

Knowledge and Decision-Making among Israeli Dentists Treating Young Patients with Type 1 Diabetes Mellitus: A Cross-Sectional Survey

Sigalit Blumer*/Hila Eliasi **/Benjamin Peretz ***/Johnny Kharouba ****/ Ehud Jonas *****

Objective: To assess decision making process and knowledge level of dentists treating children with type 1 diabetes. **Study design:** Cross-sectional survey among dentistry residents and dental specialists working in clinics that provide dental care to children with type 1 diabetes. **Results:** A total of 166 respondents were included. 42% of respondents perceived that they have sufficient knowledge to treat children with diabetes, in correlation with an average score of 1.9 out of 4 on knowledge questions. Over 80% of dentists decided to treat patients by consulting with the treating physician or by checking HbA1c and glucose blood levels independently. Greater knowledge was associated with a significantly higher tendency of the dentists to determine if the child's diabetes is controlled, and to refer less often to the hospital. Furthermore, greater knowledge was also associated with dentists' greater perception that they have enough knowledge, skills and confidence to treat children with diabetes. **Conclusions:** The study revealed significant gaps in the knowledge on diabetes among dentists who provide dental care to children. Dentists, pediatricians, endocrinologists, and other healthcare professionals who provide care for children should be encouraged to collaborate to create a mutual knowledgeable work environment for delivering best care to their patients.

Keywords: children, dentistry; Type 1 diabetes mellitus, knowledge, decision making.

*Sigalit Blumer, DMD, Senior Lecturer, Head, the Department of Pediatric Dentistry, the Maurice and Gabriela Goldschleger School of Dental Medicine, Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel.

Hila Eliasi, DMD, Private Practice.

Benjamin Peretz, DMD, Professor Emeritus, the Department of Pediatric Dentistry, the Maurice and Gabriela Goldschleger School of Dental Medicine, Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel.

Johnny Kharouba, DMD, Lecturer, the Department of Pediatric Dentistry, the Maurice and Gabriela Goldschleger School of Dental Medicine, Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel.

Ehud Jonas, DMD, This study was performed as a partial fulfillment towards the degree of Doctor of Dental Medicine conferred by the Tel Aviv University.

Corresponding Author:

Sigalit Blumer

Department of Paediatric Dentistry, The Maurice and Gabriela Goldschleger School of Dental Medicine, the Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel.

Phone: +972-3-6409254

Fax: +972-3-6409250

E-mail: blumer@012.net.il

INTRODUCTION

Type 1 diabetes mellitus is the most common types of diabetes in children and adolescents, and one of the most common endocrine and metabolic conditions in childhood. It is estimated that 600,900 children under 15 years of age have a diagnosis of type 1 diabetes¹.

Diabetes is considered a predisposing factor for periodontitis due to vascular damage and oral flora changes, increasing the risk of periodontal tissue destruction. The severity of periodontal destruction depends on the duration of the disease and the degree of glycemic control^{2,3}. Children aged 6-18 with diabetes had more gingival inflammation, dental plaque accumulation and periodontal tissue destruction, clinical attachment loss, earlier dental eruption, and higher incidence of gingival bleeding in primary and permanent teeth than children without diabetes⁴⁻⁸. Accelerated dental development and tooth eruption has been reported in children under 10 years of age with diabetes, while a delay in dental development occurs in older children⁹. Type 1 diabetes also causes functional changes in the salivary glands. Children with type 1 diabetes have lower salivary flow rates, pH, and buffer capacity, and a higher glucose content in comparison to children without diabetes¹⁰, resulting a weaker salivary innate defense system, thus creating a threat to their oral and general health¹¹. In addition, children with type 1 diabetes have greater numbers of *mutans streptococci* colonies (a pathogenic pathogen for early childhood caries) in their saliva, and

significantly higher salivary sodium levels compared to children without diabetes^{12,13}.

In addition to the typical oral characteristics of children with type 1 diabetes, such patients may suddenly develop hypo- or hyper-glycemia. Therefore, dentists and other oral health providers must obtain from the child, his/her parents and the pediatric endocrinologist a comprehensive systemic health history, details of individual blood glucose management triggers, and they must understand the risks of hypo- or hyper-glycemia, and their management, in order to prepare an individually tailored oral health treatment plan¹⁴. Dentists must also be aware of the challenges of surgical treatment of patients with diabetes. Trauma of any kind, stress and surgery induce a neuroendocrine response that suppresses insulin secretion and stimulates the production of glucagon, cortisol, and catecholamines. These catabolic hormones impede insulin's action and may cause hyperglycemia and diabetic ketoacidosis. Hyperglycemia, in turn, impedes wound healing and promotes immune system dysfunction, thereby increasing the patient's susceptibility to infections after medical treatment and making it even more difficult to maintain disease control¹⁵. Therefore, it is important to maintain normal blood glucose levels before, after, and during medical treatment. In addition, routine care for the prevention of infections, such as periodontitis, is important in controlling the disease. Dentists who approach children with diabetes should put a special emphasis on educating and clarifying the risks of diabetes complications to both parents and their children.

Several studies have reported insufficient knowledge among dentists and general practitioners in relation to dental treatment of adults with diabetes¹⁶⁻²⁰. A search of the literature has revealed very little guidance for dentists who treat children with type 1 diabetes despite the great complexity involved in treating such children. In this study we assessed knowledge, decision-making and perceptions relating to treatment of children with type 1 diabetes among dentists who provide dental care to children, in order to determine if treatment guidelines on pediatric dental patients with diabetes are necessary.

METHOD

Study setting and participants

This was a cross-sectional survey conducted among dentistry residents and dental specialists who work in clinics providing dental care to children. Between November 2011 and April 2018, an anonymous questionnaire was distributed at the School of Dentistry at Tel Aviv University, in dental clinics, and at two professional conferences: the "Israeli Society of Dentistry in Children" Meeting and the "Israel Dental Association" Meeting. All conference attendees received the questionnaires in the conferences package upon arrival at the conference registration desk. The questionnaires were completed by the respondents anonymously and left at the registration desk. At the end of the conference the questionnaires were collected by the researchers. Incomplete questionnaires were excluded from the analysis.

To assess the sample size required for this study, a power calculation was conducted using the G-power software, guided by the following assumptions: Type 1 error of 0.05, desired power of 0.80 and a moderate effect size for the association between knowledge and decision-making considerations ($r=0.2$). The minimum sample size required to meet these criteria is 153 participants.

Questionnaire

The questionnaire was constructed by the investigators and was reviewed by an endocrinologist specialist who is the head of the diabetes unit in a major hospital. The questionnaire comprised a total of 26 items, including 8 questions on participant demographics and professional characteristics, one multiple choice question on respondents' means for attaining updates in this field, 4 multiple choice questions on knowledge about type 1 diabetes, 4 multiple choice questions on decision making when treating children with type 1 diabetes, and 8 statements on respondents' perceptions regarding treatment of such children, with answers ranging from 1 (I completely disagree) to 5 (I completely agree).

Statistical analysis

Continuous variables were summarized using mean and standard deviation and categorical variables were summarized using number and percentage.

Independent t-tests were performed to compare knowledge scores or decision-making scores by various demographic parameters. Linear regression was performed to examine the associations between continuous demographic variables and knowledge or decisions making, as well as to examine the association between knowledge and decision making in multivariate models in order to control potential confounders. Multivariate regression models were adjusted for the following confounders: sex, age and professional status (resident vs. licenced). Data were analyzed using the SPSS software version 23.0 (IBM Corporation, Armonk, NY). P values less than 0.05 were considered statistically significant.

RESULTS

Participants' demographic and professional characteristics

A total of 166 respondents, most of them women (71.1%) with a mean age of 39.4 ± 8.9 years (range, 24-75 years) provided complete questionnaires and were included in the analysis. All of the respondents work in clinics that provide dental care to children. The respondents' demographic and professional characteristics are summarized in Table 1. Most of the respondents (71%) studied dentistry in Israel. Forty-two percent are general dentists who also treat children, 27% are pediatric dentistry specialists and 17% are pediatric dentistry residents. Thirty percent of respondents work in a private clinic, 29% work in a public clinic and the rest (41%) work in both types of clinics. Over half of the respondents (55.3%) are affiliated with an academic institution (teaching and/or research).

When asked how they attain professional updates on treatment guidelines, 83% of respondents reported doing so through professional meetings, 65% through the internet, 61% through professional journals, 52% gain updates from their colleagues and 44% through books. Only 38% of respondents reported attaining updates on new treatments for diabetes in the last year. The rest had last received updates 3-10 years before the study.

Dentists' perceptions on treating children with diabetes

As shown in Figure 1, 42% of respondents agreed or strongly agreed that they have sufficient knowledge and skills to treat children with diabetes, 58% agreed or strongly agreed that they have

Table 1. Participants' demographic and professional characteristics

Parameter	Study population N=166
Age, years	39.4 ± 8.91
Gender	
Female	118 (71.1%)
Male	48 (28.9%)
Country/region where participant studies dentistry	
Israel	118 (71%)
Eastern Europe	23 (14%)
Western Europe and North America	12 (7%)
Middle East*	7 (4%)
South America	5 (3%)
Asia	1 (1%)
Specialty**	
General dentist	70 (42%)
Pediatric dentist	44 (27%)
Pediatric dentistry resident	28 (17%)
Endodontist/endodontics resident	17 (10%)
Other (oral medicine, orthodontics, periodontics, public health dentistry, oral surgery) specialists/residents	7 (4%)
Clinic type	
Private and public	68 (41%)
Private	50 (30%)
Public	48 (29%)
Affiliation with an academic institution (teaching and/or research)	88 (53%)
Number of years practicing dentistry	14 ± 9.3
Means for gaining professional updates	
Professional meetings/conferences	138 (83%)
Internet	108 (65%)
Professional journals	101 (61%)
Colleagues	86 (52%)
Books	73 (44%)
Time since the participant last received/read updates on new diabetes treatments	
One year	63 (38%)
Three years	55 (33%)
Five years	25 (15%)
10 years	23 (14%)

Continuous variables are presented as mean and standard deviation and categorical variables are presented as number and percentage.

*Other than Israel; **All respondents work in clinics that provide dental treatments to children.

the skills/tools to identify and treat hypoglycemia in children with diabetes, and 47% strongly agreed or agreed that they feel confident to treat children with type 1 diabetes. Most dentists (66%) disagreed or strongly disagreed with the statement “only specialist pediatric dentists are allowed treat children with diabetes”.

Dentists' knowledge on diabetes

The questions that assessed respondents' knowledge and the percentage of respondents that answered them correctly are shown in Table 2. The average score for the knowledge questions was 1.9 out of 4 (median score, 2).

Dentists' decision making

Four questions assessed respondents' decision making when approaching pediatric patients with type 1 diabetes with typical cases in dentistry (Figure 2). In 3 questions, over 80% of dentists replied that they would treat such patients after additional consultation – either by consulting with the treating physician, or by checking HbA1c and glucose blood levels. In an additional question that asked about evaluating metabolic control in these patients, 44% of dentists said that they would ask the patient's treating physician and 40% said that would check glucose levels with a glucometer (Figure 3). However, of the dentists who answered that they would use a glucometer to assess the patient's glucose levels, 55% did not correctly answer the knowledge questions on the range of glucose levels that allow treating children with type 1 diabetes safely.

Association between demographic and professional parameters and dentists' knowledge on patients with diabetes

Prior to hypotheses testing, we tested the knowledge variable for normal distribution. Results showed a relatively normal distribution by Shapiro-Wilk test ($p=0.841$). Gender, age, the number of years of professional experience, affiliation to an academic institution, or the country where the respondent had studied dentistry, did not affect knowledge levels. General dentists had significantly lower mean knowledge levels compared to other specialties (1.73 ± 0.73 vs. 2.04 ± 0.97 , $p=0.031$). Respondents who work exclusively in private clinics had significantly mean lower knowledge compared to the other respondents (1.49 ± 0.87 vs. 2.09 ± 0.95 , $p<0.0001$), while respondents who work in both private and public clinics had the greatest knowledge compared to respondents who work exclusively in one type of clinic (2.15 ± 0.96 vs. 1.75 ± 0.93 , $p<0.01$).

To assess the knowledge in a multivariate model, a linear regression model was performed. In this model the average score of knowledge was the dependent variable, the time of updating was independent variable. A significant negative correlation was found between the time since the last update and dentists' knowledge: knowledge levels were higher in dentists who had received updates more recently ($B = -0.068$, $SE B = 0.025$, $\beta = -.212$; $R^2=0.45$, $F(4,161)=7.72$, $p<0.01$).

Dentists who acquire updates through professional meetings had significantly higher knowledge than dentists who acquire updates by other means (1.98 ± 0.94 vs. 1.57 ± 1.05 , $p=0.046$). Dentists who acquire updates through professional journals showed a trend for significantly higher knowledge than dentists who acquire updates by other means (2.01 ± 0.96 vs. 1.74 ± 0.94 , $p=0.077$).

Association between demographic and professional parameters and dentists' decision making

Figure 1. Respondents' perceptions on treating children with type 1 diabetes. The percentage of respondents that agreed or disagreed with each statement.

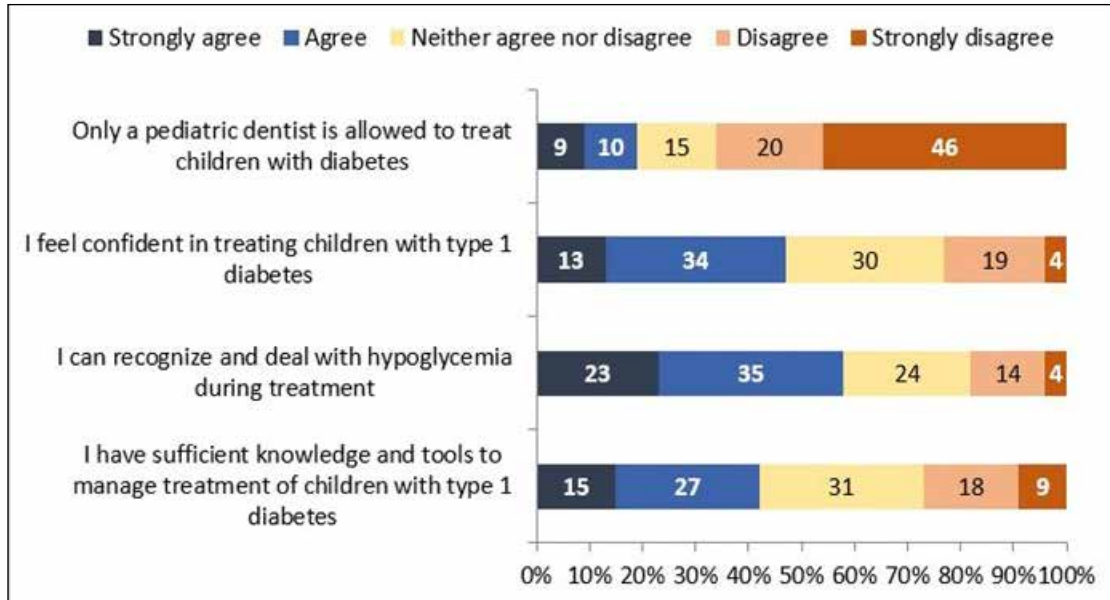


Table 2. Assessment of participants' knowledge

Question	Correct answer	Subjects who answered correctly n (%)
Is there a limit for using local anesthetics containing adrenalin 1:100000 in patients with diabetes?	No limit	116 (70%)
Is it necessary to administer prophylactic antibiotics to children with metabolically imbalanced type 1 diabetes?	No	75 (45%)
What are the blood glucose levels that allow safe treatment of children with type 1 diabetes?	101-250 mg/dl	70 (42%)
What is the recommended HbA1c value for children with type 1 diabetes?	7.5% (58 mmol/mol)	7 (4.2%)

Figure 2. Respondents' treatment decisions regarding typical dental cases of children with type 1 diabetes

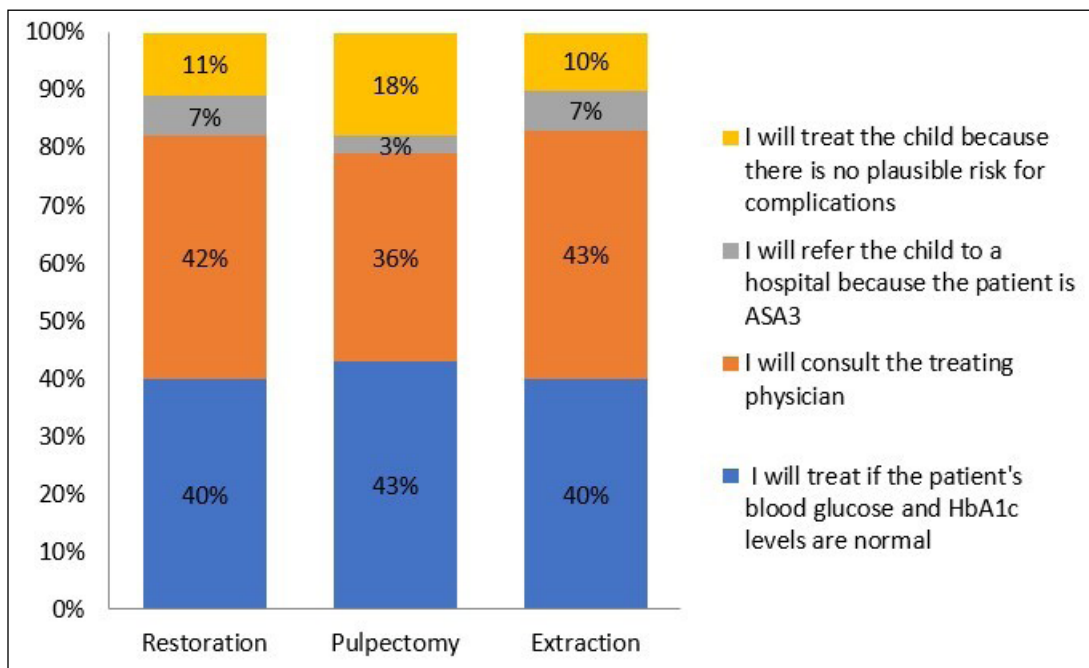
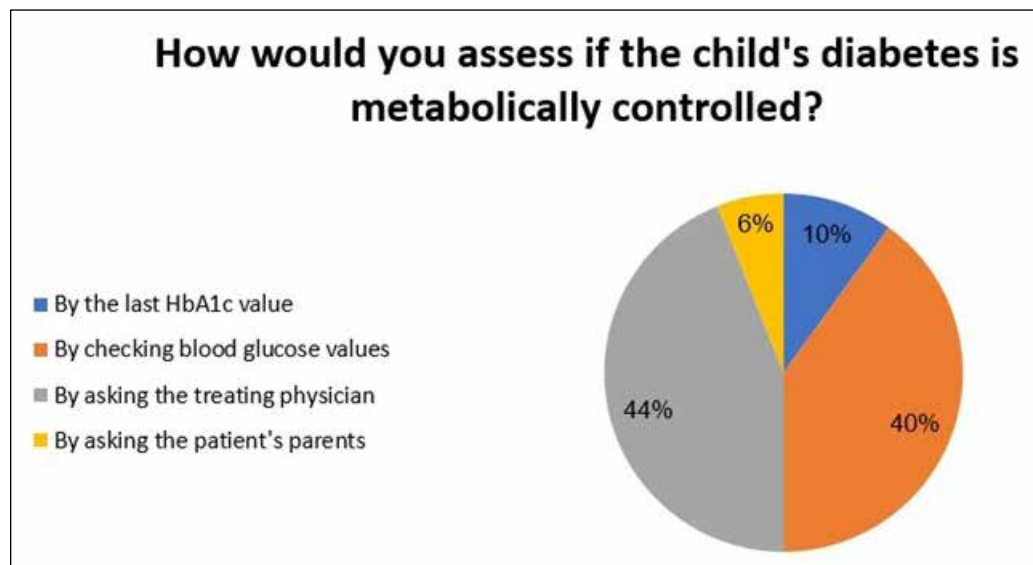


Figure 3. Respondents' assessments whether the patient's diabetes is controlled



The associations between professional and demographic variables and decision-making were calculated. Dentists' decision-making items were aggregated by average, showing a high internal reliability (Cronbach's alpha = 0.70), and a general average score of 2.41.

Pediatric dentists showed a significantly higher tendency to refer their patients to hospitals or to consult with the treating physician (2.22 ± 0.55 vs. 2.48 ± 0.57 , $p < 0.011$). Gender, age, the number of years of professional experience, affiliation to an academic institution, the country where the respondent had studied dentistry, the type of clinic where the dentist works, the time since the dentist's last update or the means of acquiring updates were not associated with the dentist's decision-making process.

Association between dentists' perceptions, knowledge on patients with diabetes and decision making

Greater knowledge was associated with a significantly higher tendency of the dentists to determine if the children's diabetes is controlled, to consult less often with the child's treating physician and to refer less often to the hospital ($B = 0.128$, $SE B = 0.045$, $\beta = 0.231$; $R^2 = 0.53$, $F(4,161) = 9.22$, $p < 0.01$).

Greater knowledge was also associated with higher perception that they have the knowledge and sufficient tools/skills to treat children with diabetes ($B = 0.472$, $SE B = 0.088$, $\beta = 0.391$; $R^2 = 0.15$, $F(4,161) = 28.74$, $p < 0.01$), with higher perceptions that they the tools to identify and treat hypoglycemia in these patients ($B = 0.23$, $SE B = 0.090$, $\beta = 0.200$; $R^2 = 0.04$, $F(1,161) = 6.69$, $p < 0.05$), and with greater confidence to treat children with diabetes ($B = 0.343$, $SE B = 0.081$, $\beta = 0.316$; $R^2 = 0.1$, $F(4,161) = 17.70$, $p < 0.01$).

There was a correlation between dentists who agreed with the statement "only pediatric dentists are allowed treat children with diabetes" and dentists who referred their patients to hospitals or to consult with the treating physician ($B = -0.733$, $SE B = 0.174$, $\beta = -0.315$; $R^2 = 0.1$, $F(4,161) = 17.75$, $p < 0.01$). Dentist with less knowledge also showed a trend for agreeing with this statement ($p = 0.057$).

DISCUSSION

The findings of this study indicate that dentists, including pediatric dentists and pediatric dentistry residents who provide dental care to children have insufficient knowledge regarding children with type 1 diabetes. This finding is consistent with previous studies that showed insufficient knowledge on treating adults with diabetes among dentists¹⁶⁻²⁰. Less than half of the respondents did not know the range of glucose blood levels or the value of HbA1c that allow safe treatment of children with diabetes. This lack of knowledge increases treatment risk as children with low blood glucose levels may be at risk for hypoglycemia, while higher-than-normal glucose levels may lead to decreased wound healing and infections.

Treatment of diabetes, and particularly elevated blood glucose levels, is essential for reducing and preventing the disease's symptoms and complications. According to the American Diabetes Association, children and adolescents with diabetes should maintain glycated hemoglobin (HbA1c) levels of 7.5% (58 mmol/mol)²¹. Although some physicians do not attribute much importance to HbA1c in children because this value's accuracy is affected by many factors^{22, 23}, HbA1c provides a retrospective picture of diabetes control over the previous few months²⁴. High HbA1c values are associated with hyperglycemia complications such as diabetic retinopathy, diabetic neuropathy, diabetic nephropathy²⁵, reduced wound healing²⁶, reduced host resistance to infections²⁷ and periodontitis²⁸. Low HbA1c values indicate an excessive risk of hypoglycemic events that can result in prolonged hospitalization and even death²⁹. Moreover, children younger than 5 years are at a higher risk when they are hypoglycemic because they are unable to properly explain their feelings, thus delaying the diagnosis and treatment of the event³⁰.

In a survey on knowledge on adults with diabetes, conducted among general and specialist dentists in Kuwait, dentists' older age, but not their seniority, was associated with greater knowledge on this issue¹⁹. In our study, the respondents' seniority in dentistry and older age were not associated with greater knowledge. Rather, respondents who received professional updates more recently had greater knowledge. Moreover, knowledge levels of respondents

who attend conferences were significantly higher than knowledge levels of those who did not attend conferences. This finding indicates that the participation in various conferences and encounters with dentists and specialists from different fields increases participants' knowledge and exposes them to the most recent relevant research carried out in the area of their professionalization. Respondents who received their professional updates from professional scientific journals also had greater knowledge. It is plausible that respondents who are more interested in expanding their knowledge tend to attend more conferences or read journals to keep up with advances in dentistry.

Despite the exposure of most of the respondents to updates in their fields through professional conferences, journals or academic courses, both general dentists who work with children and pediatric dentists had lower-than-average knowledge on treating children with diabetes.

Our findings provide a clear advantage to combining work in a private and public clinic as those who reported working in both types of clinics had significantly greater knowledge than those who reported working only in one type of clinic. The economic benefits of working in a private clinic together with the ability to consult and discuss cases with other oral health professionals while working in a public clinic (which usually employs several dentists), may give such dentists an advantage.

Most participants chose a similar treatment approach whereby they chose to treat the child after examining the patients' medical condition, by themselves, before the treatment, or after consulting with a physician. Greater knowledge was associated with lower tendency to consult with other physicians or to refer the child to a hospital, probably because the respondent makes informed decisions. Therefore, greater knowledge may also result in reduced burden on the health system and higher system efficiency, as fewer children would be referred to the hospital or to other physicians prior to starting dental treatment.

Many of the respondents reported that they lack confidence to treat children with diabetes, that they do not have enough knowledge and skills to treat children with diabetes and that they do not know how to identify and treat hypoglycemia. Greater knowledge was associated with the perception of having sufficient knowledge and tools to treat children with type 1 diabetes as well as with greater confidence to treat such patients and with the ability to cope with hypoglycemic events. The results indicate that the respondents can self-assess their ability to cope with the challenges they face, but many feel insecure about dealing with these children adequately. Similarly, in a study conducted in the United States, less than half of the dentists felt confident to correctly evaluate and treat patients with diabetes³¹.

The findings present an encouraging picture; the participants had a good perception of their ability to cope with treatment of children with type 1 diabetes. Although their level of knowledge is insufficient, they seem to know how to manage the medical treatment responsibly and professionally. Thus, when they feel that they do not have the skills to treat the patient safely, they establish contacts with other physicians and even refer the patients to the hospitals to avoid unnecessary complications.

The study has some limitations. First, a convenience sample was used for the study population; some of the study population

was recruited at professional dentistry conferences and from among attendees of academic courses, hence our findings may not represent the entire dentist population. According to the Israeli Ministry of Health, in 2019 there were a total of 12,038 licensed dentists in Israel, of which 9,874 were younger than 67 years. The proportion of female dentists is 40% of the entire dentist population and 46% of dentists 45 years of age or younger³². In contrast, 71% of the respondents in the study were female. Moreover, as some of the respondents were recruited to the study at professional meetings, they represent professionals seeking learning and knowledge, suggesting that the extent of knowledge on type 1 diabetes in children among the entire dentist population may be overestimated. Second, although the questionnaires were anonymous and the investigators' names were not mentioned on the questionnaires, the respondent's answers may have been affected by social desirability bias when answering some of the questions, suggesting that reporting of confidence in treating children with diabetes may have been overestimated. Third, we have no information on the rate of non-responders. We can assume that dentists who did not complete the questionnaires either do not treat children with diabetes or did not feel confident to complete a questionnaire that questions their knowledge on the subject.

Policy Implications

Our findings suggest that knowledge on treating children with type-1 diabetes should be increased among dentists. This is particularly relevant to general dentists who provide dental care to children as well as to dentists who only work in private clinics, as knowledge was lowest in these two groups. Increasing knowledge among all dentists who provide dental care to children—from all specialties—is expected to deliver safer and more optimal treatment of these children, as well as to reduce the burden on hospitals and specialists, to save health system resources and to prevent loss of chair time for dentists referring patients to hospitals.

To increase knowledge among dentists who provide dental care to children, guidelines on treating children with type 1 diabetes should be written. This will enable access to reliable professional information, prevent uncertainty and doubt, prevent erroneous decisions, and add to the dentist's confidence in caring for these children. For example, the European Federation of Periodontology and the International Diabetes Federation have jointly published consensus guidelines for physicians, oral healthcare professionals and patients to improve early diagnosis, prevention and co-management of diabetes and periodontitis. According to their recommendations (1) Oral health education should be provided to all patients with diabetes; (2) Diabetes care visits should include investigation for the presence of periodontal disease; (3) Referrals for oral health screenings and periodontal examinations should be made for children and adolescents diagnosed with diabetes and for all people with newly diagnosed diabetes mellitus; (4) Annual screening for early signs of periodontal involvement and dental caries is recommended for children and adolescents with diabetes starting as early as possible³³.

It is important to remember, however, that despite the extensive literature and guidance on dental treatment of adults with diabetes, studies have shown insufficient knowledge on dental care of patients with diabetes as well as a lack of collaboration between dentists, physicians and other healthcare professionals^{17, 34-37}. In a study that investigated the awareness among pediatric diabetes

care teams across England and Wales of diabetes as a risk factor for periodontal disease, most participants (76.2%) were aware that periodontitis is a possible complication of diabetes, but only 5.2% screened for periodontal issues and 4.8% received training for recognizing patients who require dental care for their periodontal health. In addition, 27% stated that oral advice is not typically given to patients at their clinics and 76.4% said that patients are rarely or never referred to an external dental service for their periodontal health³⁷. Therefore, writing guidelines and access to professional literature on the subject cannot be the sole solution to this problem.

To address this problem, dentists, pediatricians, endocrinologists, and other related healthcare professionals should be encouraged to collaborate in order to create a mutual work environment for providing best care to pediatric patients with diabetes. This may be done by continuing education and professional development programs that would make dentists and clinicians feel competent in providing care for this patient population. Moreover, dentists, pediatricians and endocrinologists should work together to raise awareness among parents regarding the importance of maintaining oral health among children with diabetes. Guidance to parents of children with diabetes should also be established and disseminated. Such collaborations may also be extended to additional oral health-related conditions, that affect pediatric patients' general health and vice versa.

CONCLUSIONS

This study revealed significant gaps in the knowledge on diabetes among dentists who provide dental care to children. In an age when the medical world is moving toward maximizing medical care for the patient, dentists, pediatricians, endocrinologists, and other healthcare professionals who provide care for children should be encouraged to collaborate to create a mutual knowledgeable work environment for delivering best care to their patients.

Acknowledgments

The authors thank Dr. Zohar Landau, Pediatric Endocrinologist, Head of Pediatrics Department, Barzilai Medical Center, Ashkelon, Israel, for her help with preparing the questionnaire.

DECLARATIONS

Ethics approval and consent to participate

The study was approved by Tel Aviv University's Ethics Committee. Informed consent was obtained from participants before they completed the questionnaire.

Availability of data and material

The datasets analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests in this research.

Funding

This research received no external funding.

REFERENCES

- Patterson CC, Karuranga S, Salpea P, et al. Worldwide estimates of incidence, prevalence and mortality of type 1 diabetes in children and adolescents: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Research and Clinical Practice*. 2019;157.
- Preshaw PM, Alba AL, Herrera D, et al. Periodontitis and diabetes: a two-way relationship. *Diabetologia*. 2012;55:21-31.
- Loe H. Periodontal disease. The sixth complication of diabetes mellitus. *Diabetes Care*. 1993;16:329-334.
- Lalla E, Cheng B, Lal S, et al. Diabetes mellitus promotes periodontal destruction in children. *Journal of clinical periodontology*. 2007;34 4:294-298.
- Dakovic D. Periodontal Disease in Children and Adolescents With Type 1 Diabetes in Serbia. *Journal of periodontology*. 2008;79:987-992.
- Yaacob M, Han TM, Ardini YD, et al. Periodontal diseases in children and adolescent with diabetes mellitus. *Materials Today: Proceedings*. 2019;16:2292-2301.
- Ismail AF, McGrath CP, Yiu CK. Oral health of children with type 1 diabetes mellitus: A systematic review. *Diabetes Res Clin Pract*. 2015;108:369-381.
- Novotna M, Podzimek S, Broukal Z, Lencova E, Duskova J. Periodontal Diseases and Dental Caries in Children with Type 1 Diabetes Mellitus. *Mediators Inflamm*. 2015;2015:379626.
- Orbak R, Simsek S, Orbak Z, Kavrut F, Colak M. The influence of type-1 diabetes mellitus on dentition and oral health in children and adolescents. *Yonsei Med J*. 2008;49:357-365.
- Carneiro VL, Fraiz FC, Ferreira Fde M, Pintarelli TP, Oliveira AC, Boguszewski MC. The influence of glycemic control on the oral health of children and adolescents with diabetes mellitus type 1. *Arch Endocrinol Metab*. 2015;59:535-540.
- Zalewska A, Knas M, Kuzmiuk A, et al. Salivary innate defense system in type 1 diabetes mellitus in children with mixed and permanent dentition. *Acta Odontol Scand*. 2013;71:1493-1500.
- Blumer S, Eliasi H, Rachmiel M, et al. Oral Health in Young Children with Type 1 Diabetes Mellitus. *Archives of Pediatrics*. 2018;2018:1-8.
- Siudikiene J, Machiulskiene V, Nyvad B, Tenovuo J, Nedzelskiene I. Dental caries and salivary status in children with type 1 diabetes mellitus, related to the metabolic control of the disease. *Eur J Oral Sci*. 2006;114:8-14.
- Bimstein E, Zangen D, Abedrahim W, Katz J. Type 1 Diabetes Mellitus (Juvenile Diabetes)—A Review for the Pediatric Oral Health Provider. *J Clin Pediatr Dent*. 2019;43:417-423.
- Rhodes ET, Ferrari LR, Wolfsdorf JI. Perioperative management of pediatric surgical patients with diabetes mellitus. *Anesth Analg*. 2005;101:986-999, table of contents.
- Al-Khabbaz AK, Al-Shammari KF, Al-Saleh NA. Knowledge about the association between periodontal diseases and diabetes mellitus: contrasting dentists and physicians. *J Periodontol*. 2011;82:360-366.
- Lin H, Zhang H, Yan Y, et al. Knowledge, awareness, and behaviors of endocrinologists and dentists for the relationship between diabetes and periodontitis. *Diabetes Res Clin Pract*. 2014;106:428-434.
- Saxena K, Sharma ML, Vijay B, Dhillion M. Knowledge, Attitude and Practice assessment of dental professionals towards diabetes: a cross sectional study. *J Dent Spec*. 2016;4:113-118.
- Al-Khabbaz AK, Al-Shammari KF. Diabetes mellitus and periodontal health: dentists' knowledge. *Med Princ Pract*. 2011;20:538-544.
- Bahammam MA. Awareness and practice about the association between periodontal diseases and diabetes mellitus: a cross-sectional study in Western Saudi Arabia among health care providers. *J Multidiscip Healthc*. 2018;11:511-517.
- American Diabetes A. 6. Glycemic Targets: Standards of Medical Care in Diabetes-2018. *Diabetes Care*. 2018;41:S55-S64.
- Beck RW, Connor CG, Mullen DM, Wesley DM, Bergenstal RM. The Fallacy of Average: How Using HbA1c Alone to Assess Glycemic Control Can Be Misleading. *Diabetes Care*. 2017;40:994-999.
- Juvenile Diabetes Research Foundation Continuous Glucose Monitoring Study G, Wilson DM, Xing D, et al. Hemoglobin A1c and mean glucose in patients with type 1 diabetes: analysis of data from the Juvenile Diabetes Research Foundation continuous glucose monitoring randomized trial. *Diabetes Care*. 2011;34:540-544.

24. Sherwani SI, Khan HA, Ekhzaimy A, Masood A, Sakharkar MK. Significance of HbA1c Test in Diagnosis and Prognosis of Diabetic Patients. *Biomark Insights*. 2016;11:95-104.
25. Lind M, Pivodic A, Svensson A-M, Ólafsdóttir AF, Wedel H, Ludvigsson J. HbA_{1c} level as a risk factor for retinopathy and nephropathy in children and adults with type 1 diabetes: Swedish population based cohort study. *BMJ*. 2019;366:14894.
26. Christman AL, Selvin E, Margolis DJ, Lazarus GS, Garza LA. Hemoglobin A1c predicts healing rate in diabetic wounds. *J Invest Dermatol*. 2011;131:2121-2127.
27. Critchley JA, Carey IM, Harris T, DeWilde S, Hosking FJ, Cook DG. Glycemic Control and Risk of Infections Among People With Type 1 or Type 2 Diabetes in a Large Primary Care Cohort Study. *Diabetes Care*. 2018;41:2127-2135.
28. Preshaw PM, Bissett SM. Periodontitis and diabetes. *British Dental Journal*. 2019;227:577-584.
29. Kalra S, Mukherjee JJ, Venkataraman S, et al. Hypoglycemia: The neglected complication. *Indian J Endocrinol Metab*. 2013;17:819-834.
30. Rewers M, Pihoker C, Donaghue K, Hanas R, Swift P, Klingensmith GJ. Assessment and monitoring of glycemic control in children and adolescents with diabetes. *Pediatr Diabetes*. 2009;10 Suppl 12:71-81.
31. Esmeili T, Ellison J, Walsh MM. Dentists' attitudes and practices related to diabetes in the dental setting. *J Public Health Dent*. 2010;70:108-114.
32. The Workforce in the Health Professions 2019 Jerusalem: Israeli Ministry of Health; 2020.
33. Sanz M, Ceriello A, Buyschaert M, et al. Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the International diabetes Federation and the European Federation of Periodontology. *Diabetes Res Clin Pract*. 2018;137:231-241.
34. Obulareddy VT, Nagarakanti S, Chava VK. Knowledge, attitudes, and practice behaviors of medical specialists for the relationship between diabetes and periodontal disease: A questionnaire survey. *J Family Med Prim Care*. 2018;7:175-178.
35. Ziebolz D, Reiss L, Schmalz G, Krause F, Haak R, Mausberg RF. Different views of dentists and general medical practitioners on dental care for patients with diabetes mellitus and coronary heart diseases: results of a questionnaire-based survey in a district of Germany. *Int Dent J*. 2018;68:197-203.
36. Holzinger F, Dahrendorf L, Heintze C. 'Parallel universes'? The interface between GPs and dentists in primary care: a qualitative study. *Fam Pract*. 2016;33:557-561.
37. Moore J, Csikar J, Kang J, Tugnait A, Campbell F, Clerehugh V. Awareness, practices, training, and confidence of Paediatric Diabetes Care Teams in relation to periodontitis. *Pediatr Diabetes*. 2020;21:384-389.