

RESEARCH

Open Access



# Self-Care behaviors and their association with self-efficacy and health literacy among adolescents with type 1 diabetes mellitus in palestine: a cross-sectional study

Fida Ayed<sup>1</sup>, Malakeh. Z. Malak<sup>2\*</sup>, Anas Shehadeh<sup>3</sup> and Lubna Harazneh<sup>4</sup>

## Abstract

**Purpose** Type 1 diabetes mellitus (T1DM) is the most common endocrine disorder during adolescence. Self-care behaviors are the cornerstone of diabetes management. Effective self-care behaviors require individuals to perform a range of complex daily tasks, including monitoring blood glucose, adhering to dietary recommendations, administering insulin, and recognizing symptoms of hypo- or hyperglycemia. Two critical psychosocial and cognitive factors that influence the success of self-management are self-efficacy and health literacy. There are limited studies on the factors related to self-efficacy and health literacy associated with self-care behaviors among adolescents with T1DM in the Arab World, including Palestine. Therefore, this study investigated the associations between self-efficacy, health literacy, select demographic variables, and self-care behaviors among adolescents with T1DM in Palestine.

**Methods** A cross-sectional correlational design was used, and 156 adolescents aged 14–18 years were selected by a convenience sampling method from primary healthcare settings in Palestine between February and June 2024. A self-reported questionnaire was used to collect data, which included demographic variables, the Diabetic Health Literacy Scale, the Self-Efficacy for Diabetes Scale, and the Self-Care Inventory. Descriptive statistics, Pearson's and point biserial correlation tests, and multiple linear regression were used to examine the relationships between the study variables.

**Results** Participants reported high levels of self-efficacy ( $M = 108.80$ ,  $SD = 14.92$ ), low levels of health literacy ( $M = 2.12$ ,  $SD = 0.78$ ), and low engagement in self-care behaviors ( $M = 33.82$ ,  $SD = 7.79$ ). A positive correlation was found between self-efficacy and self-care behaviors ( $r = 0.396$ ,  $p < 0.01$ ). In contrast, age was negatively associated with self-care behaviors ( $r = -0.249$ ,  $p < 0.01$ ). Furthermore, self-efficacy and age were significant predictors of self-care behaviors ( $\beta = 0.196$ ,  $p < 0.001$ ;  $\beta = -1.256$ ,  $p < 0.01$ , respectively).

**Conclusions** This study helps policymakers, healthcare providers, and parents develop strategies to enhance self-care behaviors through targeted interventions and educational programs. The findings may guide any future educational program or training sessions to improve self-care behaviors among adolescents with T1DM.

**Keywords** Adolescents, Health literacy, Self-care behaviors, Self-efficacy, Type 1 diabetes mellitus

\*Correspondence:

Malakeh. Z. Malak  
malakeh.m@zuj.edu.jo; malakehmalak@yahoo.com

<sup>1</sup>Head Nurse PICU, Registered Nurse, Palestine Medical Complex, Ramallah, Palestine

<sup>2</sup>Community Health Nursing, Faculty of Nursing, Al- Zaytoonah University of Jordan, Amman, Jordan

<sup>3</sup>American University of the Middle East, Egaila 54200, Kuwait

<sup>4</sup>Mental Health Nursing, Faculty of Nursing, Arab American University, Jenin, Palestine



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

## Introduction

Type 1 diabetes mellitus (T1DM) is the most common endocrine disorder among adolescents [1–3]. T1DM refers to juvenile or insulin-dependent diabetes [4]. The hallmark of T1DM is the autoimmune destruction of pancreatic  $\beta$ -cells due to the presence of genetic or environmental factors, which results in chronic hyperglycemia (i.e., requiring lifelong exogenous insulin administration) [5, 6]. The global population affected by diabetes increased significantly, rising from 200 million in 1990 to 830 million by 2022. The rate of increase has been notably faster in low- and middle-income countries compared to high-income nations [7]. In 2021, diabetes and diabetes-related kidney disease were responsible for more than 2 million deaths [7]. Additionally, elevated blood glucose levels contributed to approximately 11% of all cardiovascular-related fatalities [7]. Diabetes causes acute complications, including diabetic ketoacidosis, which requires urgent management in addition to long-term complications including microvascular and macrovascular diseases [8]. Diabetes can be managed, and its complications avoided or delayed with diet, physical activity, medications, and regular screening [1, 9, 10].

Adolescence is a critical stage of development that involves a variety of physical, cognitive, and psychosocial changes [11]. It is a critical period marked by increasing independence, emotional variability, and the transition from parental to self-care responsibilities [11]. Moreover, adolescence is a formative period when lifelong habits are established; therefore, it is a suitable time for adopting preventive actions and applying self-care behaviors [12]. These behaviors are related to the actions that an individual undertakes to prevent diseases or complications, and to maintain or promote health. In other words, it is the process of making decisions that maintain physiological stability, and effectively responding to symptoms when they emerge [12]. It is necessary to maintain the psychological dimension of adolescents living with T1DM. Diabetes distress—the emotional burden and stress specifically related to managing a chronic condition—can significantly impact an adolescent's mental health and overall well-being. Persistent distress may lead to reduced motivation, lower self-efficacy, and poorer self-care behaviors, ultimately affecting both glycemic management and quality of life [13, 14]. Therefore, effective diabetes care should take a holistic approach, integrating mental health support with physical health monitoring to ensure comprehensive and sustainable management of the condition.

Most T1DM management relies on self-care behaviors [15]. Therefore, adopting appropriate self-care behaviors can reduce the burden of the disease and its mortality [15]. Despite the known complications associated with T1DM, a significant proportion of people struggle with

consistent self-care. For example, a study conducted in Italy found that only 34.8% of adults with T1DM demonstrated adequate self-care management, while 74.0% had adequate self-care maintenance and 68.5% engaged in proper self-monitoring [16]. Similarly, research in Jordan indicated that a substantial number of people with T1DM patients exhibited low levels of self-care management, particularly in areas such as healthy eating, physical activity, and blood glucose monitoring [17]. Many factors affect self-care behaviors among people with diabetes, including health literacy, and self-efficacy [18].

Self-efficacy is a perception of one's ability to successfully perform tasks. Self-efficacy explains why adolescents seek out information and how they behave [19]. High self-efficacy is necessary for the successful management of diabetes, and it is a cornerstone of self-care [20]. People with high self-efficacy are generally more motivated and persistent in managing their diabetes, even when confronted with challenges [21]. Research indicates that increased self-efficacy is closely linked to better adherence to self-care behaviors, leading to improved glycemic management. Moreover, strong self-efficacy contributes to greater emotional resilience, helping individuals better cope with the psychological demands of living with a chronic condition like diabetes [18]. In contrast, low self-efficacy can have serious negative consequences for individuals with T1DM. When people lack confidence in their ability to manage their condition, they are more likely to engage in poor self-care behaviors, such as irregular insulin administration, inadequate blood glucose monitoring, and unhealthy dietary choices [20, 22]. This often results in not achieving glycemic targets, increased risk of acute complications (e.g., hypoglycemia or diabetic ketoacidosis), and long-term diabetes-related complications [20, 22]. Additionally, low self-efficacy can contribute to psychological distress, reduced quality of life, and higher rates of treatment nonadherence during a critical developmental period like adolescence [18]. Previous studies conducted among young adults with T1DM reported moderate to high levels of self-efficacy [20, 23]. Atiyeh [24] reported that Jordanian adolescents had high self-efficacy in handling the fundamental aspects of diabetes management, but showed moderate to low confidence in more complex tasks, such as adjusting insulin doses to address blood glucose fluctuations, calculating carbohydrate intake, and managing ketoacidosis independently at home. Mohammad [22] reported that more than half of Egyptian children had very poor self-efficacy.

Health literacy refers to an individual's ability to access, understand, evaluate, and apply health information to make informed decisions regarding their care [25]. For individuals with diabetes, particularly those managing insulin therapy, this includes understanding how to read nutrition labels, interpret blood glucose readings, adjust

insulin dosages, and follow medical instructions [26]. Inadequate health literacy among individuals with diabetes is associated with poor diabetes knowledge, reduced self-care behaviors, and an increased risk of complications [26]. Different levels of diabetes health literacy were reported among adolescents in the literature. According to a World Health Organization (WHO) survey in 2017/2018 in 10 countries in Europe, 13.3% of adolescents had low health literacy, and 19.9% had high health literacy [27]. While adolescents in the Eastern Mediterranean region were found to have low to moderate levels of health literacy [28]. A study in Taiwan revealed that 50% of adolescents with T1DM had sufficient health literacy, and 30% had problematic health literacy [29]. On the other hand, inadequate health literacy levels were found in Brazil, Pakistan, United Kingdom among adolescents [30].

Self-efficacy and health literacy are especially important for adolescents with T1DM who face unique developmental and psychosocial challenges. Poor adherence to diabetes management during this stage can lead to serious short- and long-term complications [31]. Moreover, integrating diabetes care into adolescents' everyday routines, including school, social activities, and peer interactions is necessary to support normal development and facilitate effective lifelong management of the disease [32]. Addressing both health literacy and self-efficacy among adolescents with T1DM is therefore vital to support their ability to make informed decisions and build their confidence in self-care behaviors.

### Conceptual framework

Self-care behaviors refer to the decisions and actions taken to prevent disease or improve health [33]. For adolescents with T1DM, these behaviors include healthy eating, adequate physical activity, blood glucose monitoring, adherence to medical treatment, problem-solving, healthy coping, and reduced complications [34]. Effective management of T1DM aims to maintain blood glucose levels close to glycemic targets [35]. According to guidelines by the International Society of Pediatrics and Adolescents (ISPAD) for the management of T1DM among adolescents, the target level of Hemoglobin A1c (HbA1c) should be <7.0% if reached without severe incidences of hypoglycemia [36].

As previously mentioned that self-care behaviors are influenced by both self-efficacy and health literacy [18]. Self-efficacy refers to the faith in one's abilities to organize and execute the courses of action needed to manage situations successfully [37]. Self-efficacy, in the context of diabetes, refers to the personal belief of how well individuals with diabetes are able to manage their condition, including their ability to follow dietary guidelines, maintain an exercise routine, and adhere to prescribed

medical treatments [38]. To achieve the desired self-care behaviors, adolescents must have faith and belief in their skills. Higher self-efficacy is associated with better application of self-care behaviors, improved glycemic control, lower levels of diabetes-associated distress, and fewer complications [20, 39].

Health literacy is another antecedent for effective self-care behaviors. Health literacy describes the social and cognitive abilities that enable a person to acquire, process, and understand health information and make appropriate decisions about lifestyle and medical treatments [40]. Accurate information is the foundation upon which effective self-care behaviors are built, thus, it is critical to provide adolescents with reliable and precise information about T1DM so they can adopt healthy habits and take responsibility for their health [41, 42].

### Situation in Palestine

In Palestine, the prevalence of diabetes was 15.3% in comparison with a global prevalence of 6% in 2023. It is estimated that 4.4% of people with diabetes had T1DM [43]. The healthcare systems in Palestine face numerous challenges due to ongoing armed conflicts, occupation, and socioeconomic constraints, which result in considerable problems, such as limited access to healthcare and a lack of medicines and supplies [44, 45, 46]. A previous study conducted in Palestine revealed that most adolescents with T1DM lacked the motivation to seek out health information [44]. Another Palestinian study found that only 5.5% of the adolescents with T1DM had high health literacy [45]. Moreover, Palestinian adolescents with T1DM have been reported to face numerous difficulties in diabetes management, with many not adhering to the dietary recommendations, resulting in not achieving glycemic targets [46]. It was reported that among Palestinian adolescents with T1DM, non-adherence rates were 66% for glucose testing, 89% for dietary recommendations, 79% for exercise, and 21% for timely insulin administration [47].

There is a lack of studies assessing the levels and the relationships between all of the previously mentioned interrelated variables (i.e., health literacy, self-efficacy, and self-care behaviors) among Palestinian adolescents with T1DM. Despite the importance of addressing self-care behaviors among this cohort, the research on this topic is scant and limited [47]. This presents a gap that this study aimed to fill. The results of this study can provide preliminary information about the situation of Palestinian adolescents with T1DM and the associations between self-efficacy, health literacy, and self-care behaviors among this cohort. The results can guide policymakers, healthcare professionals, parents, and adolescents to develop strategies to enhance self-care behaviors. Additionally, targeted interventions and educational

programs can be tailored based on the findings of this study to promote health literacy and self-efficacy, which will positively reflect on self-care behaviors and improve adolescents' quality of life. Therefore, this study aimed to answer the following questions:

- What are the levels of self-efficacy, health literacy, and self-care behaviors among Palestinian adolescents with T1DM?
- What is the relationship between select demographic characteristics (age, biological sex, parents' educational level, monthly family income, place of residence, and duration of diabetes), self-efficacy, health literacy, and self-care behaviors among participants?
- What are the predictors of self-care behaviors among participants?
- Is there any effect of self-efficacy, health literacy, and self-care behaviors on HbA1C among participants?

## Methods

### Study design, setting, and sampling

This study used a cross-sectional, descriptive correlational design. This study was conducted between February and June 2024.

The target population included all adolescents in Palestine aged 14–18 years who had T1DM and were registered in diabetic outpatients' clinics affiliated with private or governmental hospitals. According to the Palestinian Ministry of Health, the total number of Palestinians with T1DM was 980, and the number of adolescents was 404 in 2022 [48]. A total of 20 outpatient clinics were selected to collect data, representing all the major governments in Palestine including Jerusalem and the West Bank.

Participants were recruited using a convenience sampling method. The required sample size was determined using G\*Power software (version 3.0.10), with an alpha level of 0.05, an effect size of 0.15, and a power of 0.90, accounting for 10 predictors: age, biological sex, mother's educational level, father's educational level, monthly family income, residence, duration of diabetes, HbA1c, self-efficacy, and health literacy. Based on these parameters, a minimum of 147 participants was needed to conduct a regression analysis. To compensate for potential incomplete or missing responses, an additional 10% was added, making the minimum required sample size 162. Participants were eligible for inclusion if they met the following criteria: (a) aged between 14 and 18 years; (b) diagnosed with T1DM for at least six months; and (c) had legal guardians who consented to participate in the study. This age range was selected as adolescents at age 14 are expected to be cognitively and socially equipped to engage in self-care and health-related decision-making, and people are considered adults after the age of 18

in Palestine. The exclusion criteria included adolescents with cognitive impairments or other chronic diseases, which were identified by reviewing participants' medical history. Each participant's medical record was reviewed with the help of the staff at the selected settings to confirm the diagnosis of T1DM and to screen for the presence of other chronic health conditions.

### Study measurements

A structured self-administered questionnaire was used for data collection, which consisted of the following parts: sociodemographic and clinical data, the Self-efficacy for Diabetes Scale (SED), the Diabetic Health Literacy Scale, and the Self-care Inventory (SCI). The sociodemographic and clinical data included age (where ages from 14 to 15 are considered as young adolescents, and 16 and above are considered as older adolescents), biological sex, fathers' and mothers' educational levels, monthly family income, place of residence (i.e. city or village), duration of diabetes, and last HbA1c level.

The SED, developed by Allen et al. [49], was adopted to assess participants' perceived ability to effectively manage diabetes-related situations. This scale consists of 35 items divided into three subscales: SED-D: Diabetes-specific situations (24 items), SED-M: Medical situations (5 items), and SED-G: General situations (6 items). Each item is rated on a 4-point Likert scale, ranging from 1 (very sure I can't) to 4 (very sure I can). Total scores range from 35 to 140 and are categorized as follows: 0–35: very poor self-efficacy, 36–70: poor self-efficacy, 71–105: good self-efficacy, 106–140: very good self-efficacy [49]. The original English version of the scale demonstrated good reliability, with a Cronbach's alpha of 0.90 [49]. The Arabic version used in this study also showed good reliability, with a Cronbach's alpha of 0.84 [22]. In the current study, the SED scale yielded a Cronbach's alpha of 0.878, indicating good reliability.

The Diabetic Health Literacy Scale, developed by Lee et al. [50], was designed to assess health literacy among adolescents with T1DM, covering key domains including numerical, informational, and communicative health literacy. This scale comprised 15 items, each rated on a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree) [51]. The total mean score is interpreted as follows: 1–2.33: low health literacy, >2.33–3.66: moderate health literacy, and >3.66–5: high health literacy [51]. The original version of the scale had demonstrated strong psychometric properties, with a Cronbach's alpha of 0.91 [50]. Since Arabic is the native language of the participants, the scale was translated into Arabic and then back-translated into English to ensure linguistic accuracy. An expert in Arabic language (Ph.D. level) reviewed the translation for appropriateness and clarity. To evaluate content validity, the Arabic version

was assessed using the Content Validity Index (CVI). A panel of five experts in diabetes and endocrine disorders reviewed the scale and reported a CVI of 1, indicating excellent content validity. A pilot study was conducted on 20 adolescents to assess the clarity, comprehension, and time required to complete the scale. The results showed that the items were clear and understandable, with a completion time of 15 to 20 min. The reliability of the scale was assessed using internal consistency measures, yielding a Cronbach's alpha of 0.841 in the pilot sample and 0.832 in the final study sample, indicating good reliability.

The SCI, developed by La Greca [52], was designed to assess self-care practices in individuals with T1DM. It included 14 items that reflected key components of the T1DM management regimen. The items are categorized as follows: ketone testing (item 3), insulin administration (item 4), medical appointments (item 11), blood glucose regulation (items 1, 2, and 6), insulin and food regulation (items 5, 7, 8, and 9), exercising (items 13 and 14), and emergency precautions (items 10 and 12). Each item is rated on a 5-point Likert scale ranging from 1 (never do it) to 5 (always do this as recommended without fail). A total score below 34 indicates low self-care behaviors, while a score above 34 reflects high self-care behaviors [52]. The SCI demonstrated good reliability and validity, with a Cronbach's  $\alpha$  of 0.80 [53]. The Arabic version used in this study also showed acceptable reliability, with a Cronbach's  $\alpha$  of 0.737 [46]. In the current study, this inventory demonstrated excellent internal consistency, with a Cronbach's  $\alpha$  of 0.921.

### Ethical considerations

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of Arab American University, Palestine. Additional permissions were obtained from the selected outpatient clinics. Prior to participation, informed consent was obtained from the participants' legal guardians, and verbal permission was obtained from the participants. To ensure confidentiality, the participants were instructed not to disclose their names or any identifiable information. Both participants and their legal guardians were informed of their right to withdraw from the study at any time without any consequences. All collected data were securely stored in a password-protected electronic file.

### Data collection procedures

The primary researcher arranged meetings with the managers and head nurses at the selected sites to coordinate the data collection process. Subsequently, meetings were conducted with eligible participants and their legal guardians during routine follow-up visits, during which the paper questionnaires were administered. Participants

who required assistance completed the questionnaires through interviews conducted by the researcher. All completed questionnaires were collected by the primary researcher on the same day. HbA1c results were extracted from the participants' medical records. The total estimated time for participants to complete all questionnaires was approximately 25 to 40 min.

### Data analysis

Data were entered and analyzed using SPSS version 26.0. No missing data were identified. Normality of the variables was assessed using skewness and kurtosis coefficients, as well as the Kolmogorov–Smirnov test. Skewness and kurtosis values fell within the acceptable range of  $\pm 1.96$  standard errors [54], and the Kolmogorov–Smirnov test confirmed that all variables followed a normal distribution.

Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the study variables. Correlation was used to examine the relationships between variables. Pearson's correlation was used to examine the relationship between continuous study variables, while point biserial correlation was used to examine the relationship between categorical and continuous variables. Multiple linear regression analysis was performed to identify the predictors of self-care behaviors (i.e., sociodemographic and clinical data, self-efficacy, and health literacy) and predictors of HbA1c including self-efficacy, health literacy, and self-care behaviors. The Cohen's guidelines were used to interpret the analysis of correlation, where 0.10–0.29 indicating weak correlation, 0.30–0.49 indicating moderate correlation, and 0.50–1.0 indicating strong correlation [55]. A significance level of  $p \leq 0.05$  was applied throughout the analysis.

### Results

A total of 162 questionnaires were distributed, of which 156 were returned, yielding a response rate of 96.3%. Table 1 presents the sociodemographic and clinical variables of the participants. According to biological sex, the majority were female (61.5%), while 38.5% were male. Regarding parental education, 44.9% of the participants' fathers had completed secondary education, and 38.5% of their mothers had completed further education. More than half of the participants (62.8%) resided in villages. The mean age of the participants was 15.66 years ( $SD = 1.53$ ), with ages ranging from 14 to 18 years. The mean family income was \$1,176.45 ( $SD = 676.59$ ), which is considered average, with a range of \$1,000 to \$12,000. Concerning clinical data, approximately 47% of the participants had HbA1c levels ranging between 7% and 9.5%. The mean duration of diabetes was 6.08 years ( $SD = 3.81$ ), ranging from 1 to 15 years.

**Table 1** Sociodemographic and clinical characteristics of the participants (N= 156)

Characteristic	Categories	n	%
Biological sex	Male	60	38.5
	Female	96	61.5
Fathers' educational level	Secondary and less	117	75.0
	Higher than secondary	39	25.0
Mothers' educational level	Secondary and less	96	61.5
	Higher than secondary	60	38.5
Residence	Village	98	62.8
	City	58	37.2
Last HbA1c	5 < 7.0%	22	14.1
	7.0 < 9.5%	73	46.8
	9.5 < 11.5%	30	19.2
	11.5 < 13.0%	18	11.5
	13% and higher	13	8.3
	<b>Mean (± SD)</b>		
Age		15.66	(1.53)
Family income/month (Dollar)		1176.45	(676.59)
Duration of disease (year)		6.08	(3.81)

n: number; %: percentage; M: Mean; SD: Standard Deviation

HbA1c: Hemoglobin A1c

**Table 2** Levels of self-efficacy, health literacy, and self-care behaviors among participants (N= 156)

Characteristic	Categories	n (%)	M(± SD)
Self-efficacy	36–70 (poor)	4 (2.60)	108.80
	71–105 (good)	41 (26.30)	(± 14.92)
	106–140 (very good)	111 (71.20)	
Health literacy	M= 1–2.33 (Low)	113 (72.40)	2.12
	M=> 2.33–3.66 (Moderate)	33 (21.30)	(± 0.78)
	M=> 3.66-5 (High)	10 (6.50)	
Self-care behaviors	≤ 34 (Low)	78 (50.00)	33.82
	> 34 (High)	78 (50.00)	(± 7.79)

n: number; %: percentage; M: Mean; SD: Standard Deviation

**Table 3** Correlating factors of self-care behaviors

Variable	Self-care behaviors	
	p.b.r	p-value
Biological sex	0.055	0.489
Fathers' educational level	-0.025	0.753
Mothers' educational level	0.111	0.166
Residence	0.020	0.807
	<b>r</b>	<b>p-value</b>
Age	-0.249	0.002**
Family income/month	0.067	0.406
Duration of disease	-0.019	0.818
Self-efficacy	0.396	0.000**
Health literacy	0.010	0.904

p.b.r: point biserial correlation; r: Pearson correlation

\*\* Significant at p ≤ 0.01

Regarding self-efficacy, 71.20% of participants demonstrated a “very good” level, with a mean score of 108.80 (SD = 14.92). In contrast, 72.40% of participants reported low levels of health literacy, with a mean score of 2.12 (SD = 0.78). As for self-care behaviors, 50.0% of participants scored in the low range, with a mean score of 33.82 (SD = 7.79), which is also considered low (see Table 2).

Table 3 shows that a significant negative weak correlation was found between age and self-care behaviors ( $r = -0.249, p < 0.01$ ). In contrast, a positive moderate correlation was found between self-efficacy and self-care behaviors ( $r = 0.396, p < 0.001$ ).

As shown in Table 4, the variables that significantly correlated with self-care behaviors—self-efficacy and age—were included in a multiple regression model to identify the predictors of self-care behaviors. Before analysis, regression assumptions were assessed. Multicollinearity was evaluated using the Variance Inflation Factor (VIF) and tolerance values, with acceptable thresholds set at  $VIF < 10$  and  $tolerance > 0.10$ . All variables met these criteria, indicating no concerns with multicollinearity. Autocorrelation was also assessed using the Durbin-Watson (DW) test statistic, which produced a value of 1.623, indicating no evidence of significant autocorrelation.

The regression model was statistically significant ( $p \leq 0.001$ ), with  $R = 0.478, R^2 = 0.229$ , and an adjusted  $R^2 = 0.213$ , indicating that the model explained 22.9% of the variance in self-care behaviors. The model showed that self-efficacy was a significant predictor ( $p < 0.001$ ), with a beta coefficient of 0.196. This suggested that for each one-point increase in self-efficacy, self-care behavior scores increased by 0.196 points. Age also significantly predicted self-care behaviors ( $p < 0.01$ ), with a beta coefficient of -1.256, indicating that each additional year of age was associated with a 1.256-point decrease in self-care behavior scores.

Table 5 presents the factors influencing HbA1c levels. The results indicated that self-efficacy, health literacy, and self-care behaviors did not have a significant influence on HbA1c ( $p > 0.05$ ).

## Discussion

This study aimed to examine the self-care behaviors and their association with self-efficacy and health literacy among adolescents with T1DM in Palestine. The study found that participants reported high levels of self-efficacy, consistent with findings from previous research conducted in Jordan [20], Canada [56], Brazil [23], and the United States [57]. However, this result is inconsistent with studies from Iran [58] and Finland [59], which reported moderate levels of self-efficacy, and with a study from Egypt that showed low levels of self-efficacy [22]. Self-efficacy is influenced by various factors, including past experiences and social interactions [19, 36]. One of

**Table 4** Predictors of self-care behaviors: multiple linear regression

Predictor	b	B	t-test	p-value	95.0% CI	
					Lower	Upper
Self-efficacy	0.196	0.375	5.173	0.000**	0.121	0.271
Age	-1.256	-0.248	-3.478	0.001**	-1.969	-0.542

**R = 0.478, R<sup>2</sup> = 0.229, Adjusted R<sup>2</sup> = 0.213, F = 15.020, df = 2, p = 0.000**

CI = Confidence Interval, b = Unstandardized beta, B = Standardized beta

\*\* Significant at  $p \leq 0.01$

**Table 5** Factors influencing HbA1c

Predictor	b	B	t-test	p-value	95.0% CI	
					Lower	Upper
Self-efficacy	-0.010	-0.139	-1.602	0.111	-0.023	0.002
Health literacy	-0.097	-0.067	-0.841	0.402	-0.324	0.130
Self-care behaviors	-0.017	-0.120	-1.386	0.168	-0.042	0.007

**R = 0.225, R<sup>2</sup> = 0.051, Adjusted R<sup>2</sup> = 0.032, F = 2.677, df = 3, p = 0.049**

CI = Confidence Interval, b = Unstandardized beta, B = Standardized beta

HbA1c: Hemoglobin A1c

the most significant contributors for high self-efficacy is the previous successful completion of tasks, known as “mastery experiences” [36, 60]. In this study, the average diabetes duration of six years among participants most likely allowed them to encounter and manage multiple diabetes-related situations, contributing to their high levels of self-efficacy. Additionally, strong family and peer support, key elements in enhancing diabetes self-efficacy [60] may have further reinforced this outcome. This is particularly relevant in the Palestinian context, where cultural values emphasize close family bonds and a strong sense of community [61].

Our study found low levels of health literacy among participants, consistent with findings from previous studies [58, 62]. However, other research reported moderate to high levels of health literacy [28– [30, 63, 64]. This discrepancy might be attributed to differences in the measurement tools used across studies [65]. Additionally, health literacy is influenced by many factors, including biological sex, age, cognitive and social skills, family and peer support, and educational level [60]. In the Palestinian context, Sarhan et al. [66] reported that 64% of adolescents demonstrated high health literacy; however, their sample did not specifically focus on adolescents with diabetes. Furthermore, the majority of our participants resided in rural areas, where health literacy levels are generally lower than in urban populations [40]. The low health literacy observed in our study might also reflect a lack of awareness and limited access to targeted health education programs on T1DM, as well as a shortage of trained professionals equipped to deliver these programs to adolescents and their families [67].

This study found that participants reported low levels of self-care behaviors, a finding consistent with previous research conducted in Jordan [68], Italy [69], Egypt

[70], Kenya [34], Ethiopia [41], Palestine [47], and Turkey [71]. However, it contradicts studies from Italy [72], and the United States [11], which reported moderate levels of self-care behaviors.

Several factors might contribute to the low self-care behaviors among our participants. Adolescence is a developmental stage marked by hormonal and behavioral changes that can complicate diabetes management [31]. This includes fluctuating blood glucose levels and behavioral issues such as impulsivity and resistance to guidance, which may hinder consistent self-care practices [11, 47]. Social stigma might also play a role, as some adolescents could feel embarrassed and avoid performing self-care tasks in public [46, 67]. Multiple stressors affect adolescents with T1DM, including the pain of frequent injections, pressure from being observed while managing their diet, and the cognitive burden of daily decision-making and reminders [73]. These challenges likely influenced our participants.

Furthermore, the sociopolitical context in Palestine adds additional layers of difficulty. This study was conducted during the Gaza War, a period of heightened psychological stress and economic hardship, which might have further impacted self-care behaviors. As noted by Elissa et al. [74], living with a chronic illness in an occupied region significantly affects diabetes management. Limited economic resources restrict access to essential diabetes supplies and tests, such as HbA1c monitoring. High unemployment rates reduce families' ability to afford glucometers and test strips. Additionally, military checkpoints and closures between villages and cities create barriers to accessing healthcare services, including specialized diabetes clinics [44].

Our findings showed a significant positive correlation between self-efficacy and self-care behaviors, and

self-efficacy was the main predictor of self-care behaviors. This result is in line with studies conducted in Iran [75], the USA [57], Ethiopia [41], and Spain [76]. Bandura [77] was a pioneer in conceptualizing the concept of self-efficacy and explained its major role in performing actions. High self-efficacy enables people to overcome challenges and cope with long-term conditions [59]. However, Babazadeh et al. [78] emphasized the importance of having accurate information about diabetes alongside self-efficacy in managing diabetes successfully. Paulsamy et al. [79] concluded that people who have a strong faith in their capabilities in controlling their diabetes are competent at performing self-care behaviors. It is widely confirmed that self-efficacy is an essential psychological component that induces behavioral change and determines the maintenance and commitment to that change [19, 20, 80].

Our results showed no significant correlation between health literacy and self-care behaviors, which is parallel with an earlier study [65]. In contrast, a previous research suggested that health literacy had a positive correlation with self-care behaviors [63]. The lack of association in our study could be related to the low variability in health literacy scores, which might have concealed a potential association. Also, it could be interpreted as Arabic families often support adolescents and older adults in managing their health conditions which could make adolescents more dependent on their families and limit self-care behaviors [81, 82]. Therefore, health literacy may not be perceived as relevant to diabetes self-management due to these cultural factors. However, the relationship between health literacy and self-care behaviors remains unclear and warrants further investigation [65].

The study revealed a negative correlation between age and self-care behaviors, and age was also a predictor of self-care behaviors. The younger adolescents demonstrated higher levels of self-care compared to their older counterparts. This finding aligns with previous research conducted in Palestine [47], Ethiopia [41], and Jordan [66, 68]. In contrast, a study in Egypt by Diab and Hussein [70] revealed that age was a positive predictor of self-care behaviors. In adolescents with T1DM, increased psychological maturity leads to an increase in autonomy, which may result in poor self-care adherence [13]. One possible explanation is that younger adolescents tend to receive more social support and guidance from their parents—a level of support that often diminishes as they grow older [47]. While older adolescents become more independent and report stronger loyalty to their peers than to their parents [65].

The study did not find significant associations between self-efficacy, health literacy, self-care behaviors, and HbA1c, suggesting that clinical outcomes like HbA1c are influenced by a complex interplay of individual, familial,

and structural factors. For adolescents, simply having high self-efficacy may not be enough to achieve optimal glycemic control in the face of broader systemic and psychosocial challenges. HbA1c reflects blood glucose control over a long period. Thus, short-term or inconsistent self-care efforts may not significantly influence it [13]. Palestinian adolescents with T1DM often encounter external challenges that hinder effective disease management, regardless of their self-efficacy or health literacy. These challenges include limited access to insulin and monitoring supplies due to political and economic instability, fragmented healthcare services that disrupt consistent follow-up and education, and chronic stress from conflicts and displacement, which can undermine glycemic control even when self-care knowledge is present [45, 46].

### **Strengths and limitations**

This study is one of the first studies in Palestine and the Arab world to address the concepts of self-efficacy, health literacy, and self-care behaviors together among adolescents with T1DM. However, this study had several limitations. The data were gathered using self-report methods that could cause biases. The cross-sectional design made it unfeasible to establish a causal association between the independent variables and self-care behaviors. The generalizability of the results is limited, as certain regions in Palestine were inaccessible due to ongoing war conditions and the presences of blockades between districts. No data were collected from the United Nations Relief and Works Agency (UNRWA) clinics, which prevented recruiting participants who live in refugee camps in Palestine. The findings are limited by the living conditions of the target group as they might not be able to prioritize health literacy or self-care due to war conditions and might have difficulty answering the questionnaires. Further studies are encouraged to address these limitations.

### **Implications for practice**

Our study provided primary information regarding the levels of self-efficacy, health literacy, and self-care behaviors among Palestinian adolescents with T1DM, in addition to investigating self-care behaviors correlates among these participants. Although adolescents with T1DM in the current study demonstrated high levels of self-efficacy, their low health literacy and inadequate self-care behaviors highlight the need for targeted health literacy interventions. Educational programs should be age-appropriate, culturally relevant, and designed to enhance adolescents' understanding of diabetes management tasks. This need extends beyond Palestine and reflects a global concern.

Given the positive correlation between self-efficacy and self-care behaviors, integrating strategies that strengthen

self-efficacy while simultaneously enhancing health literacy may improve engagement in self-care practices among Palestinian adolescents and adolescents globally. Special attention should be directed toward older adolescents, as the observed decline in self-care behaviors with age underscores the need for ongoing support during the transition to more independent diabetes management. These interrelated factors should be carefully considered when designing interventions to support adolescents with T1DM, both in Palestine and worldwide. Such interventions require cooperation between relevant agencies, healthcare providers, policymakers, families, and adolescents. It is essential to consider the importance of highly competent adolescents in self-care behaviors, including the benefits for themselves, their families, the health sector, and the community. There is a need for more comprehensive, skills-based educational and behavioral programs to strengthen adolescents' confidence in managing their condition as a means to improve self-care and enhance greater independence. Strategies are needed to support the presence of mobile clinics in villages and remote areas, encouraging healthcare providers to specialize in diabetes and supply accessible, necessary equipment and medications. Future research is needed to investigate factors affecting self-care behaviors among this cohort group and examine other possible correlations.

## Conclusion

The current study found that adolescents with T1DM had high levels of self-efficacy, low levels of health literacy, and low levels of self-care behaviors. A positive correlation was found between self-efficacy and self-care behaviors. A negative correlation was found between age and self-care behaviors. There was no influence of self-efficacy, health literacy and self-care behaviors on HbA1c. Therefore, policymakers and healthcare professionals should develop strategies to enhance health literacy in order to improve self-care behaviors among adolescents with T1DM.

## Abbreviations

T1DM	Type 1 diabetes mellitus
SED	Self-Efficacy for Diabetes Scale
SCI	Self-Care Inventory
CVI	Content Validity Index
SD	Standard Deviation

## Acknowledgements

Not applicable.

## Author contributions

"F. A.M and M.M. designed the study and provided the data. M.M conducted data analyses, prepared tables. All authors wrote the main manuscript text and M.M. supervised the study and provided valuable comments during the drafting of the manuscript. M.M. and A.S. edited the manuscript and provided valuable comments. All authors reviewed and approved the manuscript."

## Funding

The study was not funded.

## Data availability

Available from the corresponding author upon reasonable request.

## Declarations

### Ethics approval and consent to participate

Approval was obtained in accordance with the Declaration of Helsinki from the Helsinki Committee in Palestine, and the Institutional Review Board (IRB) at the Arab American University with reference No# R-2024/A/10/N. Informed consent to participate was obtained from the parents. Confidentiality of the data was maintained throughout data collection and analysis.

### Consent for publication

Not Applicable.

### Competing interests

The authors declare no competing interests.

### Clinical trial

Not applicable.

Received: 21 April 2025 / Accepted: 9 July 2025

Published online: 15 July 2025

## References

- Asghari N, Dashtbozorgi B, Rostami S, et al. Improving self-management and diabetes indicators in adolescents with type 1 diabetes through self-care education. *J Family Med Prim Care*. 2023;12(10):2322–7. [https://doi.org/10.4103/jfmpc/jfmpc\\_373\\_23](https://doi.org/10.4103/jfmpc/jfmpc_373_23).
- Kandemir N, Vurali D, Ozon A, et al. Epidemiology of type 1 diabetes mellitus in children and adolescents: A 50-year, single-center experience. *J Diabetes*. 2024;16(5):e13562. <https://doi.org/10.1111/1753-0407.13562>.
- Reinauer C, Tittel SR, Müller-Stierlin A, et al. Outpatient screening for anxiety and depression symptoms in adolescents with type 1 diabetes - a cross-sectional survey. *Child Adolesc Psychiatry Mental Health*. 2023;17:142. <https://doi.org/10.1186/s13034-023-00691-y>.
- Lucier J, Mathias PM. Type 1 Diabetes. 2024. In: StatPearls [Internet]. Treasure Island (FL): StatPearls.
- Lee D, Lee H, Shin Y, Park G. Effectiveness of non-pharmacological interventions for adolescents with type 1 diabetes in the last five years: A systematic review and meta-analysis. *Asian Nurs Res*. 2024;18(1):51–9. <https://doi.org/10.1016/j.anr.2024.01.008>.
- Wass JAH, Arlt W, Semple RK. Oxford textbook of endocrinology and diabetes. Volume 1. Third; 2022.
- World Health Organization. Diabetes. 2024. Available at: <https://www.who.int/news-room/fact-sheets/detail/diabetes>
- Syed FZ. Type 1 diabetes mellitus. *Ann Intern Med*. 2022;175(3):ITC33–48. <http://doi.org/10.7326/AITC202203150>.
- World Health Organization. Diabetes. 2023. Available at: <https://www.who.int/news-room/fact-sheets/detail/diabetes>
- Al-Shorman NA, Atiyeh H, Kassab M, et al. Effects of an educational program on self-efficacy towards type 1 diabetes mellitus disease among parents and adolescents in Jordan. *J Pediatr Nurs*. 2023;71:66–72. <https://doi.org/10.1016/j.pedn.2023.03.011>.
- Harrington KR, Shapira A, Volkening LK, et al. Associations of diabetes self-management characteristics, HbA1c, and psychosocial outcomes with depressive symptoms in a contemporary sample of adolescents with type 1 diabetes. *J Diabetes Complicat*. 2021;35(3):107838. <https://doi.org/10.1016/j.jdiacomp.2020.107838>.
- Taba M, Allen TB, Caldwell PHY, et al. Adolescents' self-efficacy and digital health literacy: a cross-sectional mixed methods study. *BMC Public Health*. 2022;22(1):1–13. <https://doi.org/10.1186/S12889-022-13599-7/FIGURES/1>.
- de Wit M, Gajewska KA, Goethals ER, McDarby V, Zhao X, Hapunda G, Delamater AM, DiMeglio LA. ISPAD clinical practice consensus guidelines 2022: psychological care of children, adolescents and young adults with diabetes. *Pediatr Diabetes*. 2022;23(8):1373–89. <https://doi.org/10.1111/13428>.

14. Bombaci B, Torre A, Longo A, et al. Psychological and clinical challenges in the management of type 1 diabetes during adolescence. *Narrative Rev Child.* 2024;11(9):1085. <https://doi.org/10.3390/children11091085>.
15. Ahmad F, Joshi SH. Self-Care practices and their role in the control of diabetes. *Narrative Rev Cureus.* 2023;15(7):e41409. <https://doi.org/10.7759/cureus.14409>.
16. Caruso R, Rebori P, Dellafiore F, et al. Clinical and socio-demographic determinants of inadequate self-care in adults with type 1 diabetes mellitus: the leading role of self-care confidence. *Acta Diabetol.* 2019;56(2):151–61. <https://doi.org/10.1007/s00592-018-1259-z>.
17. Salem A, Masadeh A, Nofal B, et al. Self-Care management and its predictors among Jordanian patients with type 1 diabetes mellitus: Cross-Sectional study. *SAGE Open Nurs.* 2025;11:23779608251322603. <https://doi.org/10.1177/23779608251322603>.
18. Ong-Artborirak P, Seangprap K, Boonyathee S, et al. Health literacy, self-efficacy, self-care behaviors, and glycemic control among older adults with type 2 diabetes mellitus: a cross-sectional study in Thai communities. *BMC Geriatr.* 2023;23(1):297. <https://doi.org/10.1186/s12877-023-04010-0>.
19. Schunk DH, DiBenedetto MK. Self-efficacy and human motivation, 2021. In Elliot AJ, editor, *Advances in motivation science*, pp. 153–79. Elsevier Academic. <https://doi.org/10.1016/bs.adms.2020.10.001>
20. Masadeh A, Othman E, Salem A et al. Assessing self-efficacy among Jordanians with type 1 diabetes. *Journal of Diabetes Nursing.* 2024; 28: (JDN326).
21. 21- Lyngbye M, Møller AK. Motivational factors for empowering people with diabetes and the influence of perceived Self-Efficacy. *Designs Learn.* 2023;15(1):1–12. <https://doi.org/10.16993/dfl.201>.
22. Mohammad F, Ramadan R, Mohamed N. Knowledge and self-efficacy among children with type 1 diabetes and their caregivers. *Egypt J Health Care.* 2020;11(1):1199–210. <https://doi.org/10.21608/ejhc.2020.252376>.
23. Nass EMA, Marcon SS, Teston EF, et al. Psychosocial self-efficacy in young people with diabetes mellitus and its influence on self-care. *Revista Da Rede De Enfermagem Do Nordeste.* 2019;20:e41412. <https://doi.org/10.15253/2175-6783.20192041412>.
24. Atiyeh HM, AlOsta MR, Othman EH, et al. An Evidence-Based measure to assess Self-Efficacy among adolescents with type 1 diabetes mellitus in Jordan. *Sci Diabetes Self-Management Care.* 2024;50(6):532–45. <https://doi.org/10.1177/26350106241279813>.
25. Debussche X. Addressing health literacy responsiveness in diabetes. *Diabetes Epidemiol Manage.* 2021;4:100033. <https://doi.org/10.1016/j.deman.2021.100033>.
26. Weinstock RS, Aleppo G, Bailey TS et al. The Role of Blood Glucose Monitoring in Diabetes Management. Arlington (VA): American Diabetes Association; 2020 Oct. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK566165/>
27. World Health Organization. Health literacy in the context of health, well-being and learning outcomes- the case of children and adolescents in schools: concept paper. 2021. Available at: <https://iris.who.int/bitstream/handle/10665/344901/WHO-EURO-2021-2846-42604-59268-eng.pdf;sequence=1>
28. Sarhan M, Fujiya R, Kiriya J, et al. Health literacy among adolescents and young adults in the Eastern mediterranean region: a scoping review. *BMJ Open.* 2023;13(6):e072787. <https://doi.org/10.1136/bmjopen-2023-072787>.
29. Chu-Ko F, Chong M-L, Chung C-J, et al. Exploring the factors related to adolescent health literacy, health-promoting lifestyle profile, and health status. *BMC Public Health.* 2021;21(1):2196. <https://doi.org/10.1186/s12889-021-12239-w>.
30. Gomes MB, Muniz LH, Melo LGN, et al. Health literacy and glycemic control in patients with diabetes: a tertiary care center study in Brazil. *Diabetol Metab Syndr.* 2020;12(1):11. <https://doi.org/10.1186/s13098-020-0519-6>.
31. Azar S, Maroun Abou Jaoude N, Kezdzia A, et al. Barriers to type 1 diabetes adherence in adolescents. *J Clin Med.* 2024;13(19):5669. <https://doi.org/10.3390/jcm13195669>.
32. American Diabetes Association Professional Practice Committee. 14. Children and Adolescents: Standards of Care in Diabetes—2025. *Diabetes Care* 2025; 48 (Supplement\_1): S283–S305. <https://doi.org/10.2337/dc25-S014>
33. 33- El-Osta A, Sasco ER, Barbanti E, et al. Tools for measuring individual self-care capability: a scoping review. *BMC Public Health.* 2023;23(1):1312. <https://doi.org/10.1186/s12889-023-16194-6>.
34. Oluchina S. The effectiveness of an education intervention based on self-care model on diabetes self-management behaviors and glycemic control. *Int J Afr Nurs Sci.* 2022;17:100505. <https://doi.org/10.1016/j.ijans.2022.100505>.
35. Hatun Ş, Gökçe T, Can E, et al. Current management of type 1 diabetes in children: Guideline-based expert opinions and recommendations. *J Clin Res In Pediatr Endocrinol.* 2024;16(3):245–55. <https://doi.org/10.4274/jcrpe.galenos.2024.2024-1-15>.
36. de Bock M, Agwu JC, Deabreu M, et al. International society for pediatric and adolescent diabetes clinical practice consensus guidelines 2024: glycemic targets. *Hormone Res Paediatrics.* 2024;97(6):546–54. <https://doi.org/10.1159/000543266>.
37. Bandura A. *Self-Efficacy in changing societies.* Cambridge University Press; 1995. <https://doi.org/10.1017/CBO9780511527692>.
38. Parviniannasab AM, Faramarzian Z, Hosseini SA, et al. The effect of social support, diabetes management self-efficacy, and diabetes distress on resilience among patients with type 2 diabetes: a moderated mediation analysis. *BMC Public Health.* 2024;24:477. <https://doi.org/10.1186/s12889-024-18022-x>.
39. Abdelghaffar W, Amiri H, Zouari B. Self-care activities adherence in Tunisian patients with type 2 diabetes: role of diabetes-related distress and self-efficacy. *Acta Diabetol.* 2020;57(5):631–3. <https://doi.org/10.1007/s00592-020-01476-x>.
40. Asharani PV, Lau JH, Roystonn K, et al. Health literacy and diabetes knowledge: A nationwide survey in a multi-ethnic population. *Int J Environ Res Public Health.* 2021;18(17):9316. <https://doi.org/10.3390/ijerph18179316>.
41. Geneti Y, Wondwossen K, Adimasu M, et al. Adherence to diabetes self-management and its associated factors among adolescents living with type 1 diabetes at public hospitals in addis ababa, ethiopia: A cross-sectional study. *Diabetes Metabolic Syndrome Obes.* 2022;15:659–70. <https://doi.org/10.2147/DMSO.S350168>.
42. Sarpooshi D, Mahdizadeh M, Jaferi A, et al. The relationship between social support and self-care behavior in patients with diabetes mellitus. *Family Med Prim Care Rev.* 2021;23(2):227–31. <https://doi.org/10.5114/fmpcr.2021.105932>.
43. World Diabetes Foundation. (n.d.). Palestine national diabetes programme, Palestine. 2024. Retrieved from <https://www.worlddiabetesfoundation.org/w hat-we-do/projects/wdf15-1304/>
44. Sarhan M, Kitamura A, Fujiya R, Jimba M. Perceptions of adolescent health literacy in the Palestinian social context: a qualitative study. *Japanese J Health Econ Policy.* 2019;27:29–42. <https://doi.org/10.11260/kenkokyoiku.27.29>.
45. Sarhan M, Fujiya R, Shibanuma A, et al. Health literacy as a key to improving weight status among Palestinian adolescents living in chronic conflict conditions: a cross-sectional study. *BMJ Open.* 2022;12(9):e061169. <https://doi.org/10.1136/bmjopen-2022-061169>.
46. Harazneh L, Malak MZ, Ayed A. Adolescents and type 1 diabetes: A grounded theory on adolescents' experiences of adaptation to type 1 diabetes. *J Pediatr Nurs.* 2024;76:e159–66. <https://doi.org/10.1016/j.pedn.2024.02.026>.
47. Alkaiyat A, Hilo L, Braik T, et al. Adherence to the management of type i diabetes among Palestinian patients in Nablus city: a cross-sectional study. *Palestinian Med Pharm J.* 2020;5(2). <https://doi.org/10.59049/2790-0231.1079>.
48. Ministry of Health. *Health Annual Report 2022.* 2023; Palestine.
49. Allen J, Noser AE, Littlefield AK, et al. Measuring self-efficacy in the context of pediatric diabetes management: psychometric properties of the self-efficacy for diabetes scale. *J Pediatr Psychol.* 2018;43(2):143–51. <https://doi.org/10.1093/jpepsy/jsx094>.
50. Lee EH, Lee YW, Lee KW, et al. A new comprehensive diabetes health literacy scale: development and psychometric evaluation. *Int J Nurs Stud.* 2018;88:1–8. <https://doi.org/10.1016/j.ijnurstu.2018.08.002>.
51. Tefera YG, Gebresillassie BM, Emiru YK, et al. Diabetic health literacy and its association with glycemic control among adult patients with type 2 diabetes mellitus attending the outpatient clinic of a university hospital in Ethiopia. *PLoS ONE.* 2020;15(4):e0231291. <https://doi.org/10.1371/journal.pone.0231291>.
52. La Greca AM. *Brief manual for the self care inventory.*1992 Miami, FL: Author.
53. La Greca AM, Swales T, Klemp S, et al. Adolescents with diabetes: gender differences in psychosocial functioning and glycemic control. *Children's Health Care.* 1995;24(1):61–78. [https://doi.org/10.1207/s15326888chc2401\\_6](https://doi.org/10.1207/s15326888chc2401_6).
54. Field A. *Discovering statistics using IBM SPSS statistics.* 4th ed. Sage; 2013.
55. Gignac GE, Szodorai ET. Effect size guidelines for individual differences researchers. *Pers Individ Differ.* 2016;102:74–8. <https://doi.org/10.1016/j.paid.2016.06.069>.
56. Alwadiy F, Mok E, Dasgupta K, et al. Association of self-efficacy, transition readiness and diabetes distress with glycemic control in adolescents with type 1 diabetes Preparing to transition to adult care. *Can J Diabetes.* 2021;45(5):490–5. <https://doi.org/10.1016/j.cjcd.2021.05.006>.
57. Noser AE, Huffhines L, Clements MA, Patton SR. Diabetes conflict outstrips the positive impact of self-efficacy on youth adherence and glycemic control

