



Validity and Reliability of the Turkish Version of the Glucose Monitoring Satisfaction Survey

Glukoz İzleme Memnuniyet Anketi'nin Türkçe Versiyonunun Geçerlilik ve Güvenilirlik Çalışması

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ABSTRACT

Objective: The Glucose Monitoring Satisfaction Survey (GMSS) is crucial for assessing diabetes management, but its psychometric properties in Turkish patients remain unexplored. This study aimed to evaluate the validity and reliability of the Turkish version of the GMSS.

Material and Method: This methodological, descriptive, and correlational study was conducted with 220 patients with type 1 diabetes between October 2023 and February 2024. Data were collected online using a sociodemographic questionnaire, the GMSS, and the WHO-5 Well-Being Index. Statistical analyses were performed with IBM SPSS v27 and IBM SPSS Amos v24. Reliability was evaluated with Cronbach's alpha coefficients for the overall scale and each subscale, Spearman-Brown Split-Half analysis, item-total correlations, and "Cronbach's alpha if item deleted." Validity was examined through language validity, expert-based content validity, and construct validity using Confirmatory Factor Analysis (CFA). Assumptions for CFA were checked, and the maximum likelihood method was applied. Parallel form reliability was also assessed with WHO-5.

Results: Item-level content validity indexes ranged between 0.80 and 1.00, while the scale-level index was 0.960. Cronbach's alpha was 0.897 for the overall scale and ranged between 0.85 and 0.90 across the four subscales. Item-total correlations varied from 0.347 to 0.719, and "alpha if item deleted" values remained above 0.85. The Spearman-Brown Split-Half coefficient was 0.885. CFA supported the four-factor model with acceptable fit indices. Parallel form reliability showed significant positive correlations between the GMSS and WHO-5 ($p < 0.001$).

Conclusion: The Turkish version of the GMSS demonstrated strong validity and reliability for assessing satisfaction with glucose monitoring in type 1 diabetes patients. However, the predominance of female participants (72.7%) may limit the generalizability of the findings and should be considered in future research.

Keywords: Blood glucose monitoring, Patient satisfaction, Reliability, Type 1 Diabetes, Validity.

ÖZET

Amaç: Glukoz İzleme Memnuniyet Anketi, diyabet yönetimini değerlendirmek için önemli bir araçtır, ancak Türk hastalardaki geçerliliği ve güvenilirliği henüz araştırılmamıştır. Bu çalışma, Glukoz İzleme Memnuniyet Anketi'nin Türkçe versiyonunun geçerliliğini ve güvenilirliğini değerlendirmeyi amaçlamaktadır.

Gereç ve Yöntem: Bu metodolojik, tanımlayıcı ve korelasyonel çalışma, Ekim 2023 ile Şubat 2024 arasında, Tip 1 Diyabet tanısı almış 220 hasta ile gerçekleştirilmiştir. Çalışma verileri, Anket Formu, Glukoz İzleme Memnuniyet Anketi ve DSÖ-5 İyi Oluş İndeksi kullanılarak çevrimiçi anket tekniği ile toplanmıştır. İstatistiksel analizler IBM SPSS v27 ve IBM SPSS Amos v24 kullanılarak yapılmıştır. Güvenirlik analizlerinde ölçeğin tümü ve dört alt boyutu için Cronbach alfa katsayıları, madde-toplam korelasyonları, "madde silindiğinde Cronbach alfa" değerleri ve Spearman-Brown Split-Half analizi incelenmiştir. Yapı geçerliliği, Doğrulayıcı Faktör Analizi (DFA) ile test edilmiş, varsayımlar kontrol edilmiştir ve maksimum olabilirlik yöntemi kullanılmıştır. Ayrıca, DSÖ-5 İyi Oluş İndeksi ile paralel form güvenirliliği değerlendirilmiştir.

Bulgular: Madde düzeyindeki içerik geçerliliği indeksleri 0.80 ile 1 arasında değişirken, ölçek düzeyindeki içerik geçerliliği indeksi 0.960 bulunmuştur. Ölçeğin Cronbach alfa katsayısı 0,897, alt boyutlar için ise 0,85 ile 0,90 arasında hesaplanmıştır. Madde-ölçek korelasyonları 0,347 ile 0,719 arasında değişmiştir ve "madde silindiğinde alfa" değerleri 0,85'in üzerinde kalmıştır. Spearman-Brown Split-Half analizinde ölçeğin iki yarısı arasında yüksek düzeyde pozitif yönlü bir korelasyon (0,885) bulunmuştur. DFA, dört faktörlü yapıyı doğrulamış ve uyum indeksleri kabul edilebilir düzeyde bulunmuştur. DSÖ-5 İndeksi ile hem ölçek hem de tüm alt boyutları arasında istatistiksel olarak anlamlı pozitif korelasyonlar gözlemlenmiştir ($p < 0,001$).

Sonuç: Bu çalışma, Glukoz İzleme Memnuniyet Anketi'nin, Türk toplumunda Tip 1 Diyabet hastalarında glukoz izleme memnuniyetini ölçmek için geçerli ve güvenilir bir araç olduğunu göstermektedir. Ancak, katılımcıların çoğunluğunu kadınların (%72,7) oluşturması, sonuçların genellenebilirliğini sınırlayabilir. Bu durum, gelecekteki araştırmalarda dikkate alınmalıdır.

Ahtar Sözcükler: Geçerlilik, Güvenirlik, Kan glukoz izleme, Memnuniyet, Tip 1 diyabet.

Introduction

Diabetes stands among the four non-communicable diseases (NCDs) highlighted by the World Health Organization (1). Type 1 diabetes (T1D) makes up about 5–10% of the global diabetes prevalence (2). The condition is characterized by autoimmune degeneration of β -cells in the pancreatic islets, resulting in severe insulin depletion (3). Monitoring glycemic status is widely acknowledged as fundamental in diabetes management; accordingly, glucose monitoring is deemed the key to achieving optimal glycemic targets (4).

The American Diabetes Association (ADA) recommends that individuals on intensive insulin therapy, which includes multiple dose insulin (MDI) or continuous subcutaneous insulin infusion (CSII), self-monitor blood glucose (SMBG) before meals and snacks, intermittently after meals, at bedtime, before physical activity, when hypoglycemia is suspected, after treatment for hypoglycemia, and before performing critical activities such as driving. For some people, this requires testing six to 10 times a day (or more) (5). Similar recommendations have been made by other organizations as well (6,7).

For individuals diagnosed with T1D, regular glucose testing is imperative for the safe and efficient management of blood glucose levels (3). These individuals commonly utilize either SMBG through fingersticks and a glucose meter or opt for continuous glucose monitoring (CGM) methods to monitor their glucose levels (8, 9, 10). CGM is a minimally invasive method for tracking blood glucose levels. CGM records glucose levels constantly, in contrast to SMBG, which offers intermittent measurements of glucose levels. There exist three categories of continuous glucose monitoring systems: professional CGM (P-CGM), real-time CGM (RT-CGM), and intermittent scanned CGM (isCGM). Each system possesses distinct qualities (9-11).

Self-monitoring of blood glucose and CGM each present notable drawbacks that affect their usability and effectiveness. SMBG requires frequent finger pricks, which many patients find painful and inconvenient, leading to poor adherence (12,13). While less invasive, CGM can still cause discomfort due to sensor insertion and the need for regular calibration (14,15). Recent technological advances

in CGM have been met with concerns regarding their impact on user satisfaction and the occurrence of adverse events when compared with the more established SMBG method. Intermittently scanned isCGM has been shown to enhance satisfaction rates while concurrently exhibiting adverse effects (12). A significant impediment to the widespread adoption of these technologies is their financial burden; CGM devices, in particular, are deemed excessively costly for a substantial proportion of the population, thereby impeding accessibility and adherence (16). Additionally, technical and interference issues can affect the accuracy of both methods. SMBG readings may be influenced by substances such as ascorbic acid, while CGM, despite its continuous monitoring capabilities, can suffer from technical limitations that occasionally necessitate SMBG confirmation (15,17).

Adherence to glucose monitoring systems remains a critical challenge in the management of diabetes. Research findings indicate that adherence rates for SMBG are below 50%, with time constraints, forgetfulness, and self-consciousness being identified as key barriers (13,18). Several factors influence adherence levels: higher education, ownership of a glucose meter, and specific treatment regimens, such as oral hypoglycemic drugs, correlate with better adherence (18,19). For CGM, patients' readiness for behavior change has been identified as a significant determinant of adherence (20). Intervention strategies conceived with the intention of enhancing adherence have demonstrated efficacy. Educational and motivational approaches, including cognitive behavioral therapy and motivational interviewing, have been shown to be effective in improving adherence to SMBG. Similarly, lifestyle and behavioral counseling have been found to enhance adherence to CGM and improve glycemic outcomes (20). Addressing these multifaceted barriers through tailored interventions is imperative to optimize the effectiveness of both SMBG and CGM systems in diabetes care (14).

Patient satisfaction with blood glucose monitoring systems is critical in adherence to diabetes management protocols. Research has demonstrated that elevated satisfaction with blood glucose monitoring systems is associated with superior adherence to medication and self-monitoring routines among patients with

diabetes (21-23). Conversely, individuals utilizing CGM may encounter various forms of dissatisfaction, including sensitivities to the device, such as local skin reactions, concerns about body image, feelings of being different from others, discomfort, and unpredictable errors (7,24,25). Consequently, it is imperative to closely monitor patients' satisfaction with the blood glucose monitoring system.

The Glucose Monitoring Satisfaction Survey (GMSS) was developed by Polonsky et al. (2015) (26). The Chinese version of the survey was constructed by Lu et al. (2020) (27). Studies evaluating the GMSS in individuals with diabetes are available in the literature (28-31). However, no Turkish validity and reliability study has yet been conducted. To date, there is no instrument for measuring glucose monitoring satisfaction among Turkish patients with type 1 diabetes. Therefore, this study aimed to investigate the validity and reliability of the Glucose Monitoring Satisfaction Survey within Turkish society.

Material and Method

Study Design and Settings

The study investigated the validity and reliability of the Glucose Monitoring Satisfaction Survey for Turkish society. The study was conducted using snowball sampling between October 2023 and February 2024. The survey link was disseminated to patients using social media platforms, including WhatsApp and Instagram. To conduct the study, permission was obtained from the Ankara Yıldırım Beyazıt University Health Sciences Ethics Committee (Research code: 2023-362, Approval number: 362-08). Participants provided their informed consent online after reviewing the study's aim, content, and data privacy principles. The research adhered to the principles of the Helsinki Declaration. Additionally, written permission was obtained from the original scale developer via email.

Sample

A power analysis was conducted to ascertain the minimal sample size necessary for the investigation, utilizing the anticipated Cronbach's alpha. The expected Cronbach's alpha was 0.80, and the analysis was conducted under the following conditions: 95% confidence interval, type 1 error 0.05, 15-item scale,

and an expected dropout rate of 10%. Under the above conditions, the minimum required sample size was found to be 153. The recommendations of Bonett were followed for the calculation of the sample size (32, 33). The study was terminated after recruiting 220 participants.

Inclusion and Exclusion Criteria

The study population comprised individuals aged 18 years or older who had been diagnosed with type 1 diabetes mellitus for a minimum of one year before the study's commencement to assess their satisfaction with the glucose monitoring system after a sustained period of use. The study participants were required to be able to communicate in Turkish, to have owned and consistently utilized a primary blood glucose meter for a minimum period of three months (at least once a week), and to have been willing to participate in the study. Patients were expected to utilize the glucose meter at least once per week to evaluate their satisfaction with the device. All of these conditions were confirmed through questions presented to the participants at the beginning of the online survey, where their consent was obtained.

Data Collection

The Questionnaire Form, the Glucose Monitoring Satisfaction Survey (GMSS), and the WHO-5 Well-Being Index were used for data collection. Data were gathered using an online survey. The research adhered to the standards for Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).

Questionnaire Form

The researchers created this form based on relevant literature. It comprises 11 items that investigate the sociodemographic and disease-related characteristics of the patients. The sociodemographic characteristics encompassed age, gender, marital status, education level, and working status. The disease-related characteristics included comorbidities, disease duration, glucose monitoring system, HbA1c level, satisfaction with the glucose monitoring system, and opinions on the usability of the glucose monitoring system (26, 27, 30).

Glucose Monitoring Satisfaction Survey (GMSS)

Polonsky et al. developed the scale. The scale comprises 15 items and 4 factors: Openness, Emotional Burden, Behavioral Burden, and Trust. Items are answered on a 5-point Likert scale ranging from strongly disagree to strongly agree. For 11 items, reverse responses were used to calculate the total score. The scale ranged in total score from 15 to 75. Higher scores indicate higher levels of Glucose Monitoring System Satisfaction. The scale has a Cronbach's alpha value of 0.86 (26).

WHO-5 Well-being Index

The scale is a short measure of well-being, consisting of five items. The total score ranges from 0 to 100, with each item scored between 0 (never) and 5 (always). To calculate the total score, multiply the sum of the five items by four. The scale was used in a parallel form in the current study. Cronbach's alpha value of the Turkish version was 0.83 (34).

Validity of the Turkish Version of GMSS

Language Validity

Forward and backward translations were utilized. Two independent experts, both native Turkish speakers with proficiency in English, conducted the translation process. These experts were affiliated with academic institutions in the field of health sciences. One translator was informed about the study objectives, while the other was instructed to translate naturally without bias (37). The back-translation was performed by two native English speakers proficient in Turkish but not involved in the initial translation. No semantic differences were found.

Content Validity

The content validity was assessed using the Davis method. Ten experts scored each item on a 4-point scale. The item-level content validity indexes (I-CVI) and scale-level CVI (S-CVI) were calculated. Following Lawshe's criteria, $CVR \geq 0.50$ was considered acceptable (40, 41).

Construct Validity

Confirmatory factor analysis (CFA) was performed to test the original four-factor structure. Before

CFA, assumptions such as multivariate normality, sample adequacy, and absence of multicollinearity were checked. The maximum likelihood estimation method was preferred, as the data met normality assumptions. Model fit indices (χ^2 , SRMR, GFI, AGFI, CFI, RMSEA) were used to evaluate the model (42, 43). Additionally, convergent validity was examined using composite reliability (CR) and average variance extracted (AVE).

Reliability of the Turkish Version of GMSS

Cronbach's Alpha

Cronbach's alpha coefficients were calculated for the overall scale and each subscale. Item-total correlations and "Cronbach's alpha if item deleted" were also reported to evaluate the contribution of each item.

Spearman-Brown Split-Half Analysis

The correlation between the two halves of the scale was calculated, and the Spearman-Brown coefficient was reported.

Parallel Form Reliability

Parallel form reliability was assessed by correlating the GMSS scores with the WHO-5 Well-being Index.

Stability

A test-retest design was not applied due to the online survey method and limited accessibility to the same participants. Instead, parallel form reliability with WHO-5 was used as the primary stability indicator.

Statistical Analysis

Descriptive statistics (frequency, %, mean \pm SD) were presented. Reliability analyses included Cronbach's alpha (overall and subscales), item-total correlations, and alpha if item deleted. Construct validity was examined with CFA in Amos v24. Content validity indexes were calculated based on expert ratings. Convergent validity was evaluated with CR and AVE. Correlations with the WHO-5 were used for parallel form reliability. IBM SPSS v27 and Amos v24 were used for analyses, with significance set at $p < 0.05$.

Results

Most of the patients were female (72.7%) and single (59.1%). The mean age of the participants was 34.90±12.55 years, while the mean duration of the disease was 11.55±12.18 years. Other sociodemographic and disease-related characteristics of the participants are presented in Table I. The predominance of female participants should be considered when interpreting the generalizability of the findings.

Table I. Sociodemographic and Disease-related Characteristics of the Participants (n=220)

		n	%
Gender	Female	160	72.7
	Male	60	27.3
Marital Status	Married	90	40.9
	Single	130	59.1
Education Level	Primary School	29	13.2
	High School	96	43.6
	Bachelor's Degree	83	37.7
	Master's Degree or higher	12	5.5
Working Status	Full-time employee	64	29.1
	Half-time employee	8	3.6
	Not working (including students and retirees)	148	67.3
Comorbidity	Yes	53	24.1
	No	167	75.9
Glucose monitoring system	Glucometer with pen strip	114	51.8
	Continuous Glucose Monitoring Device	105	47.7
	Genteel	1	0.5
Are you satisfied with your current glucose monitoring system?	Very satisfied	52	23.6
	Satisfied	96	43.6
	Neutral	39	17.7
	Dissatisfied	22	10.0
	Completely dissatisfied	11	5.0
Usability of the current glucose monitoring system	Easy to use	176	80.0
	Not easy to use	28	12.7
	Undecided	16	7.3
		Mean±SD	
Age (years)		34.90±12.55	
Disease duration (years)		11.55±12.18	
A1c (%)		7.54±1.42	

Validity of the Turkish Version of GMSS

The content validity index was computed at both the item and scale levels. The item-level content validity indexes varied from 0.80 to 1.00, and the scale-level content validity index was 0.960 (Table II). According to the experts, the scale's CVR ranged from 0.60 to 1.00, and the average score of the CVR

was 0.946.

Table II. Item-level (I-CVI) and Scale-level (S-CVI) content validity index of the Turkish Version of GMSS

Item No	I-CVI
1	0.90
2	0.90
3	1.00
4	1.00
5	1.00
6	1.00
7	1.00
8	0.90
9	0.80
10	0.90
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
S-CVI (Scale total)	0.96

I-CVI = Item Content Validity Index; S-CVI = Scale Content Validity Index. Values ≥0.80 indicate acceptable content validity.

Confirmatory factor analysis was used to determine construct validity. The original four-factor structure of the scale was tested in the model. Model fit indices indicated acceptable values ($\chi^2/df=1.528$; GFI=0.933; AGFI=0.902; CFI=0.965; RMSEA=0.049; SRMR=0.083) (Table III). The convergent analysis yielded CR values ranging from 0.74 to 0.78 and AVE values ranging from 0.44 to 0.50. Although some AVE values were slightly below the 0.50 threshold, convergent validity was supported since CR values exceeded AVE. The factor loadings of the items ranged from 0.39 to 0.80, according to CFA (Figure 1).

Table III. Confirmatory factor analysis (CFA) model fit indices of the Turkish Version of GMSS

Fit Index	Current Study	Acceptable Fit Levels
χ^2/df (CMIN/df)	1.528	$1 \leq \chi^2/df \leq 3$ (good); ≤ 5 (acceptable)
SRMR	0.083	≤ 0.08 (good); ≤ 0.10 (acceptable)
GFI	0.933	≥ 0.90
AGFI	0.902	≥ 0.90
CFI	0.965	≥ 0.95
RMSEA	0.049	≤ 0.05 (good); ≤ 0.08 (acceptable)

CMIN/df = Chi-square/df ratio; SRMR = Standardized Root Mean Square Residuals; GFI = Goodness of Fit Index; AGFI = Adjusted Goodness of Fit Index; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation.

The Cronbach’s alpha coefficient for the overall scale was 0.897. Cronbach’s alpha values for the subscales were 0.753 (Openness), 0.756 (Emotional Burden), 0.776 (Behavioral Burden), and 0.742 (Trust).

Table IV. Item–total correlations and Cronbach’s alpha values if item deleted for the Turkish Version of GMSS (n=220)

Item No	Subscale	Item-Total Correlation	Cronbach’s Alpha if Item Deleted
1	Openness	0.538	0.887
8	Openness	0.605	0.884
10	Openness	0.347	0.893
14	Openness	0.559	0.886
2	Emotional Burden	0.347	0.895
5	Emotional Burden	0.719	0.879
9	Emotional Burden	0.641	0.882
13	Emotional Burden	0.708	0.879
3	Behavioral Burden	0.603	0.884
6	Behavioral Burden	0.638	0.882
11	Behavioral Burden	0.566	0.885
15	Behavioral Burden	0.572	0.885
4	Trust	0.494	0.888
7	Trust	0.507	0.888
12	Trust	0.595	0.884

Item–total correlations >0.30 indicate acceptable item discrimination. All “Cronbach’s alpha if item deleted” values remained above 0.87, showing that no item deletion improved reliability.

The correlations between items and the scale varied from 0.347 to 0.719. For each subscale, item–total correlations ranged from 0.32 to 0.70, and “Cronbach’s alpha if item deleted” values remained above 0.70, indicating that no item removal improved reliability (Table IV).

Table V. Split-half reliability analysis of the Turkish Version of GMSS (n=220)

Test	Value
Cronbach’s Alpha (first half, 8 items)	0.810
Cronbach’s Alpha (second half, 7 items)	0.806
Correlation between forms	0.793
Spearman-Brown coefficient	0.885
Guttman Split-Half coefficient	0.883

Spearman-Brown and Guttman coefficients above 0.80 indicate a high level of internal consistency for the two halves of the scale.

In the Spearman-Brown split-half analysis, the two halves of the scale showed a strong positive correlation ($r=0.793$) and a high degree of internal consistency (Spearman-Brown coefficient=0.885; Guttman coefficient=0.883) (Table V).

Table VI. Parallel Form Reliability between GMSS and WHO-5 Well-being Index (n=220)

		Openness	Emotional Burden	Behavioral Burden	Trust	GMSS Total	WHO 5 Well-being Index
Openness	r	1	0.537**	0.565**	0.408**	0.770**	0.345**
	p		<0.001	<0.001	<0.001	<0.001	<0.001
Emotional Burden	r	0.537**	1	0.674**	0.616**	0.878**	0.251**
	p	<0.001		<0.001	<0.001	<0.001	<0.001
Behavioral Burden	r	0.565**	0.674**	1	0.484**	0.858**	0.169*
	p	<0.001	<0.001		<0.001	<0.001	0.012
Trust	r	0.408**	0.616**	0.484**	1	0.740**	0.134*
	p	<0.001	<0.001	<0.001		<0.001	0.047
GMSS Total	r	0.770**	0.878**	0.858**	0.740**	1	0.277**
	p	<0.001	<0.001	<0.001	<0.001		<0.001
WHO 5 Well-being Index	r	0.345**	0.251**	0.169*	0.134*	0.277**	1
	p	<0.001	<0.001	0.012	0.047	<0.001	

** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level.

GMSS: Glucose Monitoring Satisfaction Survey

Parallel form reliability demonstrated statistically significant positive correlations between the WHO-5 Well-being Index and both the overall GMSS score and all four subdimensions ($r=0.42-0.56$, $p<0.001$) (Table VI).

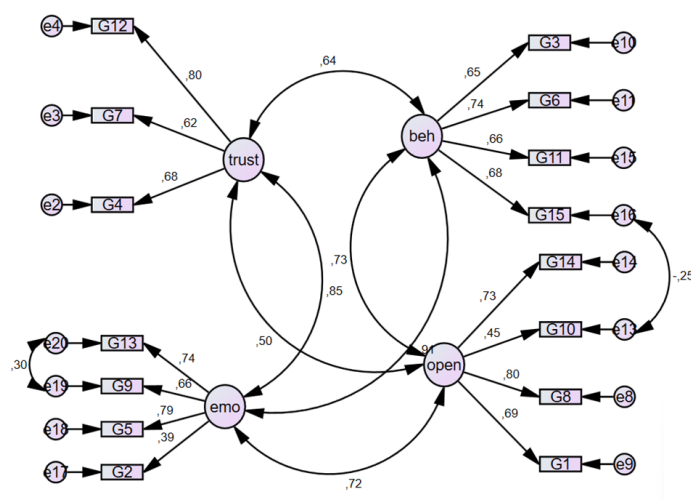


Figure I. Confirmatory Factor Analysis Model with Standardized Estimates

Discussion

Patient satisfaction with blood glucose monitoring devices is essential for maintaining healthy blood glucose levels. Turkish society needs a valid and reliable scale to measure patient satisfaction with the glucose monitoring device. GMSS is a valid and reliable instrument used in the following languages: English, Danish, Dutch, German/Austrian, German/German, Indonesian, Norwegian, Swedish, and Chinese (27, 49). This study assessed the validity and reliability of the Turkish version of the Glucose Monitoring Satisfaction Survey.

In the field of scale development or adaptation, it is widely recognized that when the Item Content Validity Index (I-CVI) and Scale Content Validity Index (S-CVI) values exceed 0.80, expert opinions converge, indicating substantial agreement on the relevance and appropriateness of scale items (50, 51). The findings of the present study indicate that the GMSS possesses favorable I-CVI and S-CVI scores, signifying expert consensus on the items' suitability for Turkish culture and their acceptable representation of the target domain (I-CVI: 0.80–1.00; S-CVI: 0.96). The results indicate that the GMSS possesses item content validity, enhancing confidence in its efficacy for evaluating satisfaction with blood glucose monitoring devices in individuals with T1D. Consistent with the present study, Lu et al. indicated that the CVI for the Chinese version of the scale was 0.910 (27). In the present study, the CVR of the scale was found to range from 0.60 to 1.0. By Lawshe's criteria, the CVR of each item was deemed to be at an acceptable level (41). Consequently, no item was removed from the scale during this study phase.

The fit indices of the confirmatory factor analysis in the literature indicate that the values of χ^2/DF , GFI, AGFI, CFI, and RMSEA should meet acceptable standards (52–55). In the confirmatory factor analysis (CFA) of the Turkish version of the scale, the χ^2/df ratio, SRMR, GFI, AGFI, CFI, and RMSEA values, which assess the model's fit to the data, were deemed satisfactory. This study indicates that a χ^2/df ratio < 3 , GFI and AGFI values ≥ 0.90 , CFI values ≥ 0.95 , and SR and RMSEA values ≥ 0.10 and < 0.05 signify a perfect or adequate model fit (56). The Confirmatory Factor Analysis (CFA) demonstrated that all factor

loadings above 0.39 signify acceptable loadings. Moreover, the model's fit was deemed adequate according to various model fit indices in Confirmatory Factor Analysis (CFA) (51,53,54,56). The CFA results revealed that all items exhibited factor loadings exceeding 0.30. Factor loadings were reported to be between 0.612 and 0.913 in the Chinese version of the scale (27). Thus, the model fit for the Turkish version of the GSMM was deemed highly robust, maintaining its original four-factor structure.

In the present study, the CR value was higher than 0.70, and the CR value was higher than the AVE value, which ranged from 0.44 to 0.50. While the threshold of 0.50 is a standard benchmark, it is acknowledged that some researchers may be willing to accept lower AVE values, provided that other validity and reliability indicators are deemed to be strong. To illustrate this point, consider a scenario with high composite reliability (above 0.70). In such a case, it is posited that the lower AVE could be compensated for, thereby suggesting that the construct is still reliable and valid overall (57). In the present study, the other reliability and validity parameters were found to be at an acceptable level. While the AVE was slightly lower than 0.50 for some domains, the results indicate a robust and reliable model. For this reason, researchers preferred to keep the tool's original factor structure.

Internal consistency dependability was evaluated utilizing Cronbach's alpha coefficient values and the split-half approach, as advocated in the literature (54, 55, 58). This study reveals that Cronbach's alpha values above 0.70 for both halves, demonstrating robust and substantial correlations between them, with Spearman-Brown and Guttman split-half coefficients surpassing 0.80 (53–55). The present investigation produced Cronbach's alpha values over 0.70 for both halves, alongside Spearman-Brown and Guttman split-half coefficients surpassing 0.80, signifying a substantial degree of dependability. The results demonstrate a robust correlation among the components, reflecting the underlying structure. The Cronbach's alpha values for the Chinese version were 0.87, 0.82, 0.83, 0.81, and 0.83 for the GMSS-T1DM total and its openness, emotional load, behavioral burden, and trust subscales, respectively.

Cronbach's alpha coefficient indicates a scale's internal consistency, demonstrating the degree to which items are interconnected and assess the same underlying concept. Alpha scores ranging from 0.60 to 0.80 signify internal consistency, and values between 0.80 and 1.00 denote high internal consistency (50, 52, 54). The Cronbach's alpha coefficient for the entire scale in this study was 0.897, signifying strong internal consistency. The alpha values for the openness, emotional burden, behavioral burden, and trust subscales were 0.753, 0.756, 0.776, and 0.742, respectively. The original version had a Cronbach alpha of 0.86 (26). These values indicate acceptable internal consistency within each subscale. The findings suggest that the items effectively measure the intended constructs, exhibit significant correlations with their respective subscale, and demonstrate reliability for the overall scale and its subscales.

Item-scale correlation evaluates the association between individual item scores and the overall score of the assessment instrument (50,52,53,54). A higher correlation suggests that the item aligns well with the measured theoretical framework, with a recommended threshold of >0.30 (51,52,58). In our study, item-scale correlations ranged from 0.347 to 0.719.

Another method is parallel form's reliability, which investigates the tool's stability (58). The current study found positive and statistically significant relationships between the WHO 5 Well-being Index and GSMM. This outcome indicates that the findings of the two scales were congruent. The scale's original version also shows a statistically significant positive relationship with WHO-5 (26). Statistically significant relationships existed between the Chinese version of the scale and the WHO-5 (27).

According to the aforementioned analysis, the scale was a valid and reliable tool for measuring satisfaction with the glucose monitoring system in Turkish society. The sample size was considered adequate to test the hypothesis according to the estimated Cronbach's alpha in the power analysis and the achieved Cronbach's alpha. However, we also recommend further validity and reliability analysis in different samples in Turkey to show the

repeatability of the measurement tool and to avoid sample bias. The study was conducted with patients with T1D, and there is a need for another valid and reliable survey for patients with Type 2 Diabetes.

This study's validity and reliability assessments revealed that the GMSS (Glucose Monitoring Satisfaction Survey) is a valid and reliable instrument for evaluating the satisfaction of individuals with T1D concerning their glucose monitoring devices throughout Turkish society. The scale objectively assesses individuals with T1D on their satisfaction with blood glucose monitoring equipment. Moreover, the GMSS enables healthcare practitioners and researchers to comprehend this particular group's preferences and requirements, promoting customized therapies and enhancements in diabetes management. The GMSS can be an essential instrument for cross-cultural comparative studies, allowing researchers to evaluate the satisfaction levels of persons with T1D across various cultural contexts.

This study has several limitations. First, the snowball sampling technique and online survey methodology may affect generalizability. Second, the sample was predominantly female (72.7%), which may introduce gender-related bias and limit the generalizability of the results to the broader T1D population. Third, test-retest reliability was not assessed due to the online design and difficulty in re-contacting participants. Although convergent validity was examined (CR and AVE), discriminant validity was not tested, and future research should address this gap. Finally, this study included only patients with T1D; therefore, there is a need to develop or adapt similar instruments for individuals with type 2 diabetes.

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