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Development and psychometric evaluation of the life management skills scale for children with type 1 diabetes

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ABSTRACT

Objective: This study aimed to develop and psychometrically evaluate the Life Management Skills Scale (LMSS-T1D), designed to assess coping and self-management skills in children with Type 1 Diabetes Mellitus (T1DM).
Methods: A methodological and correlational study was conducted between May and December 2024 with 367 children aged 10–18 years. Content validity was assessed by expert review (CVI: 0.80–1.00). Construct validity was tested via exploratory and confirmatory factor analyses. Internal consistency was measured with Cronbach's alpha; test-retest reliability was assessed using Pearson correlation.
Results: The scale revealed a two-factor structure "Diabetes Coping Skills" and "Diabetes Management Knowledge" explaining 70.9 % of the total variance. Factor loadings ranged from 0.832 to 0.963. Confirmatory factor analysis indicated a good model fit (χ^2/df = 1.683, RMSEA = 0.069, CFI = 0.968). Cronbach's alpha was 0.980 for the total scale; 0.971 for the "Diabetes Coping Skills" subscale and 0.984 for the "Diabetes Management Knowledge" subscale. Item-total correlations were significant (r = 0.823–0.904). Test-retest reliability was high (r = 0.979–0.988), and no significant differences were found between applications ($p > 0.05$).
Conclusion: The LMSS-T1D is a valid and reliable instrument for evaluating life management skills in children with T1DM. It offers a structured framework for assessing coping and self-management capabilities and may support individualized interventions.
Implications for practice: The scale may assist healthcare providers in identifying strengths and weaknesses in pediatric diabetes management, guiding personalized care plans.

Introduction

Type 1 diabetes mellitus (T1DM) is among the most prevalent chronic illnesses in childhood, characterized by the autoimmune destruction of pancreatic beta cells responsible for insulin production. Effective management of T1DM necessitates a multifaceted approach to self-care, including daily insulin administration, blood glucose monitoring, regular physical activity, and nutritional regulation (Chatterjee et al., 2020; Monaghan et al., 2022). The continuous nature of these tasks, which permeate every aspect of daily life, exerts a profound impact not only on the physiological well-being of children with T1DM but also on their social and psychological adaptation. In particular, disease management in children diagnosed at an early age imposes significant burdens on families and often results in a diminished quality of life (Monaghan et al., 2022). Psychosocial challenges associated with chronic illness are especially pronounced during childhood and adolescence. Research has shown that children and adolescents with diabetes experience elevated levels of depression, anxiety, and behavioral maladjustment compared to their healthy peers (Chatterjee et al., 2020; Hamburger et al., 2020). Frequently reported psychosocial concerns include reduced self-efficacy, intrafamilial conflict, and negative illness perceptions (de Wit et al., 2022). As highlighted in the 2022 guidelines of the International Society for Pediatric and Adolescent Diabetes (ISPAD), approximately 15 % of youth with diabetes exhibit clinically significant psychological symptoms, underscoring the necessity of integrating psychosocial interventions into diabetes care (de Wit et al., 2022). Effective diabetes management extends beyond medical compliance; it requires children to develop life management skills that enable them to cope with the psychosocial and behavioral demands of living

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with a chronic condition. The concept of self-management encompasses age-appropriate responsibilities related to insulin administration, glycemic monitoring, dietary planning, and physical activity (La Banca et al., 2022). Early acquisition of these competencies has been shown to contribute to long-term glycemic control and facilitate better psychosocial adjustment during adolescence (Monaghan et al., 2022). Life management skills extend beyond self-management and encompass a broader set of functional competencies applicable to social interaction, school participation, and emotional regulation. These include time management, stress management, interpersonal communication, problem-solving, and decision-making (Guo et al., 2011). In particular, creative problem-solving skills are critical during unanticipated glycemic fluctuations or deviations from routine, enabling children and their families to exercise adaptive flexibility in diabetes care (Monaghan et al., 2022). Well-developed life skills are associated not only with better glycemic control but also with enhanced psychological well-being and overall quality of life. In recent years, the scope of diabetes-related psychoeducational interventions has expanded to include digital games, animations, and online platforms. A recent randomized controlled trial in Türkiye demonstrated that digital game-based education improved quality of life and significantly reduced HbA1c levels among children with T1DM (Tınmaz & Altundağ, 2025). Likewise, systematic reviews have reported short-term improvements in glycemic outcomes and diabetes-related quality of life following psychoeducational programs (Cockcroft et al., 2024). However, the effectiveness of such programs is contingent upon their alignment with the child's individualized needs and existing level of life management skills. These findings underscore the critical importance of assessing and fostering life management skills in children with T1DM to support effective self-regulation and sustainable disease management. Despite this, a gap remains in the literature: no validated tool currently exists to jointly assess coping and self-management skills in this population. The present study aims to address this gap by developing and validating a reliable instrument for assessing these skills in children with T1DM, thereby providing a foundation for individualized interventions that promote psychosocial and clinical well-being.

Materials and methods

Study design

This study adopted a methodological and correlational design to develop and psychometrically evaluate a scale intended to assess life management skills in children with Type 1 diabetes.

Inclusion criteria

The study included children aged 10 to 18 who had been diagnosed with Type 1 diabetes and were actively receiving treatment in public or private healthcare institutions across Türkiye. Participation was voluntary, and informed consent was obtained from both the participants and their legal guardians in accordance with ethical principles. To ensure meaningful participation, children with any cognitive, developmental, or physical condition that might interfere with their ability to understand or complete the assessment tools were excluded. Only those who met all eligibility criteria were included in the study.

Study sample

This study was conducted between May and December 2024 with children aged 10 to 18 who had been diagnosed with diabetes and resided in Türkiye. The target population consisted of all children with T1DM living across the country. However, we clarify that a convenience sampling method was used rather than a nationwide random approach. Participants were recruited via pediatric diabetes clinics in both public and private hospitals across various regions of Türkiye, with support from diabetes care nurses. Some data were collected face-to-face using structured online forms. While the sample included diverse backgrounds, it may not fully represent the entire T1DM population. This approach aligns with scale development practices prioritizing adequate sample size and diversity over representativeness (Boateng et al., 2018; DeVellis, 2016). The sample size was determined based on scale development guidelines, which recommend including a number of participants at least 5 to 10 times greater than the number of items, with a minimum of 200 participants to ensure statistical reliability. Given that the draft version of the scale included 54 items, a total of 367 participants were recruited. According to the literature, an adequate sample size for scale development is classified as follows: 200 participants = sufficient, 300 = good, 500 = very good, and ≥ 1000 = excellent (Büyüköztürk, 2024; DeVellis, 2016). It is also commonly stated that the sample should comprise at least five participants per item (Büyüköztürk, 2024; DeVellis, 2016; Seçer, 2015). To assess the test–retest reliability of the scale, 44 participants who had previously completed the initial survey were re-contacted after four weeks and voluntarily agreed to participate in the second administration. The four-week interval was selected to minimize memory effects while avoiding actual changes in the construct, as recommended by psychometric experts who suggest an ideal range of 2–8 weeks for test–retest intervals (Furr & Bacharach, 2008). Both the initial and follow-up administrations were conducted using the same online platform (Google Forms) to ensure consistency in data collection conditions. Each participant was assigned a unique, non-identifying code to securely link Time 1 and Time 2 responses without compromising anonymity, in accordance with ethical research standards. During the four-week interval, no changes were reported in participants' clinical conditions, treatment regimens, or assessment settings, ensuring that the test–retest reliability findings reflected stability of the construct rather than external variations.

Data collection tools

Two instruments were utilized in this study: a “Sociodemographic Information Form” and the “Life Management Skills Scale for Children with Diabetes (LMSS-T1D)” Both tools were developed by the study authors, who specialize in pediatric nursing. Data were collected through an online survey created using Google Forms. Prior to participation, informed written and verbal consent was obtained from each child and their parent or guardian. Age and developmentally appropriate assent procedures were used. A child information sheet written in plain, age-appropriate language with concrete examples was provided. Children were explicitly told there were no ‘right or wrong’ answers, and a short Q&A opportunity was offered before starting the survey.

Sociodemographic information form

This form was designed to assess participants' demographic and illness-related characteristics, including age, sex, place of residence, family structure, household composition, number of siblings, parental education level, family income and expenditures, type of diabetes, duration of diabetes management, type of treatment received, perceived self-efficacy in managing diabetes, and academic performance.

Development process of the life management skills scale for children with diabetes

Conceptual framework and item generation

Prior to initiating the scale development process, a well-defined conceptual framework was established based on theoretical constructs that support creative problem-solving skills in children with T1DM. This framework was informed by an extensive literature review conducted across major academic databases, including PubMed, CINAHL, Scopus, and Web of Science. Keywords used in the search included “creative

problem solving," "childhood diabetes," "coping skills," "self-management," and "scale development." The literature review focused on identifying measurable components and theoretical perspectives related to problem-solving competencies. In addition to the literature, qualitative data were collected through interviews with pediatric nurses working in clinical settings, providing insights into the lived experiences of children managing diabetes-related challenges. Integrating findings from both sources, an initial theoretical model of the scale was developed, resulting in an item pool consisting of 145 statements.

Thematic analysis and item refinement

The theoretical framework of the Life Management Skills Scale for Children with Diabetes was established through a literature review, and items were developed in alignment with the conceptual domains identified through both the literature and expert interviews. To ensure face validity, two Turkish language experts reviewed the items for clarity and appropriateness, and necessary revisions were made to enhance readability and conceptual accuracy.

Content validity and davis technique

To evaluate content validity, an initial item pool of 145 items was developed based on the conceptual framework and relevant literature. To provide transparency, the expert panel included professionals with backgrounds in pediatric nursing ($n = 6$), pediatric endocrinology ($n = 2$), pediatric medicine ($n = 1$), and psychometrics (n = 1) using the Davis technique (Davis, 1992). Their professional experience ranged from 10 to 25 years, and all held doctoral-level qualifications. A summary of the expert panel's characteristics is provided in Supplementary Table 1. Experts rated each item on a 4-point Likert scale ranging from "Not relevant" to "Highly relevant." Following this expert review, items with a Content Validity Index (CVI) score below 0.80 were considered insufficiently representative of the construct and removed. In addition, semantically redundant, overlapping, or conceptually ambiguous items were excluded or consolidated to improve clarity and parsimony. As a result of this multi-stage content validation process, 91 items were removed, and a 54-item preliminary version of the LMSS-T1D was established. This version demonstrated both theoretical integrity and adequate content coverage, and it served as the basis for subsequent construct validity and reliability analyses.

Pilot testing

A pilot study was conducted with 10 children who met the inclusion criteria but were not part of the main study sample. The pilot results indicated that the items were understandable and that the scale took approximately 15–20 min to complete. The finalized version of the scale was then administered to the main sample via an online survey distributed through Google Forms.

Reliability and validity analyses and final scale description

Reliability and validity analyses were conducted to evaluate the psychometric strength of the items in the LMSS-T1D. Following the expert review process, a 54-item preliminary version was established based on content validity findings. This version was administered to 367 children diagnosed with type 1 diabetes. Items with item-total correlation coefficients below 0.30 and factor loadings below 0.50 were subsequently excluded through Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). As a result, 39 items were removed, yielding a final 15-item scale. The finalized LMSS-T1D consists of two subscales: "Diabetes Coping Skills" and "Diabetes Management Knowledge." It is structured as a 5-point Likert-type scale, with responses ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Total scores range from 15 to 75, with higher scores indicating stronger life management and problem-solving skills. Subscale scores are computed in the same manner as the total score.

Data analysis

Descriptive statistics were used to summarize the study variables. Categorical variables were presented as frequencies and percentages, while continuous variables were described using means and standard deviations. The assumption of univariate normality was tested in the retest sample ($n = 44$) using the Shapiro–Wilk test, which is recommended for small samples (Pallant, 2020). Although some p-values were below 0.05, skewness and kurtosis values were within the acceptable ± 1.5 range (Tabachnick & Fidell, 2019). Visual inspection of histograms and Q–Q plots further supported the assumption of approximate normality. Accordingly, parametric analyses were deemed appropriate. For the full sample ($n = 367$), multivariate normality was assessed prior to CFA using Mardia's multivariate kurtosis test. The results (normalized estimate $= 1.24$, $p > 0.05$) confirmed that the assumption was met.

In this study, due to limitations in obtaining a second independent sample, a split-sample approach was applied to the total sample ($N = 367$) to ensure independent testing of the factor structure. The sample was divided into two subsamples: the first group (odd-numbered cases, $n = 184$) was used for EFA, and the second group (even-numbered cases, $n = 183$) was used for CFA. This method is supported in the literature as a viable strategy when separate samples are not feasible (Fabrigar et al., 1999). To examine the scale's construct validity, EFA was performed using the principal axis factoring (PAF) method with Promax rotation, which is suitable when factors are expected to correlate and multivariate normality may be violated (Pallant, 2020; Tabachnick & Fidell, 2019). PAF was selected because it provides more accurate estimation of common variance and relies less on normality assumptions compared to other methods (Costello & Osborne, 2005; Fabrigar et al., 1999). Promax rotation was chosen because it allows for correlated factors, which is considered appropriate given that psychological constructs often demonstrate interrelated dimensions (Brown, 2015; DeVellis & Thorpe, 2022). Following the EFA, CFA was conducted to verify the factor structure derived from the exploratory phase. Prior to CFA, multicollinearity diagnostics were performed using variance inflation factor (VIF) and tolerance values. All VIF values were below 10 and tolerance values were above 0.1, indicating the absence of multicollinearity. The Davis technique was used to evaluate content validity based on expert reviews, as it provides a quantifiable index of expert agreement on item relevance. Relationships between subscale scores and total scale scores were analyzed using Pearson correlation. Internal consistency was examined using Cronbach's alpha coefficient. Test–retest reliability was evaluated by re-administering the scale to 44 participants after four weeks and calculating Pearson correlation coefficients between time points. All statistical analyses were performed using IBM SPSS version 25.0 and AMOS version 24.0, adopting a significance threshold of $p = 0.05$.

Ethical considerations

This study was approved by the Non-Interventional Research Ethics Committee of Hasan Kalyoncu University (Approval No: 2024/56; Date: April 15, 2024). Written and verbal informed consent was obtained from all participants and their legal guardians. Parents were provided adequate time to consider participation, ask questions, and discuss the study prior to providing consent; all queries were addressed by the research team before consent was sought. Participation was voluntary and conducted in accordance with ethical research principles. The participant information sheets described minimal risks (e.g., potential discomfort when answering personal questions) and potential benefits (e.g., contributing to improved pediatric diabetes education and scale development). The right to withdraw at any time without consequences was emphasized. This manuscript adheres to the Child-Centred Research Checklist (Foster et al., 2025) the completed checklist is available as Supplementary Table 2.

Results

Participant characteristics

Of the 367 children who participated in the study, 59.1 % ($n = 217$) were female. The mean age of participants was 14.71 years (SD = 2.58), with ages ranging from 10 to 18. A majority of the participants (69.2 %, $n = 254$) lived in urban areas; 82.0 % ($n = 301$) grew up in nuclear families, and 98.6 % ($n = 362$) lived with their families. Regarding parental education, 34.1 % ($n = 125$) of fathers and 39.8 % ($n = 146$) of mothers had completed only primary school. In terms of socioeconomic status, 49.3 % ($n = 181$) of the children reported that their household expenses exceeded their income. Concerning diabetes type, 99.5 % ($n = 365$) were diagnosed with type 1 diabetes. The remaining two participants selected "I don't know" for the question about diabetes type in the sociodemographic form, although medical records confirmed a T1DM diagnosis for all 367 children included in the study. Additionally, 38.1 % ($n = 140$) had been living with diabetes for more than five years. Regarding treatment methods, 83.9 % ($n = 308$) were receiving insulin injections. A total of 56.4 % ($n = 207$) of the children described themselves as "competent" or "highly competent" in diabetes self-management. Moreover, 64.1 % ($n = 235$) reported their academic performance as "good" or "very good."

Validity findings of the LMSS-T1D

Content validity

The content validity of the Life Management Skills Scale for Children with Diabetes was assessed by a panel of ten academic experts in pediatric nursing, pediatric endocrinology, and psychometrics. Based on their evaluations, items with a Content Validity Index (CVI) below 0.80 (n = 30) were eliminated from the scale. In addition, redundant or conceptually weak items were removed, resulting in a 54-item version. The CVI values for the retained items ranged between 0.80 and 1.00.

Exploratory factor analysis

Before conducting EFA, the data set's suitability for factor analysis was confirmed. The Kaiser-Meyer-Olkin (KMO) coefficient was calculated as 0.931, and Bartlett's test of sphericity was found to be statistically significant ($\chi^2 = 1963.996$, df = 120, $p < 0.001$), indicating that the data were appropriate for factor analysis. The EFA revealed a two-factor structure with eigenvalues greater than 1. These two factors were labeled as "Diabetes Coping Skills" and "Diabetes Management Knowledge." The first factor accounted for 57.1 % of the total variance, while the second accounted for 13.8 %, yielding a cumulative explained variance of 70.9 %. Factor loadings ranged from 0.832 to 0.907 in the first factor and from 0.935 to 0.963 in the second factor (Table 1).

Table 1
Results of exploratory factor analysis ($N = 367$).

Items and Factors	Factor Loadings	Explained Variance
Factor 1: Diabetes Coping Skills		57.1 %
M24	0.861	
M25	0.832	
M26	0.894	
M27	0.832	
M30	0.885	
M33	0.907	
M34	0.884	
M36	0.846	
M37	0.867	
Factor 2: Diabetes Management Knowledge		13.8 %
M49	0.963	
M50	0.943	
M51	0.946	
M52	0.937	
M53	0.946	
M54	0.935	
Total Variance Explained		70.9 %

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.

Confirmatory factor analysis

Following the EFA, CFA was conducted to evaluate the two-factor structure of the LMSS-T1D. The final validated structure consisted of 15 items across the two identified factors. The model demonstrated acceptable fit indices: Chi-square/df = 1.683, GFI = 0.892, NFI = 0.925, CFI = 0.968, and RMSEA = 0.069. Factor loadings for the "Diabetes Coping Skills" subscale ranged from 0.671 to 0.867, while loadings for the "Diabetes Management Knowledge" subscale ranged from 0.818 to 0.896. The path diagram (Fig. 1) illustrates the relationships between observed variables and latent constructs, confirming that items significantly loaded onto their respective subscales. Because some fit indices still remained slightly below ideal thresholds, model modifications were conducted to improve adequacy. These included the addition of error covariances based on modification indices (MI) provided in the AMOS output. In total, five error covariances were added: e8–e10 (MI = 0.40), e2–e3 (MI = 0.33), e11–e12 (MI = 0.27), e6–e8 (MI = 0.21), and e7–e10 (MI = 0.16). Each adjustment was evaluated in terms of both statistical improvement and theoretical justification. For example, error covariances were added between the following item pairs: e8–e10 (M26: "coping with emotions" and M24: "remaining calm"), e2–e3 (M37: "sharing concerns" and M36: "responding openly"), e11–e12 (M49: "monitoring blood glucose" and M50: "medication management"), e6–e8 (M30: "feeling hopeful" and M26: "coping with emotions"), and e7–e10 (M27: "engaging in relaxing activities" and M24: "remaining calm"). These pairs share close thematic content, particularly in domains such as emotional regulation, coping, social support, and daily management tasks. The residual correlations observed between them were therefore incorporated not only based on statistical indices but also due to their conceptual overlap. This approach ensured that model modifications were both theoretically justified and statistically sound, thereby preserving the structural coherence and validity of the LMSS-T1D.

Convergent and discriminant validity were assessed by calculating Composite Reliability (CR) and Average Variance Extracted (AVE) for each subscale. The CR and AVE values for the Diabetes Coping Skills subscale were 0.934 and 0.612, respectively. For the Diabetes Management Knowledge subscale, the CR was 0.941 and the AVE was 0.727. The Maximum Shared Variance (MSV) was calculated as 0.384, based on the correlation between the two subscales. These results indicate that both CR > AVE and AVE > MSV conditions were met, supporting the scale's adequacy in terms of both convergent and discriminant validity.

Reliability findings for the LMSS-T1D

Cronbach's alpha coefficients

Cronbach's alpha for the total scale was 0.980. For the subscales, coefficients were 0.971 and 0.984, respectively (Table 2). Alpha values ≥0.70 are considered acceptable; ≥ 0.90 indicate excellent internal consistency (George & Mallery, 2024; Şencan, 2005; Tavakol & Dennick, 2011).

Corrected item-total correlation analysis

The corrected item-total correlation coefficients for the scale ranged from 0.823 to 0.904, with all values found to be statistically significant ($p < 0.001$). Regarding the relationship between the total scale score and subscale scores, a strong and statistically significant positive correlation was observed: $r = 0.974$ for the Diabetes Coping Skills subscale and $r = 0.930$ for the Diabetes Management Knowledge subscale ($p < 0.001$). Detailed values for each item, including item-total correlations, CFA factor loadings, and internal consistency indicators, are presented in Supplementary Table 3.

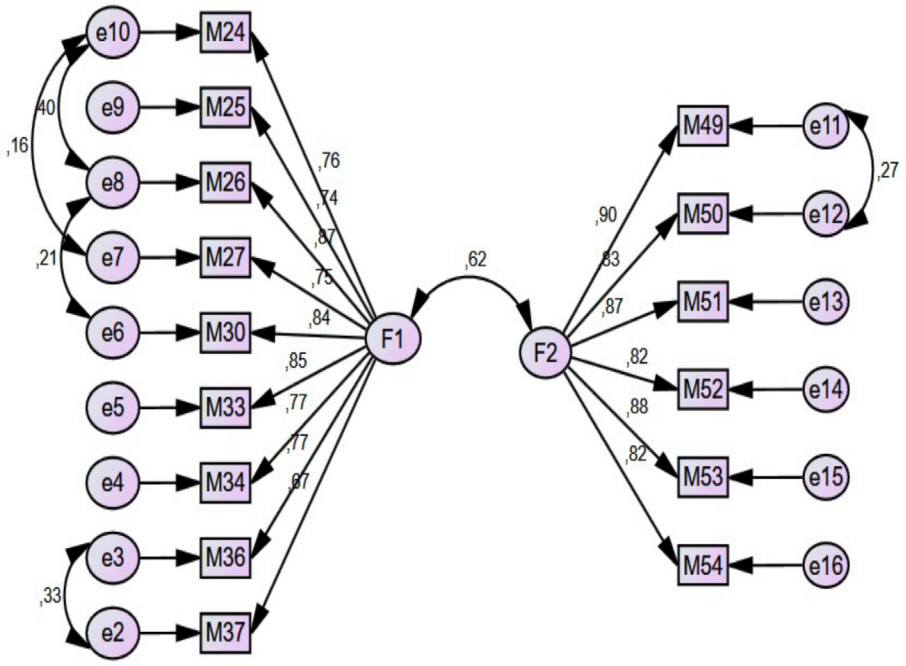

Fig. 1. Path diagram of the confirmatory factor analysis model.

Test-retest reliability

To evaluate the temporal stability of the scale, a test-retest analysis was conducted. The scale was re-administered to 44 participants with a four-week interval between administrations. Pearson correlation analysis revealed strong, positive, and statistically significant correlations between the first and second measurements: $r = 0.987$ for the total score ($p < 0.001$), $r = 0.988$ for the Diabetes Coping Skills subscale ($p < 0.001$), and $r = 0.979$ for the Diabetes Management Knowledge subscale ($p < 0.001$). Additionally, paired-sample *t*-test results indicated no statistically significant difference in mean scores between the test and retest administrations ($p > 0.05$) (Table 3).

Discussion

The present study aimed to develop and psychometrically validate the LMSS-T1D for children with T1DM. The LMSS-T1D was designed to assess the creative problem-solving and self-management competencies of children aged 10–18 with T1DM, capturing the multifaceted demands of chronic disease management in pediatric populations. The results confirmed that the LMSS-T1D is a valid and reliable instrument, with strong evidence for its content validity, construct validity, internal consistency, and temporal stability. Content validity was ensured through systematic expert evaluations in accordance with the Davis technique (Davis, 1992), as well as the guidelines proposed by Polit and Beck (2006). Ten experts in pediatric nursing, endocrinology, and measurement-evaluation rated the initial item pool of 145 items. Items with a Content Validity Index (CVI) below 0.80 were excluded, leading to a refined 54-item preliminary version (Polit & Beck, 2006). This expert-driven selection process supports the theoretical foundation and clinical relevance of the LMSS-T1D, ensuring that the scale items accurately reflect creative problem-solving behaviors in diabetes self-management. Construct validity was assessed via exploratory and confirmatory factor analyses (EFA and CFA). The EFA revealed a two-factor structure: "Diabetes Coping Skills" and "Diabetes Management Knowledge," which together explained 70.9 % of the total variance surpassing the 40–60 % threshold generally considered acceptable in social science research (Şencan, 2005; Tavşancıl, 2018) (Table 1). All factor loadings exceeded the recommended minimum threshold of 0.50, ranging from 0.832 to 0.963, indicating strong contributions of individual items to their respective latent constructs (Büyüköztürk, 2024). The CFA confirmed the robustness of the two-factor structure. Specifically, the χ^2/df ratio was 1.683, which is well below the commonly recommended maximum of 3 for a good model fit (Kline, 2005). The RMSEA was 0.069, falling under the accepted cutoff of 0.08 for an adequate fit and approaching the more stringent 0.06 threshold for a close fit (Hu & Bentler, 1999). Likewise, the CFI (0.968) and NFI (0.925) exceeded the conventional 0.90 benchmark for satisfactory fit (Bentler & Bonett, 1980; Hooper et al., 2008), with the CFI also meeting the more rigorous ≥0.95 standard often cited for excellent fit (Hu & Bentler, 1999). Although the GFI was slightly below the ideal 0.90 threshold at 0.892, it remains close to the acceptable range and still indicates a reasonable fit for the model. Taken together, these indices fall within reported literature reference ranges (Browne & Cudeck, 1993; Gerbing & Anderson, 1992), supporting that our two-factor CFA model achieved a good fit to the data. Additionally, the CR and AVE values were examined to evaluate the convergent and discriminant validity of the LMSS-T1D. According to established guidelines, CR values ≥0.70 and AVE values ≥0.50 are considered acceptable, while AVE values should also exceed the MSV to

Table 2
Reliability and descriptive statistics of the scale and its subscales ($N = 367$).

Scale / Subscale	Number of Items	Possible Score Range (Min–Max)	Mean ± SD	Cronbach's α
Total Scale	15	15–75	59.56 ± 18.65	0.980
Diabetes Coping Skills	9	9–45	35.80 ± 12.07	0.971
Diabetes Management Knowledge	6	6–30	23.76 ± 7.41	0.984

Note: N = sample size; SD = standard deviation; Min: Minimum value, Max: Maximum value α = Cronbach's alpha internal consistency reliability coefficient.

Table 3
Results of the test–retest reliability analysis ($n = 44$).

Scale / Subscale	First Administration Mean ± SD	Second Administration Mean ± SD	r	p	t	p
Total Scale	61.00 ± 10.03	61.18 ± 9.51	0.987	< 0.001	−0.739	0.464
Diabetes Coping Skills	34.95 ± 7.24	35.25 ± 7.04	0.988	< 0.001	−1.730	0.091
Diabetes Management Knowledge	26.05 ± 3.80	25.93 ± 3.46	0.979	< 0.001	0.927	0.359

Note: N = sample size; SD = standard deviation; r = Pearson correlation coefficient; t = paired samples *t*-test statistic.

support discriminant validity (Harrington, 2008). In our study, the Diabetes Coping Skills subscale yielded CR = 0.934 and AVE = 0.612, while the Diabetes Management Knowledge subscale showed CR = 0.941 and AVE = 0.727. The MSV was calculated as 0.384, which remained lower than the AVE values for both subscales. These findings confirm that the LMSS-T1D demonstrates strong convergent and discriminant validity, fully meeting psychometric standards reported in the literature.

In terms of reliability, the LMSS-T1D demonstrated excellent internal consistency. The overall Cronbach's α coefficient was 0.980. Specifically, the Diabetes Coping Skills subscale yielded $\alpha = 0.971$, and the Diabetes Management Knowledge subscale yielded $\alpha = 0.984$ (Table 2). These figures exceed the commonly accepted standard of $\alpha > 0.70$ and indicate that the items are both homogeneous and stable (Nunnally & Bernstein, 1994; Polit & Beck, 2006; Şencan, 2005). The corrected item-total correlations ($r = 0.823–0.904$) further validated the items' ability to consistently reflect the constructs they were intended to measure. The test–retest reliability, assessed after a four-week interval with 44 participants, yielded high Pearson correlation coefficients ($r = 0.979–0.988$) for the total and subscale scores, with no statistically significant differences between the two administrations ($p > 0.05$) (Table 3). These results indicate strong temporal stability, affirming the consistency of the LMSS-T1D over time (Terwee et al., 2007). When compared with similar instruments in the literature, the LMSS-T1D demonstrates notable strengths. While previous scales focused on adherence (Harrington, 2008), psychosocial support (Grey et al., 1998), or quality of life (Ayar & Ozturk, 2016; Varni et al., 2003), the LMSS-T1D uniquely emphasizes creative problem-solving, an essential but under-measured skill in pediatric diabetes management. The scale aligns with the World Health Organization's (1997) life skills framework, targeting higher-order cognitive competencies such as decision-making, creativity, and emotional coping skills critical for managing unpredictable glycemic fluctuations and complex daily routines (WHO, 1997). Additionally, the practical utility of the LMSS-T1D is significant. In clinical settings, the scale may inform individualized educational interventions, identifying areas of strength and areas requiring support. For instance, children with lower coping scores might benefit from scenario-based simulations or digital game-assisted education programs, which have been shown to improve glycemic outcomes and quality of life (Hill-Briggs, 2003; Tınmaz & Altundağ, 2025). Sharing LMSS-T1D results with families and care teams could also foster child-centered care and enhance collaboration between healthcare providers and families (Anderson & Butcher, 2006). The findings of this study are consistent with previous psychometric investigations of pediatric diabetes instruments. Looking forward, the LMSS-T1D holds promise for future research. It may serve as a mediator or predictor in studies examining the relationship between problem-solving abilities and diabetes outcomes, such as HbA1c levels, treatment adherence, or psychosocial functioning (Hill-Briggs, 2003; Hill-Briggs & Gemmell, 2007). Moreover, LMSS-T1D scores could help tailor educational curricula, psychosocial interventions, or digital health innovations, providing objective feedback on children's evolving self-management competencies.

Strengths and limitations

One key strength of this study is the development of a psychometrically robust instrument specifically designed to assess life management skills in children with Type 1 diabetes. The LMSS-T1D was constructed based on a comprehensive theoretical framework and validated through rigorous content analysis, factor analyses, and reliability testing. Its strong internal consistency and alignment with the WHO life skills framework support its utility in both clinical and educational contexts. However, several limitations should be noted. The scale was developed and validated within a Turkish sample, which limits cross-cultural generalizability. Future studies are needed to test its applicability across diverse populations. The test–retest reliability was assessed with 44 participants, a number consistent with psychometric guidelines, though larger samples may enhance generalizability. Criterion-related validity was not assessed in this study. Future research should investigate how LMSS-T1D scores correlate with established behavioral or psychosocial indicators such as treatment adherence or diabetes-related self-efficacy. In addition, while the CFA supported a two-factor structure with excellent fit indices, we did not test bifactor or second-order models to evaluate whether a total score is psychometrically justified. Similarly, CFA was conducted using Maximum Likelihood (ML) estimation; although acceptable with five-point Likert data, Weighted Least Squares Mean and Variance Adjusted (WLSMV) is generally recommended for categorical items. Future research should therefore examine these alternative approaches to further strengthen the psychometric evidence.

Implications for practice

The LMSS-T1D provides healthcare professionals with a practical tool to assess the coping and self-management skills of children with T1DM. By identifying specific areas of need, the scale can inform the development of individualized education strategies and child-centered interventions. Its use in pediatric care settings may enhance treatment adherence, emotional resilience, and self-efficacy, ultimately improving diabetes outcomes and quality of life.

Conclusion

The LMSS-T1D is a valid and reliable instrument for assessing life management skills in children with T1DM. Its clear two-factor structure comprising Diabetes Coping Skills and Diabetes Management Knowledge and high internal and temporal reliability support its use in both clinical and research settings. The final structure confirmed through CFA comprises 15 items across two factors. As the first tool developed specifically to measure life management competencies in pediatric diabetes, the LMSS-T1D addresses a significant gap in the literature. It offers a practical and theoretically grounded framework for guiding personalized interventions, empowering children to take an active role in managing their health. Future validation across different cultural and clinical populations is warranted to maximize its applicability and impact.

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CRediT authorship contribution statement

Adnan Batuhan Coşkun: Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Methodology,

Conceptualization. **Nermin Olgun:** Supervision. **Nuran Tosun:** Supervision, Methodology. **Hakan Dokumuş:** Validation, Data curation. **Nimet Barna:** Resources, Data curation. **Erhan Elmaoğlu:** Resources, Data curation. **Nurdan Yildirim:** Validation.

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Declaration of competing interest

The authors declare that there are no conflicts of interest associated with this study titled "Development And Psychometric Evaluation of the Life Management Skills Scale For Children with Type 1 Diabetes" None of the authors hold any financial, professional, or personal interests such as employment, consultancies, stock ownership, honoraria, or intellectual property rights that could be perceived as influencing the research process or its outcomes. This study was conducted independently, without any external influence on its design, implementation, data analysis, or interpretation. The research was undertaken solely to contribute to the scientific and clinical understanding of pediatric diabetes care, upholding the highest standards of academic integrity.

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