Development and validation of the hypoglycaemia problem-solving scale for people with diabetes mellitus

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Abstract

Objective: To develop and psychometrically test a new instrument, the hypoglycaemia problem-solving scale (HPSS), which was designed to measure how well people with diabetes mellitus manage their hypoglycaemia-related problems.

Methods: A cross-sectional survey design approach was used to validate the performance assessment instrument. Patients who had a diagnosis of type 1 or type 2 diabetes mellitus for at least 1 year, who were being treated with insulin and who had experienced at least one hypoglycaemic episode within the previous 6 months were eligible for inclusion in the study.

Results: A total of 313 patients were included in the study. The initial draft of the HPSS included 28 items. After exploratory factor analysis, the 24-item HPSS consisted of seven factors: problem-solving perception, detection control, identifying problem attributes, setting problem-solving goals, seeking preventive strategies, evaluating strategies, and immediate management. The Cronbach's α for the total HPSS was 0.83.

Conclusions: The HPSS was verified as being valid and reliable. Future studies should further test and improve the instrument to increase its effectiveness in helping people with diabetes manage their hypoglycaemia-related problems.

Keywords

Problem-solving, diabetes mellitus, hypoglycaemia, scale development

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Introduction

In Taiwan, 1.5 million adult cases of diabetes mellitus were diagnosed, and the condition accounted for 9438 deaths in 2013.[1] A goal of tightly controlling glycaemic levels during diabetes treatment encourages introducing insulin at an earlier stage and using more intensive regimens that may increase the risk of hypoglycaemic episodes and minimize the overall quality of life.[2] Approximately 30%–40% of all patients on insulin regimens experience mild or moderate hypoglycaemic episodes.[3] Hypoglycaemia is a common, potentially avoidable consequence of diabetes treatment and a major barrier to optimizing glycaemic control in people with diabetes.[4] Studies have documented the adverse effects of hypoglycaemia on health-related quality of life and treatment satisfaction including how patients with hypoglycaemia are more affected by diabetes, how they are more influenced by their physical health, impaired glycaemic control, and emotional distress, and how they are more anxious about hypoglycaemia or diabetic complications and tend to increase glycaemic levels occasionally by eating more or injecting less insulin.[2,5–7] Improving patients' self-management ability may mitigate some of the adverse consequences of hypoglycaemia. Enhancing the problem-solving ability of people with hypoglycaemia is essential for determining whether they can administer medications correctly, perform self-monitoring of blood glucose, adjust insulin doses, and know when to ask for assistance. For patients living with diabetes mellitus, symptomatic hypoglycaemia can cause poor blood glucose control and emotional distress; these conditions may affect the ability of patients to cope with hypoglycaemia and may limit their ability to self-manage their diabetes.[2] Healthcare professionals need a better patient-monitoring strategy immediately after a hypoglycaemic event in patients with diabetes.[8]

Problem-solving skills and informed decisions regarding diet, exercise and medications will help patients identify hypoglycaemia.[9] Problem-solving is a core skill for self-management in patients with diabetes, involving education and skills training.[10,11] Problem-solving is a learned self-management behaviour,[12–14] which has long been an effective therapeutic intervention for behavioural change.[15,16] Problem-solving training should help patients manage unpredicted glucose changes.[17] Therefore, assessing the problem-solving ability of patients with hypoglycaemia is important for providing better care and for enhancing patients' ability to self-manage their diabetes.

Diabetes self-management includes skills, behavioural strategies (goal setting, problem-solving), and engagement with emotional concerns.[18,19] Problem-solving refers to a mental process that involves discovering, analysing, and solving problems.[15] The strategies used to solve problems depend on the unique situation. Problem-solving is a series of cognitive and behavioural processes, composed of two dimensions: (i) problem orientation, which encompasses the general beliefs and perceptions that people have toward their own problem-solving ability; and (ii) problem-solving skills, which are the strategies that people employ to solve problems.[20] These problem-solving skills are of four major goal-oriented types: (i) problem definition and formation; (ii) generation of alternative solutions; (iii) decision making; and (iv) solution implementation and verification.[20] The problem-solving ability of patients with diabetes mellitus has been correlated with symptom management.[21]

The Social Problem-Solving Inventory (SPSI) is the most commonly used instrument to assess the problem-solving abilities of patients with chronic illness (pain and cancer).[20,22–25] The Diabetes-specific Problem-Solving Scale (DPSS) was developed

to assess the self-management ability of patients with diabetes in terms of diet, exercise, and medication.[26–28] However, adequate scales do not exist to assess problem-solving in terms of hypoglycaemia. Given the unique problem-solving skills needed by patients with diabetes faced with hypoglycaemic episodes, this study aimed to develop an objective means of quantifying problem solving in patients with hypoglycaemia and to test the validity and reliability of such an instrument.

Patients and methods

Study design

This cross-sectional, descriptive instrument development study was conducted at the Division of Endocrinology and Metabolism, Department of Internal Medicine, Chang Gung Memorial Hospital, Taoyuan City, Taiwan and the Division of Endocrinology and Metabolism, Department of Internal Medicine, Tri-Service General Hospital, Taipei City, Taiwan between August 2013 and July 2014. Face, content, and divergent validity, along with internal consistency, were measured and exploratory factor analysis done to test construct validity as described in detail below.

Ethical approval to conduct this study was provided by the Institutional Review Boards of the Chang Gung Memorial Hospital, Taoyuan City, Taiwan and The Tri-Service General Hospital, Taipei City, Taiwan (no. 102-3440B and no. 1-103-05-043, respectively). All patients provided written informed consent before data collection.

Participants and setting

A purposive sampling method was applied to recruit patients with diabetes mellitus from the metabolic clinics of the Department of Internal Medicine, Division of Endocrinology and Metabolism, Chang Gung Memorial Hospital, Taoyuan City, Taiwan and the Department of Internal Medicine, Division of Endocrinology and Metabolism, Tri-Service General Hospital, Taipei City, Taiwan. Participant eligibility for the study included the following criteria: (i) age > 20 years (because consent from their legal representative or guardian was not required above this age); (ii) physician diagnosis of type 1 (T1DM) or type 2 diabetes mellitus (T2DM) > 1 year based on the diagnostic criteria of the American Diabetes Association;[29] (iii) at least one hypoglycaemic episode within the previous 6 months (hypoglycaemic episode: blood glucose level < 70 mg/dl or mild hypoglycaemic symptoms of shaking, sweating, drowsiness or behavioural changes); and (iv) treatment with an insulin-based medication regimen. Patients were excluded if they had renal failure, blindness, a severe physical handicap, or were pregnant. A chart review was conducted by trained research staff to obtain values for the clinical outcomes of the diagnosis of diabetes mellitus and the most recent outpatient glycosylated haemoglobin (HbA$_{1c}$) level. A history of hypoglycaemic episodes was recorded on the same day as the questionnaire was administered. Staff nurses from the metabolic clinics reviewed patient medical charts to identify potential study participants.

Study procedure

The process of instrument development was conducted using the following three steps: (i) construction of the instrument; (ii) testing the instrument for clarity and feasibility for use; and (iii) assessment of the instrument's validity and reliability.[30] Each step is described in detail below.

Step 1 – construction of the instrument

An instrument was constructed based on to the problem-solving model proposed by

D'Zurilla and Nezu.[20] Satisfactory psycho-metrics have been reported for the original SPSI[31] and its Chinese version.[32] The literature related to problem solving in people with diabetes mellitus was comprehensively reviewed by searching the MEDLINE®, Cumulative Index to Nursing and Allied Health Literature (CINAHL®), and ProQuest databases.[13,16,17,27,31,33] Initially, eight interview questions were asked of 18 people with hypoglycaemia. Their responses were used to modify the 28 inventory items. Prior clinical experience, as published in a hypoglycaemia-related qualitative study, was also used to inform construction of the instrument.[2]

Step 2 – testing for clarity and feasibility for use

The initial draft of the hypoglycaemia problem-solving scale (HPSS) was constructed and rated by a multidisciplinary group of 11 experts in metabolism, nutrition, healthcare and psychology (see Acknowledgements for details). The experts evaluated the HPSS for content validity. All experts (i) assessed the relevance of the included items and the representativeness of the identified constructs, and (ii) suggested revisions to wording, sequencing, and response alternatives to items.

The initial HPSS consisting of 28 items was administered. Participants used a 5-point Likert-type scale ranging from 0 to 4 to rate the applicability of each item as 'not at all true of me' to 'extremely true of me' according to their thoughts or behaviours during a hypoglycaemic episode, with higher scores indicating greater levels of problem-solving ability. From these, items were eliminated that participants reported as confusing or that during analysis of the psychometric properties were found to reduce the internal consistency of the sub-scales. The experts used the Content Validity Index (CVI) to evaluate the level of agreement, which was defined as the sum score of the CVI for each item as divided by the number of items. The CVI for the initial 28-item scale was 0.88. In a pilot study, the recruited participants ($n = 30$) agreed on the face validity of the developed HPSS, finding it easy to read and comprehend.

Step 3 – assessment of validity and reliability

The correlation between the items and the dimensions, applicability, and clarity of the content was examined by the three authors. The scale items were tested and analysed, and the questionnaires were distributed to all study participants. The construct validity of the HPSS subscale was determined through factor analysis. Cronbach's α was calculated to demonstrate the subscale's consistency, and the test–retest reliability over a 2-week interval was calculated to demonstrate its stability. An item analysis was conducted to determine how well each individual item related to other items on the scale, using a corrected item-total correlation of between 0.47 and 0.89 with a correlation over 0.40 as the cut-off to indicate the homogeneity of the item to the overall scale.[34]

Statistical analyses

The reliability and validity of the HPSS were examined. Cronbach's α was used to determine the internal consistency of the scale, and test–retest reliability was performed to examine the consistency and reliability of the scale. Exploratory factor analysis, specifically principal component factor analysis, was performed to extract factors with eigenvalues >1. For the rotation method, varimax, a form of orthogonal rotation, was adopted to determine factor loadings, and a factor loading of >0.5 was selected as the standard according to the concept of practical significance.[35] The Kaiser–Meyer–Olkin (KMO) measure and the Bartlett's test

of sphericity were performed to measure sampling adequacy and test the appropriateness of the factor model. The KMO measures of the scale were between 0.77 and 0.92, and the Bartlett's test of sphericity was significant, indicating that the data were appropriate for factor analysis. Data were presented as mean $\pm$ SD, range or n of patients (%). All statistical analyses were performed using the IBM SPSS Statistics for Windows® package, Version 19.0 (IBM, Armonk, NY, USA). A P-value < 0.05 were considered statistically significant.

Results

This study enrolled three separate groups of patients. Step 1 of the study included 10 female and eight male patients with diabetes (mean $\pm$ SD age 47.50 ± 3.01 years; range 21–64 years); of these, 11 had T2DM and seven had T1DM. Step 2 included 16 female and 14 male patients with diabetes (mean $\pm$ SD age 56.15 ± 4.75 years; range 20–73 years); of these, 17 had T2DM and 13 had T1DM. The main part of the study enrolled 313 patients with diabetes mellitus (54.6% women; $n = 171$) with a mean $\pm$ SD age of 55.49 ± 16.84 years (range 21–89 years) to complete step 3 of the testing of the HPSS (Table 1). Their mean $\pm$ SD duration of insulin therapy was 7.52 ± 7.58 years and their mean $\pm$ SD number of hypoglycaemic episodes in the previous 6 months was 9.5 ± 15.02 (range 2–144). Most participants (237 of 313; 75.7%) were diagnosed with type 2 diabetes, nearly half (147 of 313; 47.0%) of the participants had an education level lower than high school and 70 of 313 (22.4%) of the study participants who had recorded data had HbA$_{1c}$ levels $\leq$ 7%.

In terms of validity testing, the construct validity of the 28-item scale was evaluated using exploratory factor analyses, categories were extracted and four items from the setting problem-solving goals, seeking preventive strategies, and evaluating strategies

Table 1. Demographic and clinical characteristics of patients ($n = 313$) with diabetes mellitus who participated in a study to evaluate a new hypoglycaemia problem-solving scale.

Characteristic	Patient group $n = 313$
Age, years	55.49 ± 16.84
Age range, years	21–89
Age categories, years	
20–39	70 (22.4)
40–59	102 (32.6)
$\geq$60	141 (45.0)
Sex	
Male	142 (45.4)
Female	171 (54.6)
Marital status	
Unmarried	63 (20.1)
Married	250 (79.9)
Educational level	
Completed primary or lower	91 (29.1)
Completed secondary grade 9	56 (17.9)
Senior high school	73 (23.3)
College/university or above	93 (29.7)
Religious status	
No	70 (22.4)
Yes	243 (77.6)
Employment status	
Unemployed	188 (60.1)
Working	125 (39.9)
Type of diabetes mellitus	
Type 1	76 (24.3)
Type 2	237 (75.7)
Duration of insulin treatment, years	7.52 ± 7.58
Range	0.20–40.00
<1	18 (5.8)
1–5	147 (47.0)
>5–10	79 (25.2)
>10	69 (22.0)
Diabetes medication regimen	
Insulin	206 (65.8)
Oral medication and insulin	107 (34.2)
Hospital admission for hypoglycaemic episodes in the previous 6 months	
No	289 (92.3)
Yes	24 (7.7)

(continued)

Table 1. Continued.

Characteristic	Patient group $n = 313$
Frequency of hypoglycaemic episodes in the previous 6 months (range)	9.50 ± 15.02 (2–144)
≤3	157 (50.2)
4–12	101 (32.3)
≥13	55 (17.6)
HbA$_{1c}$ level, % (range)	8.56 ± 1.83 (5.6–18.3)
≤6.5	26 (8.3)
6.6–7.0	44 (14.1)
7.1–8.0	74 (23.6)
>8.0	169 (54.0)

Data presented as mean ± SD, range or n of patients (%). HbA$_{1c}$, glycosylated haemoglobin.

factors were deleted because their corresponding loadings were lower than 0.50. The exploratory factor analysis revealed a seven-factor solution (i.e. factor 7 in which all seven factors were taken into account) with an explained variance of 73.14% that had eigenvalues > 1 (Table 2). The scree plot clearly showed a seven-factor solution to be appropriate for picking factors. The HPSS had clear factor loadings with items loaded in each factor as expected. Several items on the factor loaded equally or even higher in the problem-solving perception, detection control, and setting problem-solving goals factors. The problem-solving perception factor explained most of the variance (46.32%) between the seven factors (Table 2). The validity testing demonstrated that a seven-factor solution was determined after varimax rotation using principal component analysis. The seven factors were labelled as follows: problem-solving perception, detection control, identifying problem attributes, setting the problem-solving goals, seeking preventive strategies, evaluating strategies, and immediate management.

In this present study, the reliability of the final 24-item scale was examined using internal consistency and test–retest reliability testing. As shown in Table 2, the Cronbach's α for the total HPSS was 0.83, with α coefficients for the seven factors ranging from 0.70 to 0.86. Corrected item-total correlations of the 24 items ranged 0.403–0.761. To assess the test–retest reliability, all participants were retested 2 weeks after the initial test. The correlation between the responses of the 313 study participants was 0.81.

Discussion

The results from the current study were primarily based on self-reported symptomatic hypoglycaemia and hypoglycaemic episodes that were corroborated by a blood glucose measurement. Nevertheless, the symptoms experienced were inconsistent between individual patients, which complicated efforts to determine the cause of the hypoglycaemia, particularly in patients with T1DM.[36] These results emphasize the importance of assisting patients in clarifying the process of hypoglycaemic events and encouraging them to practice proactive self-management.

The aim of this study was to develop and test the validity and reliability of the HPSS for people with diabetes mellitus. The findings show a strong factor structure that corresponded logically with the theory and concept of the social problem-solving model developed by D'Zurilla and Goldfried[37] and D'Zurilla and Nezu.[20] Various diabetes problem-solving scales are currently available;[20,26–28] however, this is the first study to develop and examine the psychometrics of the hypoglycaemia-specific HPSS. The instrument showed good internal consistency reliability. The overall test–retest reliability was 0.81, suggesting that the HPSS was generally stable.

The HPSS demonstrated satisfactory validity in measuring problem solving in patients with T1DM or T2DM who

Table 2. Results of the principal component analysis that evaluated a new hypoglycaemia problem-solving scale in patients ($n = 313$) with diabetes mellitus who had experienced hypoglycaemic episodes in the previous 6 months.

Factors	Item number/item content	Factor loading							Corrected item-total correlation
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	
Problem-solving perception	1R. When my attempt to prevent hypoglycaemia fails, I become discouraged and cannot think clearly.	0.851	0.055	0.011	0.031	−0.046	−0.006	−0.111	0.634
	2R. The difficulty I encounter in preventing hypoglycaemia makes me feel depressed or angry.	0.803	−0.059	−0.140	0.081	−0.160	−0.038	−0.077	0.652
	3R. I often worry about how to prevent hypoglycaemia but have not taken any action to address it.	0.685	−0.013	−0.018	0.463	0.080	0.169	0.073	0.511
	4R. When I cannot prevent hypoglycaemia I feel stupid.	0.656	−0.217	−0.139	0.266	0.133	−0.088	0.136	0.566
Detection control	5. I know how to handle hypoglycaemia.	0.251	0.849	0.144	0.164	0.065	0.006	−0.214	0.761
	6. I do not give up when my initial attempt to effectively prevent hypoglycaemia fails, and I believe that I will ultimately find the best approach to solve it.	0.093	0.823	−0.050	0.162	−0.138	−0.061	0.194	0.703
Identifying problem attributes	7. When hypoglycaemia occurs, I examine for any event that may contribute to the occurrence of hypoglycaemia.	−0.112	0.177	0.768	0.103	−0.053	0.007	0.158	0.663
	8. When my efforts to prevent hypoglycaemia are ineffective, I return to where I made the mistakes and attempt other methods.	−0.044	0.269	0.745	0.040	0.013	−0.080	0.139	0.621
	9. When I am not satisfied with the results of preventing hypoglycaemia, I will find a better method and attempt it again.	−0.087	0.351	0.727	−0.199	0.208	−0.029	0.125	0.623

(continued)

Table 2. Continued.

Factors	Item number/item content	Factor loading							Corrected item-total correlation
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	
	10. When my attempt to prevent hypoglycaemia fails, I will analyse and identify my mistake.	−0.063	0.090	0.633	−0.112	0.325	−0.109	0.087	0.497
	11. To prevent hypoglycaemia, I attempt to learn as much information on the occurrence of hypoglycaemia as possible.	0.003	0.010	0.569	−0.042	0.255	−0.039	0.066	0.413
Setting problem-solving goals	12. When I attempt to manage hypo-glycaemia, I remember all the goals that I have set.	0.073	0.108	0.460	0.879	0.019	−0.114	0.081	0.605
	13. When attempting to prevent hypo-glycaemia, I set a goal so that I know what I need to achieve.	0.070	0.124	0.452	0.805	−0.122	0.235	−0.019	0.613
	14. I will attempt to prevent hypogly-caemia and achieve all the goals I have set.	−0.006	0.036	0.493	0.788	−0.115	0.228	−0.012	0.586
Seeking preventive strategies	15. I usually speak with my family when I am attempting to prevent hypoglycaemia.	−0.019	0.099	0.039	0.073	0.758	−0.011	−0.060	0.583
	16. I speak with health professionals when hypoglycaemia prevention becomes complex and difficult.	−0.005	0.076	0.025	0.059	0.744	0.098	−0.048	0.660
	17. When hypoglycaemia prevention becomes complex and difficult, I seek help from friends or pay close attention to my physical changes.	−0.065	0.080	0.180	0.065	0.713	−0.202	−0.005	0.692
	18. When hypoglycaemia prevention becomes complex and difficult, I learn how to prevent hypoglycaemia from people who have the same problem as mine.	0.044	0.132	0.031	0.070	0.637	−0.295	0.077	0.558

Table 2. Continued.

Factors	Item number/item content	Factor loading							Corrected item-total correlation
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	
Evaluating strategies	19. After implementing the method for hypoglycaemia prevention, I evaluate the effectiveness of this method in preventing hypoglycaemia.	0.107	0.002	−0.038	0.393	0.097	0.794	0.074	0.617
	20. When preventing hypoglycaemia, I attempt my own method to increase the chance of success.	0.063	0.018	−0.020	0.084	−0.060	0.693	0.052	0.485
	21. When determining the best hypo-glycaemia prevention method, I attempt to predict the possible outcome.	0.107	0.002	−0.038	0.393	0.097	0.619	0.071	0.564
	22. I understand hypoglycaemia pre-vention is one of the problems that must be resolved in diabetic care.	0.218	0.031	−0.028	0.370	0.077	0.554	0.180	0.403
Immediate management	23R. When I experience hypoglycaemia, I usually snack, stop all activity, or stop insulin injections, and do not think about prevention.	0.114	0.027	−0.135	0.129	−0.032	0.114	0.781	0.531
	24R. To me, hypoglycaemia is an easily manageable problem and does not need to be a concern.	0.208	0.199	0.186	−0.046	−0.008	0.208	0.768	0.643
Eigenvalue		2.29	1.40	3.10	3.06	2.56	2.15	1.38	
Total variance explained, %		46.32	55.64	61.65	65.94	68.65	70.98	73.14	
Cronbach's α		0.73	0.71	0.86	0.82	0.81	0.73	0.70	0.83 (24 items)

Items marked with 'R' are negatively worded items and are reversely scored.

experienced hypoglycaemia. The scale is easily administered in less than 20 minutes. Instruments used with adult or elderly patients should be concise and brief because of the relatively limited attention span of the participants as well as the many demands on their time when such patients are in the healthcare setting. Although the present study included metabolic outpatients from three geographical areas, the HPSS should be tested in wider geographical areas. Moreover, although the severity of hypoglycaemia differs between inpatients and outpatients,[4] the HPSS can be applied in the future to inpatients with hypoglycaemia. The HPSS involves multiple dimensions that reflect the process of problem-solving for patients with T1DM or T2DM who experience hypoglycaemia. The seven factors involve perceptions of competencies and attitudes when facing hypoglycaemic episodes and also highlight the skill of problem-solving. Problem-solving is defined as a self-directed cognitive-behavioural process by which people attempt to cope with a difficult situation.[37] The model provides a structure for understanding the factors that influence how a person perceives a problem, the relationship between the causes of the problem and the generation of a decision, the choice of behaviours, and the influence of personal beliefs on the problem-solving needed for self-management.[38] However, construct validation is an ongoing process; further testing and expansion of the use of this instrument for people with diabetes mellitus are recommended.

The current results of the exploratory factor analysis showed generally clear factor structures across the seven factors. The highest level of variance was found in the factor 'problem-solving perception' (46.32%). Although this factor had a very clear factor structure with higher factor loadings in each item, some items were moderately loaded across the 'identifying problem attributes' and 'evaluating strategies' factors. These results suggest that patients may need individualized teaching strategies to clarify the causes of hypoglycaemia and evaluate the prevention strategies they may want to use. Participants who cannot identify hypoglycaemia may experience conflict between their seeking coping strategies and their evaluation strategies. Similarly, the model proposed by D'Zurilla and Nezu[20] has four major problem-solving skills: (i) problem definition; (ii) generation of alternative solutions; (iii) decision making; and (iv) solution implementation and verification. Each of these skilled tasks is assumed to contribute uniquely to the discovery or invention of effective solutions, or adaptive ways of coping with particular problematic situations. Diabetes self-management will always be recognized to have some element of trail-and-error or learn-by-doing as patients make ongoing lifestyle adjustments to maintain optimal blood glucose levels. However, healthcare professionals cannot prepare patients to identify problem attributes and generate preventive strategies before they experience a hypoglycaemic event; such strategies are more likely to generate negative attitudes in patients than develop skill sets. Thus, helping patients to identify the causes of hypoglycaemia may increase their skills in developing problem-solving strategies and evaluating problems. In the future, the HPSS can provide healthcare professionals with a rapid means of inspecting the problem-solving ability of patients with hypoglycaemia, enabling them to identify patients who require particular assistance with problem-solving skills and subsequently assisting them in providing suitable training in problem solving.

This present study had several limitations. First, the instrument was developed specifically for patients with diabetes mellitus who experience hypoglycaemia. Therefore, applicability to other symptom-related management is limited. Secondly,

the psychometric characteristics of the HPSS should be tested in broader geographical areas to further confirm its validity and reliability. A longitudinal study to assess the predictive validity of the HPSS is also recommended. Thirdly, the discriminant validity and convergent validity were not measured. These may be determined in the future in order to evaluate their effect on problem solving in patients with hypoglycaemia.

In conclusion, providing diabetes education involves not only clinical skills but also skills in understanding the patient's experience. The HPSS showed satisfactory validity and reliability. This scale may be a helpful reference for healthcare providers to understand the hypoglycaemia-related problem-solving ability of patients with diabetes mellitus and plan effective problem-solving strategies to strengthen those abilities.

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Declaration of conflicting interest

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