe hypoglycemia.

Not at All Upsetting		Somewhat Upsetting		Extremely Upsetting
0	1	2	3	4

2a. In the PAST 6 MONTHS, how many times has your child experienced episodes of MODERATE HYPOGLYCEMIA? (Hypoglycemic episodes when your child's blood sugar was so low that it interfered with what he/she was doing and had to wait a while to recover.)

Please put a check mark below by the number of episodes of moderate hypoglycemia your child has experienced in the past 6 months.
__ 0 __ 1 __ 2 __ 3 __ 4 __ 5 __ 6 __ 7 __ 8 __ 9 or more

2b. In the PAST 6 MONTHS, how upsetting was your child's worst episode of MODERATE HYPOGLYCEMIA? Please circle the number below that best describes your child's worst episode of moderate hypoglycemia.

Not at All Upsetting		Somewhat Upsetting		Extremely Upsetting
0	1	2	3	4

3a. In the PAST MONTH, how many times has your child experience episodes of MILD HYPOGLYCEMIA? (Hypoglycemic episodes that caused symptoms but these went away quickly after your child ate or drank something and did not interfere with his/her ability to function.)

Please put a check mark by the number of episodes of mild hypoglycemia your child has experienced in the past month.

__ 0 __ 1 __ 2 __ 3 __ 4 __ 5 __ 6 __ 7 __ 8 __ 9 or more

3b. In the PAST MONTH, how upsetting was your child's worst episode of MILD HYPOGLYCEMIA? Please circle the number that best describes your child's worst episode of mild hypoglycemia.

Not at All Upsetting		Somewhat Upsetting		Extremely Upsetting
0	1	2	3	4

4a. What was your child's most recent hemoglobin A1c reading (also called glycosylated hemoglobin and glycated Hb) reading? _____
4b: What was the date when this A1c test was done? Month ____ Year _____
5a. What is your child's target range for his/her blood sugar levels? Fill in the blanks below:
I try not to let my child's blood sugar get BELOW_____, and I try not to let my chld's blood sugar get ABOVE _____.

V. The Problem Areas in Diabetes-Parent (PAID-P) (Evans et al., 2019).

INSTRUCTIONS: Living with diabetes can be very difficult at times. In everyday life, many problems and difficulties may arise in connection with your child's diabetes. The problems can range from minor problems to major life difficulties. Below, some potentially problematic areas are listed that may occur in the case of people with diabetes. Think over to what extent you were annoyed or bothered by the following statements **DURING THE LAST MONTH** and circle the appropriate number.

Please bear in mind that we are curious to know to what extent these statements were annoying for you in your life, **NOT** whether or not the statement is simply true for you. If you feel that a statement is not a problem or concern for you, please circle "1". If it is very troublesome for you, please circle "6".

	This is not a problem		Moderately problematic		Serious problem	
1. I feel sad when I think about my child suffering from diabetes and living with this disease.	1	2	3	4	5	6

2. I feel overburdened in connection with the management of the diabetes of my child.	1	2	3	4	5	6
3. I feel anger when I think about the fact that my child is suffering from diabetes and living with this disease.	1	2	3	4	5	6
4. I feel that I constantly worry about food and eating.	1	2	3	4	5	6
5. I worry about the future and about the possibility that severe complications may develop in the case of my child.	1	2	3	4	5	6
6. I feel irate when something "goes wrong" with the management of my child's diabetes.	1	2	3	4	5	6
7. I feel "burnt out" because of the efforts I am constantly making in connection with the management of my child's diabetes.	1	2	3	4	5	6
8. I feel that my child does not check his/her blood sugar level often enough.	1	2	3	4	5	6
9. I feel discouraged or defeated when I see high blood glucose level on my child's blood glucose meter.	1	2	3	4	5	6
10. I feel like I'm acting like the "diabetes commando" (e.g., I keep nagging on about eating right, checking blood sugar level, or that I am not trying hard enough).	1	2	3	4	5	6
11. I feel I can't trust my child to take care of his/her diabetes.	1	2	3	4	5	6
12. I feel I have to be perfect in managing my child's diabetes.	1	2	3	4	5	6
13. I worry that my child will miss or skip checking his/her blood sugar level.	1	2	3	4	5	6
14. I feel that my child's blood glucose level often fluctuates drastically.	1	2	3	4	5	6
15. I feel that I often fail in managing my child's diabetes.	1	2	3	4	5	6
16. I feel that I worry too much about my child's health complications.	1	2	3	4	5	6

References of the questionnaires:

Buzás, N., Horváth, M. D., Tesch, Z., & Hallgató, E. (2023). How online peer support affects management efficacy and mitigates difficulties of parents caring for children with type 1 diabetes. *Primary Care Diabetes*, *17*(6), 607–611.

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Shepard, J. A., Vajda, K., Nyer, M., Clarke, W., & Gonder-Frederick, L. (2014). Understanding the construct of fear of hypoglycemia in pediatric type 1 diabetes. *Journal of Pediatric Psychology*, *39*(10), 1115–1125.

Questionnaires used in the third study: Evaluating the impact of a short diabetes education intervention on teachers' diabetes knowledge, attitudes and confidence in diabetes care

Diabetes Knowledge Test 2 (DKT2) items rephrased for teachers (with 4 items omitted: 2, 3, 11, 12 and additional questions included) (Papp-Zipernovszky et al., 2021)

The following questions and statements are related to diabetes. Please read them carefully and mark the correct answer!

1. The diabetes diet is:
a. the way most Hungarian people eat b.b a healthy diet for most people
c. too high in carbohydrate for mostpeople
d. too high in protein for most people

2. Which of the following is a "free food"?
a. Any unsweetened food
b. Any food that has "fat free" on the label
c. Any food that has "sugar free" on the label
d. Any food that has less than 20 calories per serving

3. HbA1c is a measure of your average blood glucose level for the past:
a. day
b. week
c.b 6-12 weeks
d. 6 months

4. Which is the best method for home glucose testing?
a. Urine testing
b. Blood testing
c. Both are equally good

5. What effect does unsweetened fruit juice have on blood glucose?
a. Lowers it
b. Raises it
c. Has no effect

6. Which should not be used to treat a low blood glucose?
a. 3 hard candies
b. 1/2 cup orange juice
c. 1 cup diet soft drink d. 1 cup skim milk

7. For a person in good control, what effect does exercise have on blood glucose?
a. Lowers it
b. Raises it
c. Has no effect

8. What effect will an infection most likely have on blood glucose?
a. Lowers it
b. Raises it
c. Has no effect

9. Numbness and tingling may be symptoms of:
a. kidney disease

b.nerve disease
c. eye disease
d. liver disease

10. Which of the following is usually not associated with diabetes:
a. vision problems
b. kidney problems
c. nerve problems
d. lung problems

11. Signs of ketoacidosis (DKA) include: a. shakiness
b. sweating
c.vomiting
d. low blood glucose

12. If a person with diabetes is sick with the flu, you should: (modified)
a. Take less insulin
b. Drink less liquids
c. Eat more proteins
d.Test blood glucose more often

13. If the child with diabetes has taken rapid-acting insulin, you are most likely to have a low blood glucose reaction in: (modified)
a. Less than 2 hours
b. 3-5 hours
c. 6-12 hours
d. More than 13 hours

14. You realize just before lunch that the child with diabetes forgot to take your insulin at breakfast. What should you do now? (modified)
a. Skip lunch to lower your blood glucose
b. Take the insulin that you usually take at breakfast
c. Take twice as much insulin as you usually take at breakfast
d.Check your blood glucose level to decide how much insulin to take

15. If the child is beginning to have a low blood glucose reaction, he/she should:
a. exercise
b. lie down and rest
c.b drink some juice
d. take rapid-acting insulin

16. A low blood glucose reaction may be caused by:
a.b too much insulin
b. too little insulin
c. too much food
d. too little exercise

17. If the chils takes his/her morning insulin but skip breakfast, his/her blood glucose level will usually: (modified)
a. increase
b.decrease
c. remain the same

18. High blood glucose may be caused by: a.b not enough insulin (modified)

b. skipping meals
c. delaying snack
d. skipping exercise

19. A low blood glucose reaction may be caused by: (modified)
a.heavy exercise
b. infection
c. overeating
d. not taking insulin

20. The normal fasting blood glucose level is (added):
a. is below 6.9 mmol/l
b. is below 7,9 mmol/l
c. is below 9,9 mmol/l
d. is below 5,9 mmol/l

(added from: Bradbury, Smith, 1983):
21. If a diabetic child develops thirst, vomiting, and stomach pain is his blood sugar level likely to be low or high?
a. true
b. false
c. I don't know

22. If a diabetic child develops dizziness, sweating, and confusion is his blood sugar level likely to be low or high?
a. true
b. false
c. I don't know

(added from: Duraywish, Abdelsalam, 2017):
23. DM leads to polyuria in diabetic student
a. true
b. false
c. I don't know

24. DM leads to polydepsia in diabetic student.
a. true
b. false
c. I don't know

25. DM leads to fatigue and lack of concentration in diabetic student
a. true
b. false
c. I don't know

26. DM leads to loss of weight in diabetic student
a. true
b. false
c. I don't know

27. The diabetic student should take sweets or juices before physical activities class
a. true
b. false
c. I don't know

28...the person with diabetes is the most important member of the diabetes care team. (modified)
a. child
b. doctor
c. nurse
d. teacher
e. district/school health visitor
f. parent/guardian
g. child's peers

Diabetes Attitude Survey (DAS 3) – Reformulated items for teachers (with 15 items omitted) (Anderson et al., 1998)
The following statements are related to diabetes.
Each sentence continues with "I generally think that..." Please mark how much you agree with the statements (1 - Strongly agree, 2 - Agree, 3 - Neutral, 4 - Disagree, 5 - Strongly disagree)

Usually I think that:...
1...there is not much use in trying to have good blood sugar control because the complications of diabetes will happen anyway.
2...diabetes affects almost every part of a diabetic person's life.
3...the important decisions regarding daily diabetes care should be made by the parent of the child living with diabetes. (modified)
4...teachers should be taught how daily diabetes care affects patients' lives. (modified)
5...keeping the blood sugar close to normal can help to prevent the complications of diabetes.
6...teachers should do whatever it takes to keep their blood sugar close to normal (e.g.:managing hyprglicemia and hypoglycemia..). (modified)
7...the emotional effects of diabetes are pretty small.
8...people with diabetes should have the final say in setting their blood glucose goals.
9...diabetes is hard because you never get a break from it.
10...diabetes is a very serious disease. (modified)
11...having diabetes changes a person's outlook on life.
12...people who have diabetes will probably not get much payoff from tight control of their blood sugars.(modified)
13...tight blood sugar control is too much work.
14...it is frustrating for people with diabetes to take care of their disease.
15...people with diabetes have the right not to take good care of their diabetes.
16...support from family and friends is important in dealing with diabetes.
17…support from school personnel is important in dealing with diabetes.
18. Type 1 diabetes is incurable (modified)

School personnel diabetes attitude scale (Tannous, Khateeb, Khamra, Hadidi, Natour, 2012)

Please indicate to what extent you agree with the following 6 statements!
This time you can rate them from 1 to 6.
(1 – Strongly disagree - 6 - Strongly agree)

1. I have no problem in having information on how to deal with diabetic episodes when they occur.
2. Health problems related to diabetes are the issue of physicians only and not teachers.
3. Children with diabetes should be educated in the regular classroom.
4. School rules and regulations must take into account the special needs of children with diabetes.
5. People with diabetes can maintain a normal quality of life.
6. Teachers should have the same expectations from students with diabetes just like students without diabetes.
7. Children with diabetes might have a negative impact on their peers.

8. Families of individuals with diabetes do not need any special assistance or support.
9. Diabetes imposes pressures and constraints on the lifestyle of the family.
10. People with diabetes have their own psychological characteristics that distinguish them from everybody else.
11. Diabetes and medications affect the emotional, psychological and academic status of students with diabetes.
12. Children with diabetes should always be protected by their teachers.
13. DM increases abscence rate of diabetic student.

Confidence in Diabetes Care (Van der Ven et al., 2003):
Please indicate on a scale of 1-5 how confident you feel about the following statements.
(1 – Not at all – 5 – Completely)

Tudom, hogy mi a különbség az 1-es és a 2-es típusú cukorbetegség között. I know the difference between type 1 and type 2 diabetes. (modified)	1	2	3	4	5
I know what type 1 diabetes is. (modified)	1	2	3	4	5
I believe I can detect low levels of blood glucose. (modified)	1	2	3	4	5
I believe I can detect high levels of blood glucose. (modified)	1	2	3	4	5
I believe I can treat a low blood glucose correctly.	1	2	3	4	5
I believe I can treat a high blood glucose correctly.	1	2	3	4	5

Semantic differential about feelings related to diabetes care tasks (based on: Kiviniemi et al., 2007):
Checking blood glucose levels for me is:

Uncertain	1	2	3	4	5	Safe
Repulsive	1	2	3	4	5	Attractive
Frightening	1	2	3	4	5	Reassuring
Indifferent	1	2	3	4	5	Important
Burdensome	1	2	3	4	5	Simple
Useless	1	2	3	4	5	Useful

Administering insulin is:

Uncertain	1	2	3	4	5	Safe
Repulsive	1	2	3	4	5	Attractive
Frightening	1	2	3	4	5	Reassuring
Indifferent	1	2	3	4	5	Important
Burdensome	1	2	3	4	5	Simple
Useless	1	2	3	4	5	Useful

Treating hypoglycemia is:

Uncertain	1	2	3	4	5	Safe
Repulsive	1	2	3	4	5	Attractive
Frightening	1	2	3	4	5	Reassuring
Indifferent	1	2	3	4	5	Important
Burdensome	1	2	3	4	5	Simple
Useless	1	2	3	4	5	Useful

Treating hyperglycemia is:

Uncertain	1	2	3	4	5	Safe
Repulsive	1	2	3	4	5	Attractive

Frightening	1	2	3	4	5	Reassuring
Indifferent	1	2	3	4	5	Important
Burdensome	1	2	3	4	5	Simple
Useless	1	2	3	4	5	Useful

Demographic Data:

Age: .....

Gender: 1.Male 2. Female

Marital status: A. Single B. Divorced C. Widowed D. Married E. In a relationship

Highest level of education: A. Primary school B. Vocational school C. Secondary technical school D. High school E. College/University

Do you have any healthcare qualifications?

1. Yes: .....
2. No

Do you have diabetes?

1. Yes, Type 1
2. Yes, Type 2
3. No

Do you have a family member with diabetes? (If yes, please specify the relationship)

1. Yes:.....
2. No

Do you have a close acquaintance with diabetes? (If yes, please specify the relationship)

1. Yes:.....
2. No

What is your current position as a teacher: .....

How long have you been working as a teacher? .....

Do you have a child with diabetes in your class/group?

1. Yes
2. No

Is there a child with diabetes in the institution where you work?

1. Yes
2. No

Do you participate in the care of the diabetic child at your institution?

1. Yes, I actively help in managing the condition
2. Yes, I only monitor the child and notify the parents in case of any issues
3. No, and I do not want to
4. No, but I am open to it

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Papp-Zipernovszky, O., Klinovszky, A., & Buzás, N. (2021). Betegségismeret 2-es típusú diabetesszel élők körében: A Diabetes Knowledge Test 86agyar nyelvű validálása. *Orvosi Hetilap*, *162*(22), 870–877.

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