ORIGINAL ARTICLE

DOI: 10.4274/jcrpe.galenos.2022.2022-2-10

J Clin Res Pediatr Endocrinol 2022;14(3):324-333

Psychometric Properties of the Turkish Version of the Diabetes Strengths and Resilience Measure for Adolescents with Type 1 Diabetes

Aslı Demirtaş[1], Burcu Aykanat Girgin[2], Ayla Güven[1], Heves Kırmızıbekmez[3]

[1]Zeynep Kamil Maternity and Children Diseases Training and Research Hospital, Clinic of Pediatric Endocrinology, İstanbul, Turkey
[2]University of Health Sciences Turkey, Hamidiye Faculty of Nursing, Department of Pediatric Nursing, İstanbul, Turkey
[3]İstanbul Ümraniye Training and Research Hospital, Clinic of Pediatric Endocrinology, İstanbul, Turkey

What is already known on this topic?

In adolescents with type 1 diabetes mellitus (T1DM), diabetes resilience is reported to reduce the negative emotions associated with diabetes, increase self-efficacy behavior in diabetes management, and facilitate metabolic control. At present, there is no validated assessment tool to measure diabetes-specific resilience and strengths of adolescents with T1DM in Turkey.

What this study adds?

The Turkish version of the Diabetes Strengths and Resilience Measure for Adolescents with Type 1 Diabetes is valid and reliable scale in the assessment of diabetes resilience and strengths in adolescents with T1DM. Healthcare professionals can use this brief self-report scale to evaluate adaptive strengths and resilience related to diabetes management for adolescents with T1DM.

Abstract

Objective: Resilience in diabetes refers to the capacity overcome diabetes-related challenges to achieve favorable psychosocial and health outcomes. Despite the known benefits of resilience in adolescents with type 1 diabetes mellitus (T1DM), there tends to be more emphasis on risk factors in research and practice. This study evaluated the psychometric properties of the Diabetes Strengths and Resilience Measure for Adolescents with Type 1 Diabetes (DSTAR-Teen) in Turkey.

Methods: This descriptive, methodological study was conducted between October 2020 and May 2021. The Turkish DSTAR-Teen was administered to 120 adolescents with T1DM, and the data were evaluated using Cronbach's alpha coefficients, factor analyses, test-retest correlation, and item-total score correlations.

Results: The Turkish DSTAR-Teen has 12 items in two factors that explained 50.64% of the total variance. Confirmatory factor analysis revealed goodness-of-fit and comparative fit indices of 0.92 and 0.95, respectively. The total Cronbach's alpha value of the scale was 0.85. Item-total score correlations ranged from 0.49 to 0.74 ($p < 0.001$).

Conclusion: Our analyses showed that the Turkish DSTAR-Teen is a valid and reliable instrument in Turkish adolescents with T1DM. The Turkish DSTAR-Teen can be used to evaluate strengths and resilience associated with diabetes management in adolescents with T1DM in Turkey.

Keywords: Adolescent, diabetes, resilience, reliability, validity

Introduction

Diabetes mellitus type 1 (T1DM) is a chronic metabolic disorder primarily caused by absolute insulin deficiency (1,2). T1DM is common among adolescents, and its incidence is increasing rapidly worldwide. The International Diabetes Federation (IDF) reported that in 2021, over 1.2 million children and adolescents had T1DM globally, 26,832 of which were in Turkey (3). According to the Ninth

Address for Correspondence: Burcu Aykanat Girgin PhD, Associate Professor, University of Health Sciences Turkey, Hamidiye Faculty of Nursing, Department of Pediatric Nursing, İstanbul, Turkey
E-mail: aykanat_87@hotmail.com **ORCID:** orcid.org/0000-0002-2601-8781

Conflict of interest: None declared
Received: 09.03.2022
Accepted: 23.05.2022

edition of the IDF Diabetes Atlas, Turkey will be among the 10 countries with the largest population of children and adolescents with T1DM by 2035 (4).

The self-care tasks involved in diabetes management can be challenging for adolescents, who are already dealing with various psychological and physiological changes (2,5,6). These tasks include adhering to diet and exercise, measuring blood glucose, administering insulin, and responding to changes in blood glucose levels (2). During adolescence, the increased need for insulin, greater desire for independence, immature cognitive function, and more time spent out of the house can disrupt these routines and potentially lead to unwanted complications (7,8). Moreover, adolescents' changing relationship with their parents during this period, which is often marked by increased conflict, and the transfer of responsibility for T1DM management from parents to adolescents make it more difficult for parents to be involved in the process and reduces treatment adherence (9,10,11). Adolescents with T1DM are also susceptible to mental health disorders, such as diabetes distress and depression (12).

Diabetes resilience has been described as the ability to achieve favorable health and psychosocial outcomes in spite of the numerous challenges involved in living with and managing diabetes in adolescence (13). In adolescents with T1DM, diabetes resilience is reported to reduce the negative emotions associated with diabetes, increase self-efficacy behaviors in diabetes management, and facilitate metabolic control (14,15,16,17). Therefore, it is important to know and support the strengths and protective factors that increase resilience in patients with T1DM (14,18). In the literature, collaborative parental involvement, supportive family communication, problem-solving skills, and diabetes self-efficacy have been identified as strengths that contribute to resilience in the face of diabetes-related challenges (18,19,20). Despite the known advantages of resilience, the assessment and promotion of resilience often takes a back seat to the evaluation of problems and obstacles related to diabetes management in pediatric research and practice (14).

Although some resilience measures are available in the literature, they have various limitations, such as focusing on only one construct or the technical aspects of diabetes management and failing to reflect the adaptive nature of diabetes management in adolescents (18). As a result, Hilliard et al. (14) developed the Diabetes Strengths and Resilience Measure for Adolescents with Type 1 Diabetes (DSTAR-Teen) to assess young people's self-efficacy and help-seeking behaviors in diabetes management. The DSTAR-Teen is a brief self-report tool for evaluating diabetes-specific strengths and resilience that can be easily filled out by adolescents and has been validated for use in this population. At present, there is no validated assessment tool to measure diabetes-specific resilience and strengths of adolescents with T1DM in the Turkish language. Concepts and manifestations of resilience may vary according to culture and environment (21,22). Therefore, the aim of this study was to adapt the DSTAR-Teen into Turkish and investigate its psychometric properties in adolescents with T1DM living in Turkey.

Methods

Participants

This descriptive, methodological study was conducted with 120 adolescents aged 14 to 18 years who were registered in the pediatric endocrinology outpatient and inpatient clinics of two training and research hospitals in western Turkey between October 2020 and May 2021. For validity and reliability studies, a sample size 5-10 times (23) or 10-20 times the number of items in the assessment tool is recommended (24). Sample sizes for analyzing the validity and reliability of a scale have also been categorized as good (100-500), very good (500-1000), and excellent (≥1000) (24,25). Based on this information, we included 120 adolescents who met the selection criteria in the sample for this study. For test-retest analysis, we administered the Turkish version of the DSTAR-Teen again, after a 3-week interval, to 24 of the adolescents in the sample (25).

Inclusion criteria were: 1) being between 14 and 18 years of age; 2) having a diagnosis of T1DM for at least 1 year; 3) receiving at least 0.5 units of insulin per kg per day; and 4) agreeing to participate and providing both personal and parental informed consent. Exclusion criteria were: 1) undergoing treatment for major depressive disorder or using antidepressant medication; and 2) having any hearing, speech, or cognitive impairment.

Written permission to carry out the Turkish adaptation and validity/reliability analyses of the DSTAR-Teen was obtained via e-mail from the developer of the original scale (14). Approval was obtained from the institutional review board of a Zeynep Kamil Maternity and Children Diseases Training and Research Hospital in İstanbul, Turkey (no: 08.07.2020/146). Institutional permissions were also obtained from the hospitals where data collection was carried out. Adolescents and their parents were met before initiating the study to inform them of the research purpose and procedures and their verbal and written consent was obtained.

Instruments

Descriptive questionnaire: The adolescents answered nine questions (seven multiple choice and two open-ended) about their age, gender, their parents' education level, diabetes duration, frequency of blood glucose measurement, hemoglobin A1c (HbA1c) level, and instances of hypoglycemia and hyperglycemia in the last month.

DSTAR-Teen: Hilliard et al. (14) (2017) developed this scale to measure adolescents' self-efficacy and adaptive and help-seeking behaviors associated with diabetes management. The original scale comprises 12 items rated on a 5-point Likert-type scale (never = 1, almost always = 5). The DSTAR-Teen has a two-factor structure (diabetes-related confidence and help with diabetes management) that measures intrapersonal and interpersonal resilience and strengths, respectively. The six items in the diabetes-related confidence subscale assess adolescents' self-efficacy in managing their diabetes overall (item 1), dealing with abnormal blood glucose levels (item 3), asking questions to healthcare professionals (item 4), solving diabetes-related problems (item 5), and prioritizing diabetes management (item 10). The other item asks whether they believe their effort toward diabetes management makes a difference (item 8). The help with diabetes management subscale evaluates adolescents' comfort with telling their peers about their diabetes (item 2), their ability to ask for help from peers and parents (items 6, 7, 9, and 11), and their ability to communicate about diabetes with their parents (item 12).

Total scores on the DSTAR-Teen range from 12 to 60 points, and there is no defined cut-off point. A higher score represents greater resilience and strengths. The original scale had a Cronbach's alpha of 0.89 and item-total correlations between 0.55 and 0.78. Assessment of criterion validity demonstrated a significant association between adolescents' HbA1c values and their DSTAR-Teen subscale and total scores, with the adolescents who scored higher on the DSTAR-Teen having significantly more normal HbA1c values. The DSTAR-Teen was reported to be valid and reliable for the evaluation of adaptive behaviors and attitudes related to diabetes management in adolescents aged 14-18 years (14).

Procedure

To ensure cross-cultural consistency and analyze the validity and reliability of the scale before data collection, we followed a 4-step process consisting of forward and back translation, expert opinion, and pilot testing, as recommended in guidelines and the Consensus-Based Standards for the Selection of Health Measurement Instruments standards (26,27,28).

Forward and Back Translation

Two native Turkish-speaking linguists fluent in English and familiar with both cultures independently translated the scale into Turkish. We compared the translations and selected the most appropriate expressions to create a single form, which was then revised by a Turkish language expert. Two native English-speaking translators with knowledge of Turkish language and culture and experience in health terminology then independently translated the draft Turkish version of the DSTAR-Teen back into English. Their versions were compared with the original to ensure consistency in meaning.

Expert Opinion

To evaluate content validity, we presented the original and Turkish versions of the scale to a panel of 10 experts including eight faculty members, one pediatric endocrinology and metabolism specialist, and one pediatric diabetes nurse (25,29). The experts assessed each item as very appropriate (1), appropriate (2), needs minor modification (3), and requires major revision (4) (30). Item-level and scale-level content validity indices (I-CVI/S-CVI) were calculated as described previously (31,32). Items were revised as needed based on the experts' feedback and the final version was used for pilot testing (25).

Pilot Test

The scale was administered to 10 adolescents who volunteered to participate in the study during the enrollment phase but were not included in the sample (23). No negative feedback about the comprehensibility and readability of the scale items or the scale response time was received in the pilot test. Therefore, we concluded that the scale was sufficiently comprehensible, and the final version of the Turkish DSTAR-Teen (Appendix 1) was administered to the entire sample.

Data Collection

Before data collection, the adolescents and their parents were informed about the purpose of the study, and written consent was obtained from those who agreed to participate. After obtaining informed consent, the participating adolescents were asked to complete the descriptive information form and Turkish version of DSTAR-Teen individually (Appendix 1). In addition to their self-report on the descriptive information form, the participants' most recent HbA1c value was checked from their outpatient and ward records. In case of a discrepancy, the value on record was accepted as correct. Completion of the data collection forms took approximately 15

minutes. Participants filled out the data collection forms at a convenient time of their choosing. Participation in the study was completely voluntary, and participants received no compensation.

Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences Statistics, version 22.0 (IBM Corp, Armonk, NY) and AMOS software packages (https://www.ibm.com/products/structural-equation-modeling-sem). Sociodemographic information was summarized using number, percentage, minimum, maximum, and mean values.

Validity of the Turkish version of DSTAR-Teen was assessed through content, construct, and criterion validity analyses. In content validity analysis, CVI values were used to evaluate consistency in expert opinion (29). Construct validity was examined through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA was performed using the principal components method with varimax rotation after evaluating the adequacy of the data with Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) test (24,25,31). A p value < 0.05 in Bartlett's chi-square test was sought. KMO values were considered inappropriate below 0.50 and excellent as they approached 1 (25,31). CFA was done to verify that the structure of the Turkish version of the scale was consistent with that of the original. We performed CFA using goodness-of-fit index (GFI), comparative fit index (CFI), normal fit index (NFI), incremental fit index (IFI), root mean square error of approximation (RMSEA), and chi-square/degrees of freedom (χ^2/df) ratio as model fit indices (23,33). For criterion validity, we evaluated the relationship between the adolescents' most recent HbA1c values and their total and subscale scores on the DSTAR-Teen Turkish version using Pearson correlation analysis to test the hypothesis that these parameters would be inversely associated (14,34).

Cronbach's alpha, item-total correlation (Pearson correlation test), and test-retest (paired samples t-test) analyses were used to assess the reliability of the Turkish DSTAR-Teen. Statistical significance was accepted at $p < 0.05$ (23,25).

Results

Table 1 presents the sociodemographic and clinical characteristics of the adolescents included in the study. Their mean age was 15.23 ± 1.31 years and 50.2% were boys. Duration of T1DM was 1-3 years for 37.5% (n = 45) of the participants. The frequency of blood glucose measurement ranged from 2 to 12 times a day, with 31.7% (n = 38) measuring blood glucose 4-5 times a day and 25.8% (n = 31) measuring blood glucose 6-7 times a day. Evaluation of hypo/hyperglycemia frequency showed that 37.5% (n = 45) of participants reported having experienced hypoglycemia 1-3 times and 27.5% (n = 33) experienced hyperglycemia 1-3 times in the last month. The mean HbA1c value of the participants was 8.95 ± 1.88% (range: 4.7-15.3). This was higher than the recommended level of ≤7.5% for T1DM management.

Validity Analysis

Content validity: Based on the 10 experts' feedback, I-CVI and S-CVI values for the Turkish version of DSTAR-Teen were 0.92 and 0.96, respectively.

Construct validity (EFA and CFA): The Turkish DSTAR-Teen had a KMO coefficient of 0.82, while Bartlett's test of sphericity χ^2 value was 476.559 ($p = 0.001$). In EFA, the Turkish version of DSTAR-Teen showed a two-factor structure that explained 50.6% of the total variance. Item factor loadings varied between 0.620 and 0.778 (Table 2). In CFA, factor loading value ranges were 0.50 to 0.80 for the whole scale, 0.52 to 0.77 for the diabetes-related confidence subscale, and 0.50 to 0.80 for the help with diabetes management subscale (Figure 1). The model χ^2 was 90.28, degrees of freedom (df) value was 53, and RMSEA was 0.077. The χ^2/df ratio was 1.703. Other model fit index values were GFI = 0.92, CFI = 0.95, NFI = 0.96, and IFI = 0.95 (Table 3).

Criterion validity: Significant and strong negative correlations were observed between the participants' HbA1c values and their Turkish DSTAR-Teen total scores ($r = -0.947$; $p = 0.001$), diabetes-related confidence subscale scores ($r = -0.768$; $p = 0.001$), and help with diabetes management subscale scores ($r = -0.871$; $p = 0.001$). As DSTAR-Teen scores increased, the participants' HbA1c values decreased to within the reference range. These results supported the previously observed relationship between diabetes resilience and DSTAR-Teen scores.

Reliability Analysis

Cronbach's alpha values for the diabetes confidence and help in diabetes management subscales were 0.80 and 0.81, respectively, and that of the entire scale was 0.85. Item-total score correlation coefficients ranged from 0.49 to 0.74 (Table 4; $p = 0.001$). Item test and retest scores showed no significant differences in the paired samples t-test, and test-retest correlation coefficients for the items ranged from 0.614 to 0.942 ($p = 0.001$; Table 5). The intraclass correlation coefficient was 0.91, indicating high test-retest reliability.

Discussion

It has been reported that resilience in adolescents with T1DM reduces negative emotions associated with diabetes and facilitates the maintenance of metabolic control (14,16,17). Therefore, measures to evaluate and enhance resilience in patients with T1DM are important (14). In the first stage of our study, we reviewed the literature for strengths and resilience scales that have been developed for adolescents with T1DM. In this study, we adapted the DSTAR-Teen into Turkish and investigated its psychometric properties in the Turkish adolescent population.

Validity Analysis

In this study we followed a 4-step process consisting of forward translation, back translation, expert opinion, and pilot testing to ensure language and content validity of the Turkish DSTAR-Teen (26,27,28). Based on evaluation by a panel of 10 experts, both the I-CVI (0.92) and S-CVI (0.96) of the Turkish DSTAR-Teen were well above the accepted threshold of 0.80 (31,35). Therefore, we concluded the items of the DSTAR-Teen were appropriate for Turkish culture and adequately represented the construct being measured (32).

We used the KMO coefficient and Bartlett's chi-square tests to evaluate whether the data were adequate and suitable

Table 1. Descriptive characteristics of the adolescents with T1DM (n = 120)

Descriptive characteristics			
		Min-max (median)	Mean ± SD
Age (years)		14-18 (15)	15.23 ± 1.31
HbA1c (%)		4.7-15.3 (8.2)	8.95 ± 1.88
		n	%
Gender	Female	59	49.2
	Male	61	50.8
Paternal education level	Illiterate	6	5.0
	Primary school	39	32.5
	Secondary school	53	44.2
	University	22	18.3
Maternal education level	Illiterate	7	5.8
	Primary school	60	50.0
	Secondary school	33	27.5
	University	20	16.7
Diabetes duration (years)	1-3	45	37.5
	4-6	31	25.8
	7-9	22	18.4
	10-12	16	13.3
	13-15	6	5.0
Daily frequency of blood glucose measurement (times)	2-3 times	23	19.2
	4-5 times	38	31.7
	6-7 times	31	25.8
	≥8 times	28	23.3
Frequency of hypoglycemia in last month (times)	1-3 times	45	37.5
	4-6 times	24	20.0
	7-9 times	17	14.2
	≥10 times	15	12.5
	None	19	15.8
Frequency of hyperglycemia in last month (times)	1-3 times	33	27.5
	4-6 times	30	25.0
	7-9 times	21	17.5
	≥10 times	27	22.5
	None	9	7.5

T1DM: type 1 diabetes mellitus, Min-max: minimum-maximum, HbA1c: hemoglobin A1c, SD: standard deviation

to conduct factor analysis. A KMO coefficient >0.50 and statistically significant result in Bartlett's chi-square test are recommended in order to perform EFA (33,35). In our study, we determined the Turkish DSTAR-Teen had a KMO of 0.82 and Bartlett's chi-square test was significant ($\chi^2 = 476.559$; p = 0.001), indicating that the scale and sample size were sufficient for factor analysis (35). These values were consistent with the Chinese version of the scale (34).

We found that the Turkish DSTAR-Teen conformed to a two-factor structure that explained 50.64 % of the total variance in the scale. The explained variance was above the expected values of >30 % for single-factor scales and >40 % for multi-factor scales (33,35), supporting its construct validity (23,33). While the Turkish version of the scale showed a two-factor structure consistent with the original (14), the Chinese version showed a three-factor structure. The authors noted that this may be a result of different cultures and environments (34).

The factor loading value is a coefficient that explains the relationships between the items and the factors of an assessment tool. In the literature, a factor loading of >0.30 (35,36) or >0.40 is recommended for an item to be included in a scale (23,30). The factor loadings for the Turkish DSTAR-Teen ranged between 0.620 and 0.778. As these values

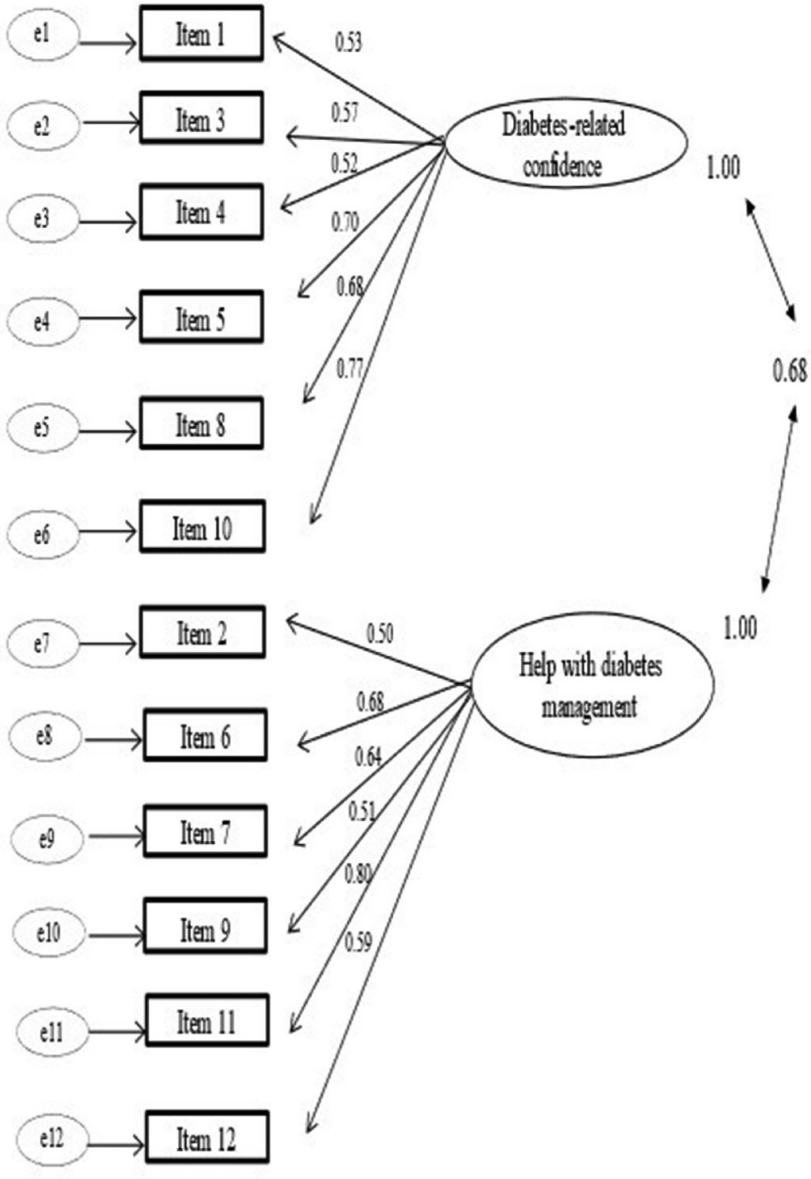

Figure 1. Factor structure of the Turkish version of DSTAR-Teen (p value for all factor loadings <0.001)

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were greater than the threshold of 0.30, none of the items were removed (35). Factor loadings were reported as 0.50 to 0.93 in the original study of the scale (14) and between 0.59 and 0.72 in the Chinese version (34), similar to our study.

Confirmatory factor analysis is a method used when adapting a scale to a different language and culture than those for which it was developed. CFA examines the suitability of the factor structure determined by EFA (23,36). According to CFA analysis, item factor loadings were greater than 0.30 (Figure 1), RMSEA was less than 0.08, χ^2/df was less than 5, and other model fit indices were greater than 0.90 (Table 3). The results of CFA were consistent with the two-factor structure of the Turkish DSTAR-Teen. The scale items were found to be relevant to their subscales and appropriate for evaluating the resilience and strengths of adolescents with T1DM in a Turkish sample (25,36). In the Chinese version of the scale, fit indices were reported as χ^2/df = 2.29, GFI = 0.87, and CFI = 0.90 (34). GFI indices for the Turkish DSTAR-Teen were higher than those of the Chinese version. The results of EFA and CFA analysis demonstrated that the Turkish DSTAR-Teen had strong construct validity.

The relationship between adolescents' HbA1c values and DSTAR-Teen scores was evaluated in the original DSTAR-Teen study (14). The authors reported that adolescents with HbA1c > 7.5% had significantly higher total DSTAR-Teen scores (52.7 ± 6.2) than those with HbA1c < 7.5% (48.2 ± 8.0) and that HbA1c values were negatively correlated with DSTAR-Teen total score. Similarly, in the study of the Chinese version, a significant negative association was observed between DSTAR-Teen and HbA1c values (r = -0.21, p = 0.002) (34). As an assessment of criterion validity, we also tested the hypothesis that HbA1c values would decrease as scores on the Turkish DSTAR-Teen increased. We detected a significant negative correlation between the participants' HbA1c measurements and their total diabetes resilience scores (r = -0.947; p = 0.001), thus supporting the criterion validity of the scale.

Reliability Analysis

The reliability of an instrument is defined as its correct measurement of the construct of interest and consistency in responses between individuals (23,37). Cronbach's alpha coefficient, a parameter of internal consistency reliability, reflects the consistency and homogeneity of the items in an assessment tool (23,25). In the literature, a minimum Cronbach's alpha of 0.70 is recommended for an assessment tool to be considered reliable in terms of internal consistency (25). An instrument is regarded as having good reliability at Cronbach's alpha coefficients between 0.70 and 0.80 and high reliability at values of 0.80 to 1 (25,37). The Cronbach's alpha coefficients for the Turkish DSTAR-Teen and its subscales were all greater than 0.80 in this study, indicating high reliability (Table 4).

Table 2. Factor analysis of the Turkish version of DSTAR-Teen (n = 120)

Factor 1: Diabetes-related confidence		Factor 2: Help with diabetes management	
Item	**Item factor loading**	**Item**	**Item factor loading**
1. I am able to take care of my diabetes pretty well.	0.666	2. I tell my friends about diabetes.	0.647
3. I am good at responding to high or low blood sugar.	0.620	6. My parent(s) help me take care of my diabetes.	0.656
4. I am able to ask my nurse or doctor questions about how to manage my diabetes.	0.647	7. I can ask for help with my diabetes management when I need to.	0.632
5. I am good at figuring out what to do for my diabetes care when problems come up.	0.715	9. I can count on my friends to help me take care of diabetes if I need help.	0.714
8. If I try hard to do everything I need to do for my diabetes, it makes a difference.	0.621	11. There is someone I can always ask for help with my diabetes.	0.716
10. I can figure out ways to take care of my diabetes even when I am busy or other things make diabetes hard to manage	0.778	12. I talk to my parent(s) calmly about diabetes, like talking about my A1c or remembering to do blood sugar checks.	0.655
Eigen value	3.090		2.986
Variance (%)	25.751		24.887
Total explained variance (%)	50.638		

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Table 3. Model fit indices for confirmatory factor analysis

Model	χ^2	df[a]	χ^2/df	RMSEA	p	GFI	CFI	NFI	IFI
Two-factor	90.28	53	1.70	0.077	< 0.001	0.92	0.95	0.96	0.95

[a]Degree of freedom.
RMSEA: Root mean square error of approximation, GFI: goodness of fit index, CFI: comparative fit index, NFI: normed fit index, IFI: incremental fit index

These findings provide evidence that the Turkish version of DSTAR-Teen and its subscales are consistent and relevant, show homogeneity, and that the items are reliable in the assessment of strengths and resilience in adolescents with T1DM. Similar to our study, Cronbach's alpha coefficients of 0.89 were reported for the original and Chinese versions of the scale (14,34).

Table 4. Cronbach's alpha coefficient and item-total score correlation of the Turkish version of the DSTAR-Teen (n = 120)

Turkish version of DSTAR-Teen	Item-total score correlation	Mean ± SD
	r*	
I am able to take care of my diabetes pretty well	0.49	4.01 ± 0.85
I tell my friends about diabetes.	0.55	3.98 ± 1.24
I am good at responding to high or low blood sugar.	0.60	3.88 ± 1.17
I am able to ask my nurse or doctor questions about how to manage my diabetes.	0.51	4.08 ± 0.98
I am good at figuring out what to do for my diabetes care when problems come up.	0.65	4.03 ± 1.03
My parent(s) help me take care of my diabetes.	0.60	4.63 ± 0.67
I can ask for help with my diabetes management when I need to.	0.68	4.15 ± 1.03
If I try hard to do everything I need to do for my diabetes, it makes a difference.	0.69	4.01 ± 1.09
I can count on my friends to help me take care of diabetes if I need help.	0.55	3.14 ± 1.51
I can figure out ways to take care of my diabetes even when I am busy or other things make diabetes hard to manage.	0.67	3.88 ± 0.98
There is someone I can always ask for help with my diabetes.	0.74	4.23 ± 1.11
I talk to my parent(s) calmly about diabetes, like talking about my A1c or remembering to do blood sugar checks.	0.60	4.16 ± 1.05
Diabetes-related Confidence subscale		23.89 ± 4.30
Help with Diabetes Management subscale		24.29 ± 4.63
Total Turkish DSTAR-Teen		48.18 ± 7.74
Cronbach's alpha	Scale/Subscale	Cronbach's alpha coefficient
	Diabetes-related confidence (items 1, 3, 4, 5, 8, 10)	0.80
	Help with diabetes management (items 2, 6, 7, 9, 11, 12)	0.81
	Total Turkish DSTAR-Teen	0.85

*r: Pearson correlation analysis, $p < 0.001$.
DSTAR-Teen: Diabetes Strengths and Resilience Measure for Adolescents with Type 1 Diabetes, SD: standard deviation

Table 5. Test-retest values of Turkish version of DSTAR-Teen (n = 24)

Items	Test	Retest	Pearson correlation analysis		Paired samples t-test	
	Mean ± SD	Mean ± SD	r*	p	t	p
Item 1	4.09 ± 0.68	4.14 ± 0.83	0.646	0.001**	-0.326	0.747
Item 2	4.18 ± 1.10	4.36 ± 0.85	0.898	0.001**	-1.702	0.104
Item 3	3.64 ± 1.14	3.77 ± 1.15	0.735	0.001**	-0.767	0.451
Item 4	4.00 ± 1.02	4.18 ± 0.85	0.873	0.001**	-1.702	0.104
Item 5	4.09 ± 0.87	4.18 ± 0.91	0.825	0.001**	-0.810	0.427
Item 6	4.86 ± 0.35	4.77 ± 0.43	0.733	0.001**	1.449	0.162
Item 7	4.23 ± 0.92	4.27 ± 0.70	0.635	0.001**	-0.295	0.771
Item 8	4.18 ± 0.73	4.18 ± 0.66	0.614	0.001**	0.000	1.000
Item 9	3.14 ± 1.55	3.23 ± 1.54	0.942	0.001**	-0.810	0.427
Item 10	4.09 ± 0.75	4.18 ± 0.73	0.835	0.001**	-1.000	0.329
Item 11	4.59 ± 0.80	4.55 ± 0.74	0.802	0.001**	0.439	0.665
Item 12	4.55 ± 0.60	4.45 ± 0.80	0.753	0.001**	0.810	0.427

*r: Pearson correlation analysis, **$p < 0.01$.
DSTAR-Teen: Diabetes Strengths and Resilience Measure for Adolescents with Type 1 Diabetes, SD: standard deviation

Test-retest analysis determines whether an instrument shows consistency and stability between two assessments performed under the same conditions after a certain period of time. For test-retest analysis, the instrument should be administered to at least 20 people with an interval of two to six weeks (25). Therefore, we administered the Turkish version of the DSTAR-Teen again after a 3-week interval to 24 of the adolescents in the sample. The test-retest results of the Turkish DSTAR-Teen showed significant correlations ($p = 0.001$), with no statistical differences in mean item scores between the test and retest and an intraclass correlation coefficient of 0.91 (Table 5). These findings demonstrate that the Turkish scale was highly reliable and consistently measured the constructs of resilience and strengths at different times in adolescents with T1DM (23,25). Our results were consistent with those reported for the Chinese version of the scale (34). However, we could not compare our results with the findings reported by Hilliard et al. (14) (2017) because they did not conduct test-retest analysis.

Item-total score correlations demonstrate how scores obtained from individual items relate to the total scale score and to what extent the items differentiate, based on the measured characteristic (35,36). Item-total score correlation coefficients are expected to be positive and greater than 0.30 (23,24). In our study, item-total score correlations were between 0.49 and 0.74. Therefore, we concluded that all items were related to the scale, adequately measured resilience and strengths in adolescents with T1DM, and had high reliability (24,35). In the original study of the scale, item-total correlations were between 0.55 and 0.78, similar to our study (14). As item-total correlations were not examined for the Chinese version of the scale, no comparison could be made (34).

In our study, the mean total scale score of adolescents was 48.18 ± 7.74, which is above the average of the potential score range. Mean total scores were reported as 49.0 ± 7.9 for the original scale and 42.4 for the Chinese version. Our results are similar to the original study (14) and may be higher than in the Chinese study because they included adolescents diagnosed with major depression (34).

Study Limitations

Because this study was conducted in two centers and used convenience sampling, our results may have limited representativeness and generalizability.

Conclusion

The Turkish version of the DSTAR-Teen has 12 items in two subscales, consistent with the original, and showed a high Cronbach's alpha. The results of our analyses demonstrate that the Turkish DSTAR-Teen is valid and reliable in the assessment of diabetes resilience and strengths in adolescents in Turkey. All healthcare professionals can use this brief self-report scale to evaluate adaptive strengths and resilience related to diabetes management and investigate their effects on glycemic control and mental health in adolescents with T1DM. We also believe the DSTAR-Teen will be useful in experimental studies evaluating the effect of interventions to improve resilience behaviors in adolescents with T1DM.

Acknowledgements

We would like to thank the adolescents participating in the study.

Ethics

Ethics Committee Approval: The study was approved by the Zeynep Kamil Maternity and Children Diseases Training and Research Hospital of Ethics Committee (protocol no: 146, date: 08.07.2020).

Informed Consent: Consent form was filled out by all participants.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Aslı Demirtaş, Burcu Aykanat Girgin, Ayla Güven, Heves Kırmızıbekmez, Concept: Aslı Demirtaş, Burcu Aykanat Girgin, Design: Aslı Demirtaş, Burcu Aykanat Girgin, Ayla Güven, Data Collection or Processing: Aslı Demirtaş, Burcu Aykanat Girgin, Ayla Güven, Heves Kırmızıbekmez, Analysis or Interpretation: Aslı Demirtaş, Burcu Aykanat Girgin, Ayla Güven, Heves Kırmızıbekmez, Literature Search: Aslı Demirtaş, Burcu Aykanat Girgin, Ayla Güven, Heves Kırmızıbekmez, Writing: Aslı Demirtaş, Burcu Aykanat Girgin, Ayla Güven, Heves Kırmızıbekmez.

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

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