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Original Article

The Impact of Remote Diabetes Education on Parental Training

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ABSTRACT

Aim: This study aimed to investigate the impact of remote education provided to parents of children newly diagnosed with type 1 diabetes on parental knowledge of diabetes care and the children's metabolic control.

Materials and Methods: This research was conducted with 32 children (aged 2-15 years) and their parents (remote education: n=16; face-to-face education: n=16). Structured diabetes education consisting of eight modules was conducted over an average of 12±2.5 days. At the end of the education and 3 months later, HbA1c values, parental knowledge levels, and 3-day food diaries were evaluated.

Results: At the 3-month follow-up, the median diabetes knowledge score was significantly higher in the remote education group [32 (interquartile range (IQR): 4.5)] compared to the face-to-face group [30.5 (IQR: 3.75)] (p=0.020). Baseline HbA1c levels were 11.4% (IQR: 1.7) for G1 (the remote education group) and 12.4% (IQR: 2.3) for G2 (The face-to-face education group) (p=0.262). By the 3rd month, these levels decreased significantly to 7% (IQR: 0.8) and 6.9% (IQR: 1.3), respectively, with no significant difference between the groups (p=0.862). Energy and macronutrient intakes were similar in both groups at baseline and at the 3rd month, meeting national and international recommendations. Paternal participation was markedly higher in the remote group compared to the face-to-face group (50% vs. 6.25%).

Conclusion: The remote education model is an effective method which can be integrated into diabetes management.

Keywords: Type 1 diabetes, diabetes education, remote education, parental training

Introduction

Type 1 diabetes (T1D) is the most common chronic disease in childhood. Improving self-care practices is fundamental for optimal diabetes management. The vast majority of day-to-day diabetes care is handled by the parents of those children with T1D (1). Educational interventions designed to facilitate the development of diabetes self-management skills can improve the quality of life for individuals with diabetes, as well as enhance their knowledge, self-care practices, coping skills, and the attitudes necessary for effective self-management (2).

Children with T1D and their parents should have access to comprehensive and structured education in order to empower them in the effective management of diabetes

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(3). In order to maximize the effectiveness of diabetes treatment, it is essential to ensure high-quality structured education. This education should also be repeated regularly in order to maintain its effectiveness (3,4). However, diabetes education provided in hospital settings presents certain disadvantages. During these sessions, parents are often required to take time away from their work, their other children, and their daily responsibilities. Additionally, other family members, caregivers, and particularly fathers often report limited access to diabetes education (5).

Remote education technologies offer a valuable opportunity for those parents of children with T1D, other caregivers, and anyone seeking access to information (4). Previous studies have supported the promising role of web-based interventions in improving diabetes management (6,7). However, few studies have evaluated online educational interventions for the parents of children with T1D in our country. This study examined the impact of online education provided to the parents of children with T1D on the parents' knowledge levels and the metabolic control of their children. The primary objectives of this research were to evaluate whether distance education significantly increases the average knowledge test scores of the parents and whether it leads to improved HbA1c levels in those children with T1D when compared to conventional face-to-face education.

Materials and Methods

Study Design and Participants

This study utilized an experimental design and was conducted from February to June 2023, following the CONSORT 2010 Statement (updated guidelines for reporting parallel group randomized trials). This study began with a cohort of 32 parents of children and adolescents newly diagnosed with T1D. The participants were assigned into 2 groups using systematic randomization based on their order of diagnosis. To prevent selection bias, allocation was determined by diagnosis sequence (odd numbers for G1, even numbers for G2), an external factor unpredictable by the researchers. A comparison of baseline clinical data, specifically HbA1c levels (p=0.262) and demographic characteristics, confirmed that this systematic allocation successfully produced balanced and homogeneous groups.

Inclusion and Exclusion Criteria

The eligible participants were the parents of children aged 0 to 18 years diagnosed with T1D within the prior 30 days, who were proficient in using digital devices (computers or smartphones), and were able to communicate in Turkish. The exclusion criteria included having vision or hearing impairments, a diagnosis period exceeding 30 days, or a refusal to participate.

The Intervention

Prior to the randomized phase, all participants received comprehensive training on insulin administration, blood glucose monitoring, and hypoglycemia management. The core intervention consisted of:

- **G1 (Remote education):** Individual, family-centered sessions conducted within the participants' home environment using remote education technologies.
- **G2 (Face-to-face education):** Individual, family-centered sessions conducted in hospital settings.

Both groups received a concentrated dose of one 60-minute session per day, totalling approximately 7 hours of contact time. The education modules were developed based on the Turkish Childhood Educator's Guide and ISPAD Clinical Practice Consensus Guidelines (2018, 2022). Following the training, a WhatsApp support group (including a diabetes nurse, dietitian, and pediatric endocrinologist) provided guidance for 30 days.

Outcome Measures

Data were collected at baseline (t-0) and 12 weeks after the training program (t-1):

- **Diabetes knowledge score:** This was assessed using a 34-item questionnaire (0-34 points). Content validity was confirmed by 13 experts using the Davis method, yielding a content validity ratio of 0.98 (α=0.05).
- **Metabolic control:** HbA1c values were retrieved from the patients' medical records.
- **Dietary intake:** This was evaluated using 3-day food diaries (two weekdays, one weekend). Dietitians provided oral and written instructions for weighing food. Total energy and nutrient intake were calculated using BeBiS 8.2 (Stuttgart, Germany).
- **Satisfaction:** This was measured using a 5-point rating scale ranging from "did not like it" to "very good".

Ethical Considerations

This study was approved by the Ege University Medical Clinical Research Ethics Committee (approval no.: 23-3.1T/33, date: 23.03.2023). The purpose of this study was explained to each participant, and written informed consent was obtained. All procedures adhered to the principles of the Declaration of Helsinki.

Statistical Analysis

Statistical analysis was performed using SPSS 25.0. Descriptive statistics are presented as median [interquartile range (IQR) for numerical variables as the data did not meet normality assumptions due to the sample size (n=32). The groups were compared using the Mann-Whitney U test. A p-value of less than 0.05 was considered statistically significant.

Results

During the study period, 32 parents of children newly diagnosed with T1D participated in the diabetes education program. The first follow-up assessment included all 32 parents, with 16 in the remote education group (G1) and 16 in the face-to-face group (G2). Three months later, during the second follow-up assessment, 28 parents participated, 12 from G1 and 16 from G2. Four parents were excluded from this study because they did not continue the education program. Comparing the initial assessment (t-0) to the second follow-up (t-1), the dropout rate was 25% for the remote education group and 0% for the face-to-face group.

The median age of the children was 8.62 years (IQR: 3.08) in the remote education group and 8.97 years (IQR: 5.88) in the face-to-face group. No significant differences were observed in HbA1c levels (%), basal and bolus insulin ratios, or total insulin dose (U/kg/day) between the two groups at baseline or at the three-month follow-up. At baseline, the median (IQR) HbA1c values were above the target for both groups: 11.4% (IQR: 1.7) for G1 and 12.4% (IQR: 2.3) for G2 (p=0.262). At the three-month follow-up, there was no significant difference in HbA1c levels between the groups: the median (IQR) for G1 was 7% (IQR: 0.8) and for G2, it was 6.9% (IQR: 1.3) (Table I).

The intervention effects on HbA1c were independent of socio-economic factors, including the child's gender, age, school type, family structure, mother's educational and employment status, or place of residence. Additionally, neither group experienced hypoglycemia, diabetic ketoacidosis, or hospitalization during the study period.

Table II displays the energy and nutrient intake of the participants at baseline and during the follow-up period. Carbohydrate, fat, and protein intakes met the recommended levels outlined in national and international guidelines at both time points. However, saturated fat intake exceeded recommendations, while fiber intake fell below recommendations at baseline and during the three-month follow-up.

The total education knowledge scores for the parents in the remote education group before and after online education were median (IQR) 32.5 (2.75) and 32 (4.5), respectively (p=0.063). In contrast, the scores for those parents in the face-to-face education group decreased from a median (IQR) of 33 (1.75) to 30.5 (3.75) (p=0.001). At the three-month follow-up, the total education score was higher in the remote education group (32, IQR: 4.5) compared to the face-to-face group (30.5, IQR: 3.75) (p=0.020). The scores obtained by the groups following the training are presented in Table III.

Satisfaction with the Intervention

The overall satisfaction with the education program was exceptionally high. All 12 parents who participated in the remote education group assessment rated the program as "very good", indicating a high level of satisfaction with the intervention.

Table I. Children's clinical characteristics (n=28)

Clinical and anthropometric parameters	Newly diagnosed Median (IQR)		p[1]	3 months after training Median (IQR)		p[2]
	G1	G2		G1	G2	
Weight SD score	0.16 (1.30)	-0.39 (1.30)	0.150	0.54 (1.85)	0.42 (1.35)	0.693
Height SD score	0.04 (1.33)	1.23 (1.26)	0.039	0.42 (1.84)	0.81 (2.27)	0.546
Body mass index SD score	0.66 (1.96)	-0.85 (1.64)	0.004	0.38 (1.36)	0.42 (1.25)	0.403
Total insulin (U/kg/day)	0.65	0.52	0,307	0.55	0.46	0.521
Basal insulin (%)	36	35	0.429	32	33	0.570
Bolus insulin (%)	64	65	0.429	68	67	0.570
HbA1c (%)	11.4 (1.7)	12.4 (2.3)	0.257	7 (0.8)	6.9 (1.3)	0.862

G1: The remote education group, G2: The face-to-face education group
p[1]: New diagnosis period, p[2]: Significance of difference between groups at 3 months
*Alpha at the 0.05 significance level
IQR: Interquartile range

Table II. Energy and nutrient intake of participants during the follow-up period

Clinical and anthropometric parameters	ISPAD recommendations	New diagnosis Median (IQR)		p¹	3 months after training Median (IQR)		p²
		G1	G2		G1	G2	
Protein intake (% energy)	15-25	19.67 (2.67)	18.58 (1.67)	0,640	17.66 (4.33)	19.00 (2.17)	0.111
Carbohydrate intake (% energy)	40-50	43.67 (4.33)	47.66 (6.33)	0.166	49.33 (4.67)	46.16 (6.17)	0.162
Fat intake (% energy)	30-40	38.00 (6.0)	33.66 (6.09)	0.244	33.66 (4.33)	34.33 (7.50)	0.467
Fiber intake (g/1.000 kcal)	14	13.00 (3.92)	12.81 (2.62)	1.00	13.08 (3.54)	11.68 (2.90)	0.412
Saturated fatty acid (% energy)	<10	16.15 (4.39)	15.79 (2.67)	0.584	14.86 (2.15)	15.43 (4.67)	0.572
Energy (kcal/day)	Varies according to age, gender and physical activity level	1.493 (240)	1.632 (557)	0.250	1.537 (564)	1.584 (523)	0.661

G1: The remote education group, G2: The face-to-face education group
p¹: New diagnosis period, p²: Significance of difference between groups at 3 months
*Alpha at the 0.05 significance level
IQR: Interquartile range

Table III. The diabetes knowledge scores of the groups

Diabetes education topics	New diagnosis Median (IQR)		p¹	3 months after training Median (IQR)		p²
	G1	G2		G1	G2	
What is diabetes	5 (1)	5 (0)	0.095	4 (1.75)	4 (1.5)	0.504
Hypoglycemia management	8 (0)	8 (0)	0.819	8 (0)	8 (1)	0.124
Insulin management	5 (0.75)	5 (0)	0.365	5 (1)	5 (1)	0.574
Hyperglycemia management	4 (0)	4 (0)	0.248	4 (1)	3 (1)	0.001*
Disease management	4 (0)	4 (1)	0.386	4 (0.75)	3,5 (1)	0.192
Exercise management	4 (1)	4 (0)	0.408	4 (0)	4 (1)	0.356
Healthy nutrition principles	4 (0)	4 (1)	0.036	4 (0)	4 (1)	0.356
All topics	32.5 (2.75)	33 (1.75)	0.469	32 (4.5)	30.5 (3.75)	0.020*

G1: The remote education group, G2: The face-to-face education group
p¹: New diagnosis period, p²: Significance of difference between groups at 3 months
*Alpha at the 0.05 significance level
IQR: Interquartile range

Discussion

Self-care skills and education are critical for managing T1D, a condition which requires significant responsibility and poses numerous challenges (11). This study evaluated the effectiveness of two diabetes education models for the parents of children with T1D, namely remote education or face-to-face education.

Diabetes education, delivered at diagnosis and during ongoing management, is essential for effective self-management. However, face-to-face education has limitations, particularly in engaging fathers. In clinic-based settings, mothers are often the primary accompanying parents, while fathers are frequently absent due to work or other commitments. This absence reduces paternal involvement in daily diabetes management, limiting their ability to support their children (12). Fathers are often perceived as less communicative and less likely to take action (13), a trend influenced by cultural norms which view childcare as primarily the mother's responsibility. Studies have shown that the fathers of children with T1D express a need for training to effectively manage their children's care (5,14,15). In our study, 50% of the fathers participated in the remote education group, compared to only one father in the face-to-face group. The flexibility of remote education, particularly in scheduling, accommodates the fathers' availability, giving it a significant advantage.

Family members of children with T1D often have unmet educational needs due to low attendance in clinic-based face-to-face education (12). Remote education can address this gap by increasing participation. In our study, 50% of families (mother, father, and child) participated in remote education, while participation in the face-to-face group was limited to mother-child or father-child pairs.

Access to education from a specialized diabetes healthcare team is crucial (11). Research by Zamanzadeh et al. (16) demonstrated that telephone and SMS-based education can empower patients with Type 2 diabetes. Similarly, online education for parents and family members outside clinical settings can improve self-efficacy in managing T1D. In our study, remote education increased the parents' diabetes knowledge, with the remote group achieving higher scores than the face-to-face group at the three-month follow-up [32 (IQR: 4.5) vs. 30.5 (IQR: 3.75), p=0.020].

Online support systems can be as effective as face-to-face guidance for children with diabetes and their families (17-19). However, some results from other studies have been mixed. For example, Pinsker et al. (20) found that remote education improved HbA1c values, while other studies showed no significant metabolic control improvements despite increased patient contact (21,22). In our study, HbA1c values for both groups aligned with international guidelines at the three-month follow-up, indicating that both methods were effective in achieving metabolic control (z: -0.174, p=0.862). Remote education is particularly beneficial for families with limited access to health services.

In cases of financial constraints, lack of social support, or time limitations, online support systems may be more convenient and efficient than clinic visits (17-19). Integrating messaging systems with online education can further enhance its effectiveness (23). The parents of children with T1D often need assistance with diabetes-related challenges, such as adjusting insulin doses based on dietary plans. Rapid telehealth responses are crucial, especially during the early diagnosis period. In our study, both groups received uniform telehealth support via WhatsApp for 30 days, ensuring timely assistance and guidance. This additional support likely contributed to the positive metabolic outcomes observed in both groups.

Study Limitations

This study had several limitations which should be considered when interpreting the results. First, the sample size was relatively small, and this research was conducted as a single-center study, which may limit the generalizability of the findings to a broader population. Second, the follow-up period was limited to three months; a longer observation period is necessary in order to assess the long-term sustainability of the educational outcomes and their lasting impact on metabolic control. Another significant limitation was the absence of continuous glucose monitoring or sensor-derived glycemic data (such as time-in-range or glycemic variability). While HbA1c is a standard measure of average glycemia, it does not fully reflect daily glycemic fluctuations or the risk of hypoglycemia. Therefore, the lack of sensor data prevented a more nuanced analysis of glycemic variability between the remote and face-to-face education groups. Lastly, as is common in educational interventions, the potential for social desirability bias in self-reported data (such as food diaries and satisfaction scales) cannot be entirely ruled out.

Conclusion

This study demonstrated that remote education is a highly effective and feasible alternative to traditional face-to-face education for those parents of children who have been newly diagnosed with T1D. While both educational models successfully achieved the target metabolic control (HbA1c ~7%) at the three-month follow-up, remote education led to significantly higher parental knowledge scores and substantially increased paternal involvement in the care process. From a clinical perspective, the flexibility and accessibility of remote education address common barriers such as work commitments and geographical limitations, and it particularly encourages fathers to take an active role in diabetes management. These findings suggest that integrating remote education technologies into standard pediatric diabetes care can empower families, maintain high-quality self-management skills, and provide a cost-effective, family-centered approach to long-term diabetes education.

Ethics

Ethics Committee Approval: This study was approved by the Ege University Medical Clinical Research Ethics Committee (approval no.: 23-3.1T/33, date: 23.03.2023).

Informed Consent: The purpose of this study was explained to each participant, and written informed consent was obtained.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: D.G., Ş.D., S.Ö., E.A., Concept: G.D., Design: G.D., Y.A.A., Y.M., Data Collection or Processing: G.D., Y.A.A., Y.M., Analysis or Interpretation: G.D., Literature Search: D.G., G.D., Y.A.A., Y.M., Ş.D., S.Ö., E.A., Writing: D.G., G.D., Y.A.A., Y.M., Ş.D., S.Ö., E.A.

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References

1. Colmegna P, Bisio A, McFadden R, et al. Evaluation of a web-based simulation tool for self-management support in type 1 diabetes: a pilot study. IEEE J Biomed Health Inform. 2023; 27:515-25.
2. Abolfotouh MA, Kamal MM, El-Bourgy MD, Mohamed SG. Quality of life and glycemic control in adolescents with type 1 diabetes and the impact of an education intervention. Int J Gen Med. 2011; 4:141-52.
3. Haas L, Maryniuk M, Beck J, et al. National standards for diabetes self-management education and support. Diabetes Care. 2014; 37(Suppl 1):S144-53.
4. Lindholm Olinder A, DeAbreu M, Greene S, et al. ISPAD Clinical Practice Consensus Guidelines 2022: diabetes education in children and adolescents. Pediatr Diabetes. 2022; 23:1229-42.
5. Albanese-O'Neill A, Schatz DA, Bernhardt JM, Elder JH. Educational needs and technological preferences of fathers of youth with type 1 diabetes. Diabetes Educ. 2016; 42:209-19.
6. Bell JA, Patel B, Malasanos T. Knowledge improvement with web-based diabetes education program: brainfood. Diabetes Technol Ther. 2006; 8:444-8.
7. Rochmah N, Faizi M, Hisbiyah Y, et al. Quality of life differences in pre- and post-educational treatment in type 1 diabetes mellitus during COVID-19. Diabetes Metab Syndr Obes. 2021; 14:2905-11.
8. Davis LL. Instrument review: Getting the most from a panel of experts. Applied Nursing Research. 1992; 5:194-7.
9. Aycan Z, Bundak R, Hatun Ş, Özkan S, Yıldırım N, editörler. Çocukluk Çağı Diyabeti Eğitimci Rehberi. Ankara; 2020.
10. Phelan H, Lange K, Cengiz E, et al. ISPAD Clinical Practice Consensus Guidelines 2018: diabetes education in children and adolescents. Pediatr Diabetes. 2018; 19 Suppl 27:75-83.
11. von Sengbusch S, Müller-Godeffroy E, Häger S, Reintjes R, Hiort O, Wagner V. Mobile diabetes education and care: intervention for children and young people with type 1 diabetes in rural areas of northern Germany. Diabet Med. 2006; 23:122-7.
12. Markowitz JT, Volkening LK, Laffel LM. Care utilization in a pediatric diabetes clinic: cancellations, parental attendance, and mental health appointments. J Pediatr. 2014; 164:1384-9.
13. Seiffge-Krenke I. "Come on, say something, dad!": communication and coping in fathers of diabetic adolescents. J Pediatr Psychol. 2002;27:439-50.
14. Sullivan-Bolyai S, Rosenberg R, Bayard M. Fathers' reflections on parenting young children with type 1 diabetes. MCN Am J Matern Child Nurs. 2006; 31:24-31.
15. Wennick A, Lundqvist A, Hallström I. Everyday experience of families three years after diagnosis of type 1 diabetes in children: a research paper. J Pediatr Nurs. 2009; 24:222-30.
16. Zamanzadeh V, Zirak M, Hemmati Maslakpak M, Parizad N. Distance education and diabetes empowerment: a single-blind randomized control trial. Diabetes Metab Syndr. 2017; 11 Suppl 1:S247-51.
17. Ayatollahi H, Hasannezhad M, Fard HS, Haghighi MK. Type 1 diabetes self-management: developing a web-based telemedicine application. Health Inf Manag. 2016; 45:16-26.
18. Kwon HS, Cho JH, Kim HS, et al. Development of web-based diabetic patient management system using short message service (SMS). Diabetes Res Clin Pract. 2004; 66(Suppl 1):S133-7.
19. Mulvaney SA, Rothman RL, Wallston KA, Lybarger C, Dietrich MS. An internet-based program to improve self-management in adolescents with type 1 diabetes. Diabetes Care. 2010; 33:602-4.
20. Pinsker JE, Nguyen C, Young S, Fredericks GJ, Chan D. A pilot project for improving paediatric diabetes outcomes using a website: the Pediatric Diabetes Education Portal. J Telemed Telecare. 2011; 17:226-30.
21. Bertuzzi F, Stefani I, Rivolta B, et al. Teleconsultation in type 1 diabetes mellitus (TELEDIABE). Acta Diabetol. 2018; 55:185-92.
22. Ładyzynski P, Wójcicki JM. Home telecare during intensive insulin treatment--metabolic control does not improve as much as expected. J Telemed Telecare. 2007; 13:44-7.
23. Mulvaney SA, Anders S, Smith AK, Pittel EJ, Johnson KB. A pilot test of a tailored mobile and web-based diabetes messaging system for adolescents. J Telemed Telecare. 2012; 18:115-8.