Original Article

The Effect of Web-based Diabetes Education on the Metabolic Control, Self-efficacy and Quality of Life of Adolescents with Type 1 Diabetes Mellitus in Turkey

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ABSTRACT

Aim: The purpose of this study was to examine whether web-based diabetes education is effective in improving metabolic control, self-efficacy for diabetes self-management, and quality of life in adolescents with type 1 diabetes mellitus in Turkey.

Materials and Methods: This study was conducted with adolescents with type 1 diabetes mellitus who were registered in the pediatric endocrinology polyclinic of a university hospital in the western region of Turkey. A total of 32 were included in the control group who received diabetes education in a clinical setting, and 30 were included in the intervention group who received web-based diabetes education. Although the adolescents in the control group received standard medical care as usual, with no participation on the website, those in the intervention group were also educated on diabetes management by using the web site.

Results: For self-efficacy, a statistically significant difference between the groups was found. Regarding the group, time, and group-time interaction for quality of life, a statistically significant difference was found between the mean scores of the groups. Web-based education was found to be effective in increasing the quality-of-life mean scores when compared with the standard care provided for the adolescents with type 1 diabetes mellitus, with the intervention group having a higher quality of life than the control group.

Conclusion: We found that the web-based diabetes education program had no effect on A1C levels, but the education model effectively increased the self-efficacy and quality of life of adolescents with diabetes.

Keywords: Adolescent with diabetes mellitus, web-based education, web-based diabetes education

Introduction

Type 1 diabetes mellitus (T1DM) is a chronic metabolic disease commonly seen in childhood; it occurs as a result of the destruction of the pancreatic beta cells, accompanied by T-cells, for reasons relevant or irrelevant to autoimmunity (1). In Turkey, approximately 17,000 children have TIDM, and about 2,000 children are diagnosed with it per year (2).

Adolescence is the transitional phase of development between childhood and emerging adulthood and it is marked by the biological and psychosocial changes of puberty (3).

Adolescence is a period in which these young patients can learn the required knowledge and self-care methods related to T1DM; nevertheless, management of the disease is most difficult during this developmental stage. Management of T1DM requires frequent blood glucose monitoring, multiple insulin injections or the use of an insulin pump, frequent alterations in insulin dose to match changing diet and activity patterns, and regular visits to health care providers (4).

Diabetes management requires frequent and high levels of education at diagnosis and afterward to support children and adolescents. Education is necessary for its successful management (5). Education programs aimed at diabetes have been revealed to be a very cost-effective intervention, due to the savings to be obtained via low levels of hospital admissions and emergency presentations. To maintain blood glucose of those adolescent with T1DM at recommended levels and prevent complications, these patients need to be able to contact the diabetes team frequently and easily and have access to health services at all times (6). Adolescents not receiving sufficient levels of education or not continuing to have educational support exhibit more possibility of developing diabetes-related complications (5). Diabetes education needs to be an ongoing process and be repeated in order for it to be more effective. In addition, the failure to increase the number of health professionals for diabetes care in line with the increase in the number of patients with diabetes has led to lower access to education for patient self-management (7). In addition, evidence obtained through group discussions conducted with young people points out that the education programs using web-based applications are attractive for them, and there are data to back up its frequent use (8). Web-based education also provides an accessible and permanent record of information for patients that enables fast and effective communication with health professionals. Web-based education has been shown to improve patient satisfaction, improve self-management of diabetes and clinical results (9). Web-based applications that include individualized evaluations, supervision and skills development by feedback are reported to be more effective in the improvement of glycemic control than didactic teaching (10). Studies have indicated that web-based education provided to adolescents with diabetes is effective in enhancing self-efficacy and quality of life (QOL) (11,12).

Higher self-efficacy is believed to have an impact on the adolescents' life, self-management, and outcomes related to diabetes. This concept has also been revealed to be significantly associated with the likelihood of obtaining positive results and acquiring the means of self-management for diabetes as well as QOL (13,14). A higher QOL, higher levels of self-efficacy and better diabetes education have positive effects on metabolic control (15,16). QOL is lower among children and adolescents with T1DM compared to children without diabetes; previous studies have shown that better QOL in adolescents is associated with higher self-efficacy and improved self-management. In addition, glycemic control may improve (17,18). Therefore, health professionals need to understand the importance of self-efficacy for diabetes self-management and QOL in diabetes, and they should evaluate adolescent self-efficacy for diabetes self-management (18,19). No studies have so far been conducted in Turkey to examine the influence of web-based diabetes education on metabolic control, self-efficacy for diabetes self-management, and QOL of adolescents with T1DM. In Turkey, there is limited access to pediatric endocrinology and pediatric endocrine nurses in every region. Most of the patients enrolled in the clinic where the study was conducted live six-to-ten hours away. Thus, it is very difficult for them to reach diabetes providers when they need to and it is very important that they have the right source of information. Thus, the aim of this study was to examine whether web-based diabetes education was effective in improving metabolic control, self-efficacy for diabetes self-management, and QOL in adolescents with T1DM in Turkey.

Hypotheses

Our hypotheses were:

H_1: A1C levels of adolescents with T1DM who were provided with web-based education will be lower than those who were educated about diabetes in a polyclinic environment.

H_2: Self-efficacy for diabetes self-management scores of adolescents with T1DM who receive web-based education will be lower than those who are educated about diabetes in a polyclinic environment.

H_3: QOL scores of adolescents with T1DM who were provided with web-based education will be higher than those who are educated about diabetes in a polyclinic environment.

Materials and Methods

This study was carried out with adolescents who had T1DM and who were registered in the pediatric endocrinology polyclinic of a university hospital in the western region of Turkey. Their ages ranged between 11 and 18 years. The design was a pre-test/post-test quasi-experimental approach.

The Study Population and Sample

The required study sample size was estimated based on an anticipated p-value, power level, and effect size, with G*Power 3.0. Researchers used the analysis of variance and accepted an effect size of 0.5, and type 1 and 2 error levels of 0.05 and 0.20 (80% power), so that sample size was estimated based on A1C with 19 adolescents; self-efficacy with 14 adolescents; and QOL with 29 adolescents. To account for potential losses due to the long-term follow-up, it was decided to include 36 adolescents in each group. We randomly assigned individuals into groups.

Data Collection

This study was conducted from September 2015 to March 2016. Before collecting pretest data, the researchers assigned participants to the intervention and control groups based on the order that they came to the polyclinic. The first patient was allocated to the control group and the second patient to the intervention group and so on. The researchers introduced the web site on IPads™ to the intervention group and explained how to use them. When the target sample size was achieved, the adolescents included in the intervention group were informed via text message that the web site was activated, and they should begin using it. A total of 34 were included in the control group who received diabetes education in the clinical setting, and 36 were included in the intervention group who received the web-based diabetes education. Following the initial data collection, data loss occurred in the intervention group at the end of the third month, because four of the adolescents' use of internet was limited at home, and two adolescents did not use the site actively. The researchers could not contact two control group adolescents at the end of the third month. Consequently, we completed the study with 32 adolescents in the control group and 30 in the intervention group (Figure 1).

Intervention

The standard of care at the Pediatric Endocrinology Outpatient Clinic at the University Hospital is the provision of basic diabetes education. A diabetes nurse, who has a Diabetes Training Nursing Certificate, provides basic diabetes education to adolescents with diabetes and their families. At diagnosis, they are told to come to the outpatient clinic when they need to, and patients are expected to come to the clinic every three months. The diabetes nurse meets with each child in the education room and provides T1DM education using various pamphlets and/or posters as needed. Children with newly diagnosed T1DM and their
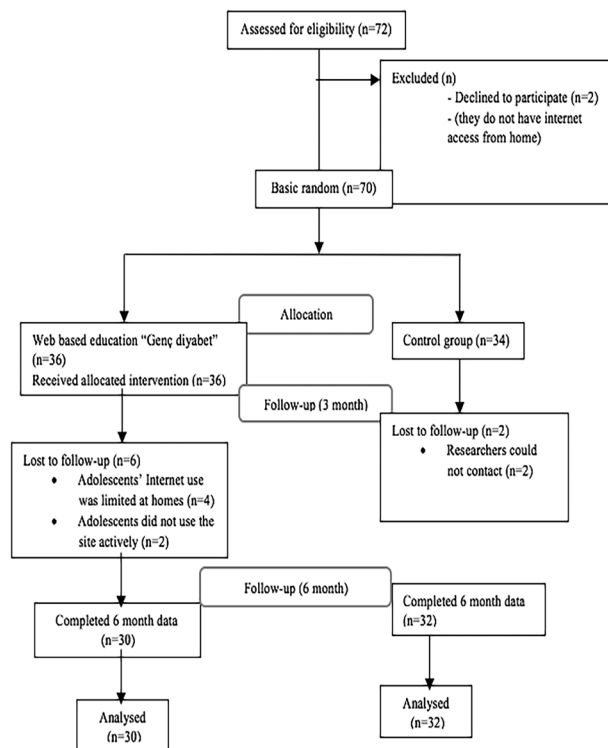
Figure 1. Flowchart for enrollment and follow-up of study participants

families receive basic diabetes education at the time of clinical admission. Information about diabetes, acute complications (hypoglycemia, hyperglycemia), treatment, insulin injection, and issues that they should pay attention to are provided at initial diagnosis.

An experimental website was created using the open-source code WordPress Content Management System and was structured using PHP Script language. Two user groups use the website-administrators and members. The administrator panel includes the elements required for the performance, organization, and implementation of the operations that are necessary for the entire system. It has menu elements, user operations, and unanswered survey forms as well as the content display. It can also be used to add and delete users and update the website. The member panel user homepage includes a valid username and password that is given to the member by the researcher to enable signing in to the system. Users can login to the web page when they enter their usernames and passwords correctly. Both groups received standard medical care, while those in the intervention group were educated on diabetes management by using the web site. The web site includes a series of learning objectives. Where appropriate, the material uses multimedia learning

tools such as tutorials using Powerpoint™ files about diabetes management, quizzes, and blogs. The blog was designed as a platform so that adolescents included in the intervention group could chat and share their experiences. The adolescents were asked to write comments and share their experiences on issues suggested by the researchers. The appropriateness and sufficiency of the educational topics uploaded on the web site were examined by relevant experts (pediatric endocrinologists, professors working on pediatric nursing, diabetes clinic nurses, and the head of the diabetes association in Turkey-11 experts in all). The content validity index regarding educational content was found to be 0.96, suggesting high agreement among experts with this conclusion being higher than 0.80.

Data Collection Procedures

The intervention was delivered over a six-month period. Participants were encouraged to log in at least two times each week to update their blogs. The adolescents used the blog site actively. We used Counterize™ plugins to collect data on use. Counterize is a complete counter and statistics plugin with no external library dependency, and these data and site traffic and each users' usage were recorded. An active learning process was ensured where the adolescents received support from their peers via blog use. The researcher was notified by short message and e-mail when the adolescents posted a comment on the blog site. Comments were published on the website under the supervision of the researcher. The following are examples of issues included in the blog site: "What is diabetes in your opinion?"; "Is exercise important in the management of type 1 diabetes?"; "Let's share our experiences: how do you know when you have high blood glucose?"; "How do you know when you have low blood glucose?" The topics were selected from the literature. New topics (e.g., definition of the disease, nutritional aspects, carbohydrate counting, management of acute and chronic complications, insulin regimen, physical exercise, and self-management) and relevant blog texts were added to the site every week. A reminder message about new materials added to the web site was sent. The adolescents were not expected to respond to this message.

We introduced the website, "youth diabetes", to those adolescents included in the intervention group and informed them about its use as part of their polyclinic appointments. Adolescents included in the intervention group could log in at any time day or night.

Three-and-six-month follow-up data were collected by the researchers from the adolescents in the control group when they arrived for their polyclinic appointments. Adolescents included in the intervention group were asked to fill out the scale-based forms on the web. The A1C values of the adolescents in both groups were collected from the polyclinic records at 3 months and 6 months after the start of the intervention.

Measures

Psychosocial data were collected using the pediatric QOL Inventory™ 3.0 diabetes module and the diabetes management self-efficacy scale in adolescents with type 1 diabetes mellitus.

The Pediatric QOL Inventory™ 3.0 Diabetes Module

Varni et al. (20) developed the pediatric QOL Inventory™ 3.0 diabetes module, which was adapted for Turkish by Ayar and Ozturk (21). The scale comprises of 28 items. A five-point Likert scale was used in which 0=never a problem, and 4=almost always a problem. Items were linearly transformed to a 0-100 score. The score was 100 if the items were rated "never a problem" and 0 if the items were rated "almost always a problem". Thus, higher scores indicate higher health-related QOL. The Cronbach alpha for the scale in this population was 0.86. The split-half reliability was 0.71 for the first and second half of the child report. The correlation coefficient between the first and second halves was 0.55 (p<0.001). The Kaiser-Meyer-Olkin coefficients were found to be 0.80 and χ^2=15,275, p<0.001, respectively. Item-total correlations for the scale varied between 0.32 and 0.86 (p<0.001). The model fit indicators were: CFI=0.87, incremental fit index (IFI)=0.87, GFI=0.78, χ^2=432.34, df=337, and root mean square error of approximation (RMSEA)=0.051, p<0.001. Thus, this scale is a reliable and valid instrument that can be used by diabetes teams to measure QOL in Turkish children with T1DM (21).

The Diabetes Management Self-efficacy Scale in Adolescents with Type 1 Diabetes Mellitus

The diabetes management self-efficacy scale in adolescents with type 1 diabetes mellitus was developed by Moens (22) and its Turkish validity and reliability was determined by Ozturk et al. (23). The scale involves 26 single-choice items that are scored on a 5-point scale which range between 1 (definitely yes) and 5 (definitely not). The scores obtained are summed up and divided by the total number of items in order to show the magnitude of perceived self-efficacy of different self-management performance levels. High scores represent lower self-efficacy. The CFA showed respective factor-loading ranges of factor 1 (medical treatment and nourishment) as 0.41-0.86; factor 2

(evaluation of glycaemia) as 0.42-0.89; factor 3 (mentioning your diabetes) as 0.75-0.77; and factor 4 (honesty with yourself and others) as 0.41-0.72. The model fit indicators were as follows; the GFI=0.90, non-normed fit index=0.93, CFI=0.93, and IFI=0.93, with $\chi 2$=470.15 for df=290, p<0.001, and the RMSEA was 0.056. The total Cronbach's alpha internal consistency reliability coefficient value was 0.85. The item-total correlations changed between 0.40 and 0.59 and were seen to be statistically significant (p<0.001). This scale is designed as a disease-specific one in order to evaluate the level of self-efficacy in Turkish adolescents with T1DM (23).

Ethical Considerations

Written permission was obtained from the owners of the scales used. To conduct this study, the researchers obtained permission (with protocol no: 779-GOA, 2012/36-02) from the institution and University Non-Invasive Research Ethics Board. Since participants of this study were adolescents, the researchers obtained written consent from participants' parents, and verbal assent from the adolescents.

Statistical Analysis

Multivariate analysis of variance was employed in order to compare the total mean of A1C levels and mean scores on the diabetes management self-efficacy scale and QOL of children with diabetes scale according to grouping, timing, and the group-time interaction. One-Way analysis of variance was used for analysis of the difference between the total mean scores of diabetes management self-efficacy scale for the adolescents with T1DM and QOL in children with diabetes scale. It was also employed in an attempt to compare the mean scores of groups. The Bonferroni correction t-test for dependent groups was employed in an attempt to compare the measurements. The Bonferroni

significance test of the difference between two corrected averages was used for the analysis of the difference between the groups over time.

Results

Patients' Characteristics

We completed our study with 62 adolescents who had T1DM with 30 in the intervention group and 32 in the control group. The mean ages of those who participated in the intervention group were seen to range between 11 and 18 years [mean, 14.60 years; standard deviation (SD), 1.90 years] and that of the control group ranged in age from 11 to 18 years (mean, 13.96 years; SD, 1.61 years). The duration of diabetes of the intervention group participants was 5.66±4.22 years and that of the control group was 6.34±3.17 years. The mean A1C value observed in the intervention group was found to be 8.10±1.30%, while the same value in the control was 8.36±1.82% at the start of the study. The mean diabetes related QOL scores of those included in the intervention group was 37.06±6.91 and the same score in the control group was 38.79±10.15 at the start of the study. The diabetes management self-efficacy scores of those in the intervention group was 108.40±15.30, while the same in the control group was 108.48±13.27 at the start of the study. The number of adolescents using insulin injection in the intervention group was 8 (26.66%), and 22 were using insulin pumps (73.33%). The socio-demographic characteristics of the participants are presented in Table I.

Analyses indicated that the experimental and control groups did not differ in terms of age, sex, diabetes history, initial A1C levels, and initial mean scores of self-management and self-efficacy in the diabetes scale for the adolescents with type 1 diabetes and the QOL in children with diabetes scale. While there were no statistically

Table I. Descriptive characteristics of the adolescents with type 1 diabetes (n=62)			
Characteristic	**Intervention group (n=30)**	**Control group (n=32)**	**p-value**
	(mean ± SD)	**(mean ± SD)**	
Mean age	14.60±1.90	13.96±1.61	0.129
Duration diabetes (years)	5.66±4.22	6.34±3.17	0.069
Onset level of HbA1c	8.10±1.30	8.36±1.82	0.068
Onset diabetes related quality of life scores	37.06±6.91	38.79±10.15	0.354
Onset diabetes management self-efficacy scores	108.40±15.30	108.48±13.27	0.620
Using insulin injection (%)	8 (26.66)	10 (31.25)	
Using insulin pump (%)	22 (73.33)	22 (68.75)	
SD: Standard deviation			

significant differences between the two groups (p>0.05), A1C levels and diabetes duration showed trends toward significance, with the intervention group having lower A1C and shorter diabetes duration at baseline (Table I).

Multiple analysis of variance was used to determine whether there was a difference between the A1C mean scores of the study groups. Regarding the group (F=0.212, p=0.647), time (F=1.225, p<0.297) and group-time interactions (F=1.393, p<0.252), no statistically significant differences were found between the mean scores of the groups (Table II).

Multiple analysis of variance was used to determine whether there was a difference between the QOL mean scores of the study groups. Regarding the group (F=7.862, p=0.007), time (F=7.555, p<0.001) and group-time interactions (F=12.747, p<0.001), statistically significant differences were found between the mean scores of the groups (Table II).

Multiple analysis of variance was used to determine whether there was a difference between the self-efficacy mean scores of the study groups. Regarding the group (F=44.058, p=0.001), time (F=37.715, p<0.001) and group-time interactions (F=45.115, p<0.001), statistically significant differences were found between the mean scores of the groups (Table II). Further analysis for the mean scores of the self-efficacy scale and QOL for the adolescents with T1DM in group, time, group-time interaction revealed statistically significant differences between the mean scores of the groups (Table III).

Discussion

In this study, we found no significant difference between the intervention and control groups on A1C levels. In previous studies conducted by a multi-disciplinary team, it was reported that web-based educational programs were effective in improving A1C levels of adolescents with T1DM (15,24,25). While our study group was not multidisciplinary, we found no significant difference between the A1C mean scores of the two groups. This finding suggests that this difference may be related to differences in methods. Self-management is necessary to prevent short and long-term

Table II. Comparing A1C, quality of life and self-efficacy mean scores of the adolescents with type 1 diabetes in groups, at time and at group*time points (n=62)

Time/group	A1C		Quality of life		Self-efficacy	
Time	Intervention group (mean ± SD)	Control group (mean ± SD)	Intervention group (mean ± SD)	Control group (mean ± SD)	Intervention group (mean ± SD)	Control group (mean ± SD)
Baseline	8.10±1.30	8.36±1.82	108.40±15.30	108.48±13.27	37.06±6.91	38.79±10.15
Three months	8.38±1.47	8.33±1.89	116.53±14.49	108.84±11.98	34.40±7.81	41.75±10.30
Six months	8.19±1.39	8.63±1.58	122.23±13.24	106.53±7.78	35.13±6.70	59.28±8.74
	F	p	F	p	F	p
Group	0.212	0.647	7,862	0.007	44,058	0.001
Time	1,225	0.297	7,555	0.001	37,715	0.001
Group*time	1,393	0.252	12,747	0.001	45,115	0.001
SD: Standard deviation, p: Significance level, F: Analysis of variance						

Table III. Further analysis for the mean scores of self-management and self-efficacy in diabetes scale and quality of life for the adolescents with type 1 diabetes in groups, time, group*time (n=62)

Time/group	Self-efficacy				Quality of life			
Time	Intervention group (mean ± SD)	Control group (mean ± SD)	t	p	Intervention group (mean ± SD)	Control group (mean ± SD)	t	p
Baseline	37.06±6.91	38.79±10.15	0.793	0.431	108.40±15.30	108.48±13.27	0.024	0.981
Three months	34.40±7.81	41.75±10.30	3,170	0.002	116.53±14.49	108.84±10.98	2,301	0.025
Six months	35.13±6.70	59.28±8.74	12,244	0.000	122.23±13.24	106.53±7.78	5,644	0.000
F	1,381	74,154			16,956	0.846		
p	0.260	0.000			0.000	0.434		
SD: Standard deviation, p: Significance level, t: Significance test of the difference between two means/t-test for dependent groups, F: Analysis of variance								

complications such as seizures, nephropathy, diabetic ketoacidosis, neuropathy and retinopathy (15).

Self-management requires frequent blood glucose monitoring and insulin injections or the use of pump therapy, both of which require frequent adjustment depending on food intake and physical activity. Diabetes self-management is intensive, constant, complex and visible, and it contributes to feelings of stress and social awkwardness in adolescents. Any acute or chronic stress in this period will directly affect diabetes management (26). General emotional stress in adolescents negatively affects both their blood sugar and glycemic control levels and may limit their ability to perform diabetes self-management tasks. Feeling stress due to diabetes management and a stressful living situation may lead to poorer metabolic control for those adolescents with T1DM and also to problems with adaptation to the condition (13,27). Among our intervention group adolescents, 33% were studying for the high school or university admission exams, which are important and often stressful periods. Even the presence of a factor such as an exam causes great stress for adolescents. In addition, with the hormonal changes in the approach to maturity, metabolic control of adolescents is negatively affected. Consequently, in the follow-up assessments, no statistically significant difference was found between the A1C mean scores of the adolescents with diabetes in the intervention or in control groups.

Self-efficacy levels of those in the intervention group were found to increase compared with those provided only with standard care. Therefore, hypothesis H_2 was accepted. Increasing self-efficacy in adolescents with T1DM is important for healthy self-management behavior change. The findings of this study are similar to those of previous studies (13,14,27) that examined the impact of Web-based diabetes education on self-efficacy. Web-based diabetes education was found to be an effective method for increasing self-efficacy for diabetes self-management in adolescents with diabetes. It is believed that web-based educational programs for those adolescents with T1DM should be made more commonly available because the number of adolescents using the Internet is increasing in Turkey, and web access allows for information to be sought whenever they need and wherever they are.

In this study, we found a significant difference between the QOL Mean Scores in the adolescents with T1DM in the intervention group and also those in the control group. Our web-based education program was found to be effective in increasing QOL mean scores when compared with the standard care provided for the adolescents with T1DM. Therefore, the third hypothesis was accepted. This finding is similar to that of some previous studies (14,27) that examined the impact of diabetes education on QOL of adolescents with diabetes. Thus, web-based diabetes education was found to be an effective method for enhancing the QOL of the adolescents with T1DM.

Study Limitations

This study has several limitations that must be considered in the interpretation of the findings. Initially, there were 36 adolescents in the experimental group, and at the end of the third month, four adolescents could not access the internet from their homes, and two adolescents did not actively use the site. In addition, we did not look at long-term effects. The initiation of the website by the group of entrants in June created difficulties for the researcher in reaching the adolescents due to the summer holiday. Also, the Pediatric QOL Inventory sub-scale which we used in our study had low Cronbach alpha and so limits our results.

Conclusion

We found that our web-based diabetes education program effectively increased the self-efficacy and quality of life of adolescents with diabetes, but it had no effect on A1C levels. Thus, we recommend web-based programs for adolescents with T1DM to enhance their QOL and self-efficacy and to perform observations over a longer time period to see the impact on A1C levels more clearly. We did not examine cost-effectiveness. It is also recommended that cost-effectiveness should be evaluated in new studies for better understanding of the effectiveness of the web-based education.

On the basis of this study, we believe that the use of web-based diabetes education will help to ensure that both adolescents with diabetes and health care providers will use their time together more effectively. It is also possible that diabetes education may be more accessible by using Web-based approaches. Our study contributes to the diabetes education literature because there was no web-based education program for those adolescents with T1DM set up and available to diabetes nurses in Turkey.

Ethics

Ethics Committee Approval: To conduct this study, the researchers obtained permission (with protocol no: 779-GOA, 2012/36-02) from the Institution and University Non-Invasive Research Ethics Board.

Informed Consent: Since participants of this study were adolescents, the researchers obtained written consent

from participants' parents, and verbal assent from the adolescents.

Authorship Contributions

Concept: D.A., C.Ö., Design: D.A., C.Ö., Data Collection or Processing: D.A., Analysis or Interpretation: D.A., C.Ö., M.G., Literature Search: D.A., C.Ö., M.G., Writing: D.A., C.Ö., M.G.

Conflict of Interest: None of the authors had conflict of interest.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Mayer-Davis EJ, Kahkoska AR, Jefferies C, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Definition, epidemiology, and classification of diabetes in children and adolescents. Pediatr Diabetes 2018; 19:7-19.

2. Diabetes Education Program in School, Purposes of the Program Last Accessed Date: 24.01.2020. Available from: http://www.cocukendokrindiyabet.org/okuldadiyabet/files/odp_program.pdf.

3. Cameron FJ, Garvey K, Hood KK, Acerini CL, Codner E. ISPAD Clinical Practice Consensus Guidelines 2018: Diabetes in adolescence. Pediatr Diabetes 2018; 19:250-61.

4. American Diabetes Association. Children and adolescents: standards of medical care in Diabetes 2019. Diabetes Care 2019; 42:S148-64. https://doi.org/10.2337/dc19-S013

5. Phelan H, Lange K, Cengiz E, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Diabetes education in children and adolescents. Pediatr Diabetes 2018; 19:75-83.

6. 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.

7. Azar M, Gabbay R. Web-based management of diabetes through glucose uploads: has the time come for telemedicine? Diabetes Res Clin Pract 2009; 83:9-17.

8. Hieftje K, Edelman EJ, Camenga DR, Fiellin LE. Electronic media-based health interventions promoting behavior change in youth: a systematic review. JAMA Pediatr 2013; 167:574-80.

9. Bin-Abbas B, Jabbari M, Al-Fares A, El-Dali A, Al-Orifi F. Effect of mobile phone short text messages on glycaemic control in children with type 1 diabetes. J Telemed Telecare 2014; 20:153-6.

10. Döğer E, Bozbulut R, Soysal Acar AŞ, et al. Effect of telehealth system on glycemic control in children and adolescents with type 1 diabetes. J Clin Res Pediatr Endocrinol 2019; 11:70-5.

11. Berndt RD, Takenga C, Preik P, et al. Impact of information technology on the therapy of type 1 diabetes: a case study of children and adolescents in Germany. J Pers Med. 2014; 4:200-17.

12. Jaser SS, Whittemore R, Chao A, Jeon S, Faulkner MS, Grey M. Mediators of 12-month outcomes of two internet interventions for youth with type 1 diabetes. J Pediatr Psychol 2014; 39:306-15.

13. Newton KT, Ashley A. Pilot study of a web-based intervention for adolescents with type 1 diabetes. J Telemed Telecare 2013; 19:443-9.

14. Cramm JM, Strating MM, Roebroeck ME, Nieboer AP. The importance of general self-efficacy for the quality of life of adolescents with chronic conditions. Soc Indic Res 2013; 113:551-61.

15. Guo J, Whittemore R, He GP. The relationship between diabetes self-management and metabolic control in youth with type 1 diabetes: An integrative review. J Adv Nurs 2011; 67:2294-310.

16. 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.

17. Armstrong B, Mackey ER, Streisand R. Parenting behavior, child functioning, and health behaviors in preadolescents with type 1 diabetes. J Pediatr Psychol 2011; 36:1052-61.

18. Chih AH, Jan CF, Shu SG, Lue BH. Self-efficacy affects blood sugar control among adolescents with type 1 diabetes mellitus. J Formos Med Assoc 2010; 109:503-10.

19. Rasbach L, Jenkins C, Laffel L. An integrative review of self-efficacy measurement instruments in youth with type 1 diabetes. The Diabetes Educator 2015; 41:43-58.

20. Varni JW, Burwinkle TM, Jacobs JR, Gottschalk M, Kaufman F, Jones KL. The PedsQL in type 1 and type 2 diabetes: reliability and validity of the pediatric quality of life inventory generic core scales and type 1 diabetes module. Diabetes Care 2003; 26:631-7.

21. Ayar D, Ozturk C. Psychometric evaluation of the Pediatric Quality of Life InventoryTM 3.0 diabetes module for Turkish children with type 1 diabetes mellitus. Oxid Commun 2016; 39:438-50.

22. Moens A. Ontwikkeling van een valide en betrouwbaar meetinstrument dat perceived self-efficacy meet t.a.v. diabetes zelfzorg bij adolescenten met type 1 diabetes mellitus. Master Thesis, Gent University, Belgium, 1998.

23. Ozturk C, Ayar D, Bektas M. Psychometric properties of a Turkish version of the diabetes management self-efficacy scale in adolescents with type 1 diabetes mellitus. Child Health Care 2017; 46:331-43.

24. Choi YS, Berry-Caba´n C, Nance J. Telemedicine in paediatric patients with poorly controlled type 1 diabetes. J Telemed Telecare 2013; 19:219-21.

25. Schiaffini R, Tagliente I, Carducci C, et al. Impact of long-term use of eHealth systems in adolescents with type 1 diabetes treated with sensor-augmented pump therapy. J Telemed Telecare 2016; 22:277-81.

26. Hapunda G, Abubakar A, van de Vijver Pouwer F. Living with type 1 diabetes is challenging for Zambian adolescents: qualitative data on stress, coping with stress and quality of care and life. BMC Endocr Disord 2015; 15:20.

27. Whittemore R, Jaser SS, Jeon S, et al. An internet coping skills training program for youth with type 1 diabetes: six-month outcomes. Nurs Res 2012; 61:395-404.