Patient Preference and Adherence

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ORIGINAL RESEARCH

Validation of the Traditional Chinese Version of the Belief About Medicines Questionnaire-Specific Among Adults with Type 2 Diabetes in Taiwan

Yen-Ming Huang[1–3], Yu-Meng Yang[1], Tzu Wang[2], Yunn-Fang Ho[1,2], Hsun-Yu Chan[4]

[1]Graduate Institute of Clinical Pharmacy, College of Medicine, National Taiwan University, Taipei City, 100025, Taiwan; [2]School of Pharmacy, College of Medicine, National Taiwan University, Taipei City, 100025, Taiwan; [3]Department of Pharmacy, National Taiwan University Hospital, Taipei City, 100229, Taiwan; [4]Department of Industrial Education, National Taiwan Normal University, Taipei City, 106308, Taiwan

Correspondence: Yen-Ming Huang, Graduate Institute of Clinical Pharmacy, College of Medicine, National Taiwan University, Taipei City, 100025, Taiwan, Tel +886-2-3366-8784, Email yenming927@ntu.edu.tw; Hsun-Yu Chan, Department of Industrial Education, National Taiwan Normal University, Taipei City, 106308, Taiwan, Tel +886-2-7749-3550, Email hsunyuchan@ntnu.edu.tw

Background: Understanding personal beliefs about medications is an effective approach to improving adherence. A validated tool is essential for identifying these beliefs in routine clinical practice.

Objective: To validate the factor structure and reliability of the Traditional Chinese version of the Beliefs about Medicines Questionnaire-Specific (BMQ-Specific) among individuals with type 2 diabetes (T2D) in Taiwan.

Methods: The original 10-item BMQ-Specific was translated into Traditional Chinese using a forward-backward translation process and reviewed by four experts in pharmacy practice and educational psychology. A cross-sectional study was conducted among adults with T2D who were using diabetes medications. Participants were recruited from five community pharmacies in Taiwan between June 2023 and May 2024. Internal consistency was assessed using McDonald's omega (ω). Construct validity was examined through exploratory factor analysis, and criterion validity was determined by exploring associations between concern beliefs, medication adherence, and glycemic control, as measured by A1C levels.

Results: Two hundred and seventy-three patients participated in the study. Exploratory factor analysis confirmed a two-factor structure consistent with the original English version, comprising the Specific-Necessity and Specific-Concerns subscales. All items loaded onto their respective subscales. The internal consistency reliability of the instrument was acceptable, with McDonald's ω values of 0.785 for both the BMQ-Specific Necessity and BMQ-Specific Concerns subscales. These satisfactory properties were further supported by predictive validity data, which demonstrated the impact of treatment beliefs on adherence levels. The BMQ-Specific Concerns subscale showed a positive correlation with higher barriers to medication-taking ($r = 0.270$, $p < 0.001$) and poorer glycemic control ($r = 0.130$, $p = 0.032$).

Conclusion: The Traditional Chinese BMQ-Specific is a reliable and valid tool for assessing medication beliefs among patients with T2D in Taiwan. It can be effectively incorporated into clinical practice to support patient-provider communication and improve medication adherence.

Keywords: adherence, belief, diabetes, medication, Taiwan, traditional Chinese, validation

Introduction

Despite advancements in antidiabetic therapies, over half of the global population with type 2 diabetes (T2D) still struggles to achieve optimal glycemic control.[1,2] Although pharmacological treatments are among the most effective strategies for diabetes management,[3] less than half of patients adhere to their prescribed medication regimens.[4] Numerous obstacles prevent many individuals with T2D from following their medication plans,[5] leading to increased costs, including more frequent hospitalizations and emergency visits as well as higher expenses for acute and outpatient care. This poor adherence ultimately results in compromised health outcomes and reduced quality of life.[6] In Taiwan, more than 40% of patients do not take their medications as prescribed,[7,8] and around 30% have uncontrolled glycemic

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levels in spite of diabetes treatment.[9] Recently, it has been estimated that poor medication adherence accounts for approximately 50% of treatment failures, contributing significantly to morbidity and mortality.[3] Globally, non-adherence to medications results in an unnecessary annual expenditure of between US$100 billion and 300 billion, representing a substantial 2–6% of global healthcare spending.[10]

A variety of factors have been identified as being associated with medication adherence, including age, gender, race, health beliefs, medication costs, copayments, insurance coverage, and regimen complexity.[11,12] However, not all of these factors can be effectively addressed within the scope of clinical practice. We are unable to alter patients' sociodemographic backgrounds, and improving access to medications often requires policy changes or financial assistance.[13] These individual- and system-level factors are either unmodifiable or cannot be changed quickly. For example, altering an individual's age, gender, or education level is not feasible. While healthcare professionals may offer financial support for affordable healthcare, changing a person's household income is more challenging. Empirical research consistently shows that there are specific and prospective links between positive psychological states as well as health behaviors and outcomes.[14] Among the modifiable components, psychosocial factors can be effectively addressed in routine patient care.[15] Positive psychological states, which influence factors such as motivation, self-regulation, and beliefs, can significantly enhance participation in health-promoting behaviors (eg, medication-taking), particularly in the management of T2D.[16]

Patients' beliefs and attitudes toward disease treatment have been shown to significantly influence medication adherence.[11,12] In fact, beliefs about medications are stronger predictors of adherence than sociodemographic or clinical factors.[13,17] Low adherence rates have been consistently linked to negative beliefs among patients in studies on chronic diseases like diabetes[18] and hypertension.[19] In particular, patients with T2D often experience mental distress, which may prevent them from having adequate trust in the medication.[20–22] Understanding and addressing patients' health beliefs is essential for enhancing adherence and, consequently, improving glycemic control among individuals with T2D.[23] To maximize treatment outcomes, several rigorous reviews recommend focusing on modifiable factors, such as patients' beliefs, rather than unchangeable demographic variables, as a way to improve medication-taking behaviors and health outcomes.[11,12]

Patients hold beliefs about their medications, encompassing not only the perceived effects and side effects but also the rationale behind the prescriptions provided by healthcare professionals.[24] These beliefs shape patients' attitudes, whether positive or negative, toward their medications and influence their adherence behaviors.[25] The Necessity-Concerns Framework (NCF), developed by Horne, provides a theoretical foundation for understanding these beliefs and their role in adherence.[13,25] This framework posits that medication adherence is driven by the balance between necessity and concern beliefs. Necessity beliefs reflect patients' perceptions of how essential their medications are for managing their condition. Concern beliefs capture worries about potential adverse effects, dependence, or long-term harm.[13,24] According to this model, stronger necessity beliefs support adherence, whereas heightened concerns may lead to intentional non-adherence. Given the established role of the NCF in explaining medication adherence across various conditions, it serves as a suitable model for assessing beliefs about medications in this study. The Beliefs about Medicines Questionnaire-Specific (BMQ-Specific) was developed based on the NCF to assess patients' necessity and concern beliefs regarding their prescribed medications.[26] This questionnaire elucidates the relative impact of beliefs about the benefits versus the risks of medication.[24,25] It specifically measures patients' concerns about their own medications and their perceived necessity to take them.

Over the past two decades, the BMQ-Specific has been extensively applied to assess patients' beliefs about medications across various medical conditions, including acute coronary syndrome,[27] diabetes,[18,28–30] epilepsy,[31] HIV,[30] hypertension,[32] rheumatoid arthritis,[33] and severe mental disorders.[34,35] The questionnaire, originally developed in the UK,[13] has been translated and validated in many languages, such as French,[30] Malay,[29,32] Spanish,[28,34] Swedish,[31,35] and Vietnamese.[27] In Taiwan, patients often hold negative perceptions of medication, viewing it as inherently harmful or addictive and something to be avoided.[36] These beliefs are shaped in part by the historical and cultural integration of traditional Chinese medicine (TCM) with Western pharmacotherapy.[37] Many individuals use herbal remedies and TCM practices either as complementary approaches or as alternatives to prescribed medications. This duality may influence their beliefs about the efficacy and safety of medications in ways that differ from Western

perspectives.[38] Furthermore, a cultural stigma associated with medication dependence may lead some individuals to fear becoming "addicted" or overly reliant on pharmaceuticals, thereby affecting their adherence.[39] Such culturally rooted perspectives underscore the necessity of validating instruments like the BMQ-Specific within the Taiwanese context to ensure they accurately reflect local perspectives on medication use.

Understanding patients' beliefs about medications is a stepping stone for identifying negative beliefs that may hinder medication adherence. This allows healthcare professionals to intervene early and address these challenges. Given the influence of cultural context on how patients interpret and respond to questionnaire items, cross-cultural validation is critical for ensuring the relevance and effectiveness of assessment tools in a specific local context.[40] Despite the recognized utility of the BMQ-Specific internationally, few validated tools are available in Taiwan for assessing beliefs about medication use. This gap is particularly pronounced in the context of managing T2D, where adherence remains a major challenge. To address this need, the present study aimed to translate the BMQ-Specific into Traditional Chinese and to evaluate its validity among individuals with T2D in Taiwan. We examined the factor structure and internal consistency of the translated version and assessed its criterion validity by investigating associations between medication beliefs, adherence, and glycemic control.

Methods

Study Design and Setting

This cross-sectional study was conducted in two phases, beginning with translation followed by validation. Before conducting this study, we obtained permission from the original author to use this instrument.[26] The BMQ-Specific was first translated into Traditional Chinese by the research team and then validated for its psychometric properties by administering it to eligible participants through face-to-face interviews at five community pharmacies in northern and central Taiwan between June 2023 and May 2024. These pharmacies collaborate with National Taiwan University for experiential courses in community pharmacy practice,[41] where established pharmacist-patient rapport facilitated participant recruitment.

Translation Procedure of the BMQ-Specific in Traditional Chinese

The BMQ-Specific was translated into Traditional Chinese in accordance with the Principles of Good Practice for the Translation and Cultural Adaptation Process for Patient-Reported Outcomes Measures (Figure 1). [42] First, two independent translators, who were native speakers of Chinese and proficient in English and practicing pharmacists in Taiwan, conducted forward translation of the original English version of the BMQ-Specific into Traditional Chinese. A bilingual pharmacist with a background in educational psychology then performed a back-translation into English. Four experts specializing in pharmacy practice and educational psychology compared the back-translation with the original English BMQ-Specific, identifying only minor discrepancies, thereby ensuring content validity. The final version was subsequently tested for face validity by administering it to 10 patients with T2D, who reported no issues with understanding or clarity in completing the questionnaire. Data from these 10 pilot patients were excluded from the study analysis. The research team then proofread the translated BMQ-Specific before distributing it to the study participants.

Validation Procedure of the BMQ-Specific in Traditional Chinese

Participant Recruitment

Two trained researchers oversaw participant recruitment and data collection. We used convenience sampling to recruit eligible individuals who were 18 years or older, diagnosed with T2D, prescribed at least one oral medication for diabetes management, and proficient in reading Traditional Chinese. The National Health Insurance MediCloud System was used to verify participants' diagnosis (ie, International Classification of Diseases, Tenth Revision, Clinical Modification diagnosis code of E11.XXX) and their diabetes medications. Patients without active electronic health records (EHRs), those unable to understand Traditional Chinese, or those with cognitive disabilities, such as dementia or Alzheimer's disease, were excluded.

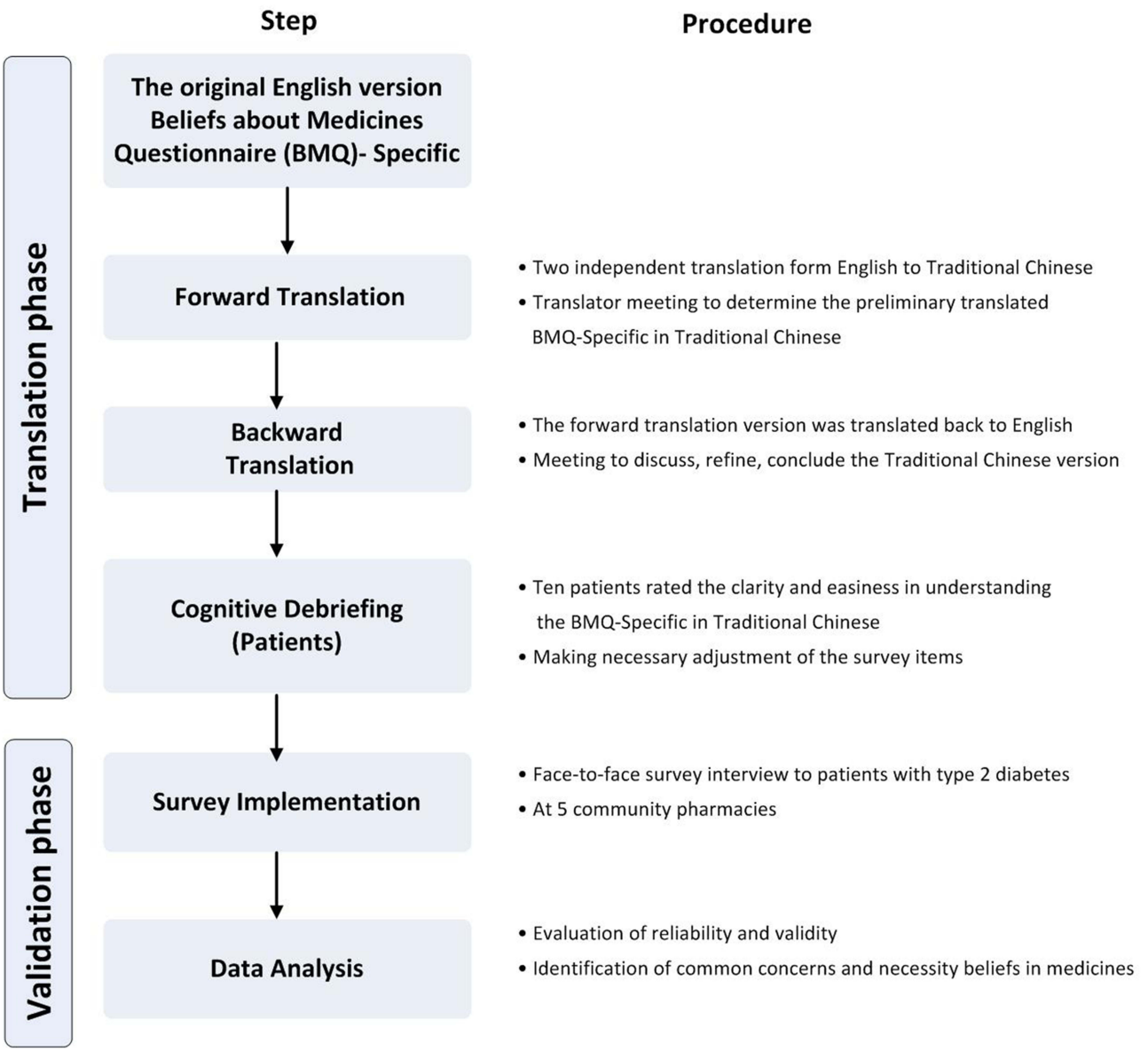

Figure 1 Overview of translation and validation process of the BMQ-Specific in Traditional Chinese.

At the research sites, pharmacists screened potential participants who were refilling prescriptions and referred eligible individuals to the trained researcher. The trained researcher then accompanied eligible patients to a private area, provided study details, distributed information sheets, and allowed 5–10 minutes for review. After fully explaining the study, participants were invited to sign the informed consent form and were given a copy of the blank consent form for their records. The researchers then administered the survey and collected the patients' clinical data through the MediCloud System. This paper-and-pencil survey consisted of 26 items and typically took 5–10 minutes to complete. Upon completing the survey, participants received NT$200 (approximately US$7) in cash as compensation.

There is no consensus on the optimal sample size for exploratory factor analysis (EFA). However, previous recommendations suggest that an adequate sample size for factor analysis requires at least 10 cases per variable, with a minimum of 200 subjects generally considered sufficient for assessing the psychometric properties of instruments that measure social constructs.[43] Since the BMQ-Specific consists of 10 items, this recommendation led to a minimum required sample size of 200 for conducting EFA.

Measures

The self-reported survey collected patient information in three sections, which included the translated 10-item BMQ-Specific,[26] 8-item medication-taking subscale of the Adherence to Refills and Medications Scale in Traditional Chinese (ChARMS-T),[8] and 8 items on sociodemographic and clinical backgrounds.

The Beliefs About Medicines Questionnaire-Specific

The BMQ-Specific includes 10 items to assess two key concepts, covering patients' beliefs about the necessity of prescribed medication for managing their disease (5 items) and their concerns about potential adverse effects (5 items).[26] Respondents rate their agreement with each statement on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The scores for individual items within each scale are summed, resulting in total scores for the Necessity and Concerns scales ranging from 5 to 25. A higher score on the Necessity scale reflects stronger beliefs in the importance of the treatment, while a higher score on the Concerns scale indicates greater apprehensions about the medication.

Following the NCF proposed by Horne and colleagues, the difference between the Necessity and Concerns subscale scores was calculated for each patient to assess their perceived benefit-cost analysis of the medication.[13] This necessity-concerns differential, ranging from −20 to 20, represents the balance that each patient perceives between the costs (concerns) and benefits (necessity beliefs) of their treatment.

The Traditional Chinese Version of Adherence to Refills and Medications Scale

The ChARMS-T was used to assess participants' self-reported adherence to prescribed medications for diabetes management. This scale has been cross-validated with objective pharmacy refill data and showed a strong agreement with the objective refill measure, proportion of days covered. We focused on the 8-item medication-taking subscale of the ChARMS-T to evaluate barriers to medication intake, which are closely linked to individuals' beliefs.[8] This subscale has shown strong construct validity and high internal consistency, with a McDonald's omega (ω) of 0.841, among individuals with T2D.[8] Each item is rated on a 4-point Likert scale (1 = none of the time, 2 = some of the time, 3 = most of the time, and 4 = all of the time). The total score for these 8 items ranges from 8 to 32, with higher scores indicating greater barriers to medication adherence. Scores can be analyzed as a continuous measure or dichotomized with a cutoff of 8 or higher.

Sociodemographic and Clinical Backgrounds

Sociodemographic data collected included age, gender, education level, and annual household income. Clinical information consisted of the number of prescribed diabetes medications, the medication regimen complexity index (MRCI),[44] duration of T2D diagnosis, and diabetes control status. Diabetes medications were verified by cross-referencing participants' medication histories in EHRs. Additionally, patients' diabetes control was assessed using their most recent A1C level from the past six months, as recorded in their EHRs. Although the ideal interval for A1C monitoring is three months, the frequency of measurements in this study followed the guidelines of Taiwan's National Health Insurance system for patients with stable diabetes. Lower A1C values indicate better glycemic control, with values of 7.0% or below recommended for individuals managing diabetes.[45]

Statistical Analysis

Descriptive statistics were used to summarize the characteristics of the study participants. For continuous variables, the mean and standard deviation (SD) were reported, while categorical variables were presented as counts and percentages. Scale reliability was evaluated using McDonald's ω, with values of 0.7 or higher indicating acceptable or good internal consistency.[46] McDonald's ω is often preferred over Cronbach's alpha, particularly for scales measuring multiple dimensions or constructs, as it provides a more accurate estimate of reliability when the assumptions of Cronbach's alpha are not met.[47]

To validate the Traditional Chinese version of the BMQ-Specific, we evaluated both construct validity and criterion validity. Construct validity was assessed through EFA to identify the minimum number of underlying constructs that

could account for the observed covariation among the measured variables.[48] Initially, we examined the correlation matrix of all ten items and calculated the mean inter-item correlation to gauge the strength of associations between items. Bartlett's test of sphericity was applied to confirm that the correlation matrix was not random, and the Kaiser-Meyer-Olkin (KMO) statistic was required to exceed 0.50.[49] Given our aim to uncover the underlying factor structure, common factor analysis was chosen instead of principal components analysis.[50] Factor extraction was performed using the iterated maximum likelihood method, with initial communalities estimated via squared multiple correlations.[51] The number of factors to retain was determined using both the eigenvalue-greater-than-one rule and visual inspection of the scree plot. Assuming that the factors would be correlated, we applied oblimin rotation to evaluate whether the items clustered meaningfully onto latent constructs. Items with a factor loading of 0.40 or greater were considered to adequately measure a factor, while items loading at 0.40 or greater on two factors were identified as cross-loaders.[43]

Criterion validity was evaluated by examining the extent to which the translated BMQ-Specific aligns with theoretically related constructs. This was carried out using the medication-taking subscale of the ChARMS-T and A1C values as indicators. Previous research suggests that concerns about medications, rather than beliefs about their necessity, are more likely to influence patients' medication-taking behaviors and, consequently, their health outcomes.[18,52] Therefore, we hypothesized that higher levels of concerns about medications would be positively correlated with greater challenges in medication adherence, as measured by the ChARMS-T, and with higher A1C levels. Pearson correlation coefficients were used to test these hypotheses.

Since the translated BMQ-Specific scale had no missing data in this sample, imputation methods were not required. Descriptive statistics and correlation matrix analyses were performed using SPSS version 28, while McDonald's ω and EFA were conducted with JASP version 0.18.3. The significance level was set at a two-sided $p < 0.05$.

Ethical Considerations

The study protocol was approved by the Research Ethics Committee at National Taiwan University Hospital (202303022RIND). Participants were informed about the study purpose and assured that their participation would remain anonymous. Written consent was obtained from each participant before enrollment. The collected data were encrypted and protected with a password in line with institutional standards. All procedures adhered to the principles outlined in the Declaration of Helsinki.

Results

Demographic and Clinical Characteristics of the Participants

A total of 315 patients with T2D were invited to participate, with 273 (86.7%) enrolling and completing the survey. The majority (n = 142, 52.0%) of the participants were female aged between 28 to 94 years, with a mean age of 67.72 years (SD = 10.54). Nearly half (n = 131, 48.0%) had attained some college education or higher, and 51.3% (n = 140) reported an annual household income exceeding NT$660,000, which fell within the second quintile of annual household income in Taiwan. On average, participants had been diagnosed with T2D for 11.81 years (SD = 9.19) and were prescribed 1.96 ± 0.98 medications for diabetes management, with a mean MRCI of 6.37 (SD = 3.71). Twenty-one (7.7%) participants used both oral hypoglycemic agents and injectable medications for diabetes control. The mean A1C level among participants was 6.91% (range = 5.0–13.1; SD = 0.88) (Table 1). The average time interval between the most recent A1C test and survey completion was 55.69 ± 36.58 days (range = 1–165).

Factor Structure of the Beliefs About Medicines Questionnaire in Traditional Chinese Version

Bartlett's test of sphericity confirmed that the correlation matrix was not random ($\chi^2(45) = 824.493$, $p < 0.001$), and the KMO statistic was 0.745, which exceeded the minimum threshold for conducting EFA. Thus, the correlation matrix was deemed suitable for EFA (Table 2). Following the eigenvalue-greater-than-one rule, the EFA suggested retaining a two-factor solution. These two factors distinctly represented the dimensions of necessity beliefs (factor 1) and concern beliefs (factor 2). Each factor was saliently loaded by five items, and after rotation, the two factors together accounted for

Table 1 Demographic Background and Clinical Characteristics of the Participants (n = 273)

Variables	n (%)	Mean (S.D.)
Age (years)		67.72 (10.54)
Gender		
Female	142 (52.0)	
Male	131 (48.0)	
Education level		
Elementary school	38 (13.9)	
Junior high school	30 (11.0)	
High school	74 (27.1)	
Junior college	54 (19.8)	
Bachelor's degree or a 4-year college degree	55 (20.1)	
Master's degree or above	22 (8.1)	
Annual household income (in New Taiwan dollars, NTD)		
Less than 350,000	76 (27.8)	
350,001–659,999	57 (20.9)	
660,000–959,999	58 (21.2)	
960,000–1,309,999	53 (19.4)	
1,310,000–2,209,999	19 (7.0)	
Above 2,210,000	10 (3.7)	
Duration of diabetes diagnosis		11.81 (9.19)
Number of diabetes medications		1.96 (0.98)
Medication regimen complexity index		6.37 (3.71)
Use of injectable medications	21 (7.7)	
A1C (%)		6.91 (0.88)
Less than or equal to 7% (53.0 mmol/mol)	186 (68.1)	
More than 7% (53.0 mmol/mol)	87 (31.9)	
Self-report diabetes medication adherence (score = 8–32)		10.53 (2.63)
BMQ-Specific Necessity (score = 5–25)		17.81 (3.42)
BMQ-Specific Concerns (score = 5–25)		13.28 (4.09)

Table 2 Inter-Item Correlations of the Traditional Chinese Version of the BMQ-Specific (n = 273)

	Items	I1.	I2.	I3.	I4.	I5.	I6.	I7.	I8.	I9.	I10.
I1.	My health at present depends on my diabetes medicines	1.000									
I2.	Having to take diabetes medicines worries me	−0.147*	1.000								
I3.	My life would be impossible without my diabetes medicines	0.387***	−0.039	1.000							
I4.	Without my diabetes medicines I would be very ill	0.295***	0.019	0.681***	1.000						
I5.	I sometimes worry about the long term effects of my diabetes medicines	−0.115	0.643***	0.016	0.045	1.000					

(*Continued*)

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Table 2 (Continued).

	Items	I1.	I2.	I3.	I4.	I5.	I6.	I7.	I8.	I9.	I10.
I6.	My diabetes medicines are a mystery to me	−0.170**	0.329***	−0.052	0.022	0.292***	1.000				
I7.	My health in the future will depend on my diabetes medicines	0.537***	−0.147*	0.462***	0.383***	−0.111	−0.092	1.000			
I8.	My diabetes medicines disrupt my life	−0.037	0.434***	−0.018	0.030	0.393***	0.249***	−0.223***	1.000		
I9.	I sometimes worry about becoming too dependent on my diabetes medicines	−0.078	0.410***	0.056	0.038	0.497***	0.300***	−0.033	0.414***	1.000	
I10.	My diabetes medicines protect me from becoming worse	0.328***	−0.288***	0.241***	0.133*	−0.219***	−0.233***	0.466***	−0.346***	−0.156*	1.000

Notes: Cell entries represent Pearson's correlation coefficients. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

43.14% of the total variance of the BMQ-Specific (Table 3). Specifically, necessity beliefs explained 19.02% of the total variance, while concern beliefs accounted for 24.13%.

For criterion validity, the tested hypotheses for validating the BMQ-Specific components were confirmed. The concerns component was positively correlated with higher barriers to medication-taking ($r = 0.270$, $p < 0.001$) and poorer glycemic control ($r = 0.130$, $p = 0.032$).

Reliability Assessment

Table 4 presents the internal consistency of the translated BMQ-Specific, including the means, standard deviations, item-total correlations, and reliability coefficients. The two subscales exhibited good internal consistency, with McDonald's ω values of 0.785 for both the BMQ-Specific Necessity and BMQ-Specific Concerns subscales. The item-total correlation coefficients for the Traditional Chinese version of the BMQ-Specific ranged from 0.546 to 0.813. Furthermore, McDonald's ω values, when each of the 10 items was excluded, ranged from 0.693 to 0.796.

Table 3 Exploratory Factor Analysis for the BMQ-Specific in Traditional Chinese Version (n = 273)

	Items	Factor 1 (Necessity)	Factor 2 (Concerns)
I1.	My health at present depends on my diabetes medicines	**0.576**	−0.095
I2.	Having to take diabetes medicines worries me	−0.067	**0.740**
I3.	My life would be impossible without my diabetes medicines	**0.786**	0.149
I4.	Without my diabetes medicines I would be very ill	**0.665**	0.188
I5.	I sometimes worry about the long term effects of my diabetes medicines	−0.000	**0.749**
I6.	My diabetes medicines are a mystery to me	−0.085	**0.426**
I7.	My health in the future will depend on my diabetes medicines	**0.710**	−0.109
I8.	My diabetes medicines disrupt my life	−0.079	**0.588**
I9.	I sometimes worry about becoming too dependent on my diabetes medicines	0.043	**0.619**
I10.	My diabetes medicines protect me from becoming worse	**0.412**	−0.036

Note: The bolded numbers indicate the corresponding factor for each item.

Table 4 Reliability Analysis the BMQ-Specific in Traditional Chinese Version (n = 273)

	Items	Mean (SD)	Item-Total Correlation	McDonald's ω if Item Removed
BMQ Specific-Necessity: McDonald's ω = 0.785				
11.	My health at present depends on my diabetes medicines	3.89 (0.84)	0.685	0.769
13.	My life would be impossible without my diabetes medicines	3.14 (1.10)	0.812	0.712
14.	Without my diabetes medicines I would be very ill	2.86 (1.07)	0.742	0.743
17.	My health in the future will depend on my diabetes medicines	3.69 (0.97)	0.783	0.756
110.	My diabetes medicines protect me from becoming worse	4.23 (0.73)	0.546	0.788
BMQ-Specific-Concerns: McDonald's ω = 0.785				
12.	Having to take diabetes medicines worries me	2.72 (1.18)	0.795	0.705
15.	I sometimes worry about the long term effects of my diabetes medicines	3.10 (1.33)	0.813	0.693
16.	My diabetes medicines are a mystery to me	2.76 (1.09)	0.595	0.796
18.	My diabetes medicines disrupt my life	1.97 (0.92)	0.658	0.764
19.	I sometimes worry about becoming too dependent on my diabetes medicines	2.74 (1.12)	0.727	0.754

Distribution of Beliefs About Medicines and Relations with Other Variables

The mean necessity score was 17.81 (range = 9–25; SD = 3.42), while the mean concerns score was 13.28 (range = 5–24; SD = 4.09), with a mean necessity-concerns differential of 4.52 (range = −13-20; SD = 5.70). Most participants (n = 253, 92.67%) strongly believed in the necessity of their medication for managing diabetes, with scores above the scale midpoint. However, over half of the participants (n = 144, 52.75%) also expressed significant concerns about potential adverse effects of their medication, with scores exceeding the scale midpoint. For 52 participants (19.05%), their necessity scores were lower than their concerns scores, resulting in a negative necessity–concerns differential. Participants with a more complex diabetic regimen (r = 0.294, p < 0.001), longer durations of T2D (r = 0.209, p < 0.001), and were prescribed injectable medications (r_s = 0.142, p = 0.019) tended to report stronger necessity beliefs (Table 5). Conversely, participants who faced more barriers to medication-taking (r = 0.270, p < 0.001), held fewer necessity beliefs (r = 0.146, p = 0.016), had poorer glycemic control (r = 0.130, p = 0.032), and were younger (r = 0.126, p = 0.038) were more likely to have greater concerns about medication use for diabetes control (Table 5).

Discussion

Principal Findings

This study evaluated the validity and reliability of the BMQ-Specific translated in Traditional Chinese for patients with T2D in community settings. The findings indicate that the 10-item BMQ-Specific in Traditional Chinese is reliable for this population, as demonstrated by acceptable McDonald's ω scores. The factor structure of the translated items aligns with the original conceptual framework proposed by Horne et al,[26] supporting the measure's construct validity within this group. Additionally, criterion validity testing shows that the BMQ-Specific domains can predict medication non-adherence and health outcomes, suggesting its potential usefulness in identifying patients at risk of non-adherence.

The construct validation using EFA identified two components of the BMQ-Specific in Traditional Chinese, namely the Specific-Necessity component and the Specific-Concerns component. This replicates the pattern found in the original English version[26] as well as in other validation studies among patients with T2D.[18,28–30] This demonstrates the robustness of the original BMQ-Specific scale and confirms the strength of its initial validation. Additionally, McDonald's ω coefficients indicated satisfactory internal consistency reliability for both components of the translated BMQ-Specific. Thus, the Traditional Chinese version of the BMQ-Specific maintains the psychometric qualities of the original version and provides a valid and reliable assessment of medication beliefs in patients with T2D.

Table 5 Bivariate Correlations of the Study Variables (n = 273)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Age in years (1)	1.000											
Gender (2)[a]	0.141*	1.000										
Education (3)	−0.287***	−0.421***	1.000									
Annual household income (4)	−0.262***	−0.205***	0.420***	1.000								
Medication regimen complexity index (5)	0.013	−0.127*	0.090	0.052	1.000							
Injectable medication use (6)	0.030	0.002	0.070	−0.067	0.595***	1.000						
Diabetes duration (7)	0.318***	−0.038	−0.048	−0.067	0.500***	0.275***	1.000					
Score of medication-taking (8)	−0.222***	−0.064	0.186**	0.056	0.196**	0.190**	0.017	1.000				
A1C level (9)	−0.031	0.014	0.033	−0.037	0.428***	0.226***	0.267***	0.268***	1.000			
BMQ-Specific Necessity (10)	0.022	0.004	−0.024	−0.052	0.294***	0.142*	0.209***	−0.097	0.049	1.000		
BMQ-Specific Concerns (11)	−0.126*	0.088	0.024	0.001	−0.023	−0.047	−0.112	0.270***	0.130*	−0.146*	1.000	
Necessity–concerns differential (12)	0.104	−0.068	−0.050	−0.031	0.193**	0.135	0.213***	−0.252***	−0.064	0.705***	−0.804***	1.000

Notes: [a] Female was used as the comparison group. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

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Our results resonate with the findings of previous studies, showing significant association of concern beliefs with both medication adherence and A1C levels.[53,54] A meta-analysis by Foot et al demonstrated that higher levels of concern beliefs were consistently linked to lower medication adherence across various studies.[53] Additional research in diabetes care has shown that patients with negative beliefs about their treatment are prone to experience poor glycemic control.[54,55] However, we did not find a significant association between necessity beliefs and either medication adherence or A1C levels. One possible explanation is that over 90% of participants reported high necessity beliefs, while fewer than 50% expressed low concerns about their medications. This greater variation in concern beliefs and the necessity–concerns differential may account for the significant associations observed with medication adherence. Participants who reported non-adherence had a smaller necessity-concerns differential compared to their counterparts. This implies that patients who perceived the risks of their medications (ie, concerns) outweighed the benefits (ie, necessity) were more likely to report non-adherence.[56] It is also important to acknowledge that medication adherence is typically influenced by multiple factors beyond beliefs about medications. Focusing solely on necessity beliefs, without considering other determinants, may be insufficient to improve adherence.[11,57] Behavioral factors such as diabetes-related distress and health literacy have also been shown to influence medication-taking behaviors.[58] Integrating these factors into assessment and intervention strategies may enhance the delivery of patient-centered care. Moreover, since behavioral intentions are shaped by attitudes and perceived social norms, addressing a broader range of psychosocial factors, in addition to necessity beliefs, would likely improve medication-taking behaviors more effectively.[57]

The study findings indicate that addressing concern beliefs to alleviate patients' ambivalence and skepticism about medications may be an effective strategy for improving medication adherence and health outcomes. Participants expressed notable concerns about the long-term effects of their prescribed medications, had a limited understanding of the medications themselves, and were worried about becoming dependent on them. In addition to provide general education to increase patients' knowledge about their medications, it is necessary to address other modifiable psychosocial factors.[59,60] Integrating peer support groups and patient testimonials into diabetes care can empower patients by allowing them to share experiences and strategies for managing concerns.[61] Patients with greater concerns about their medication may learn how to cope through success stories from others who have experienced positive outcomes with the same treatment. Additionally, incorporating motivational interviewing offers an opportunity to explore and resolve patients' ambivalence about medication-taking, and it provides healthcare professionals with more insights on how to address these concerns.[62] Research also suggests that cognitive-behavioral therapy techniques could help patients reframe negative thoughts about their medication and reduce anxiety related to treatment.[63] In summary, the translated BMQ-Specific appears well-suited for understanding patients' beliefs about their prescribed medication within the cultural context in Taiwan.

Limitations

When interpreting the study findings, several limitations should be considered. First, the data were collected through a single cross-sectional survey, which limits the ability to draw causal inferences between long-term beliefs and medication perceptions. It remains unclear whether beliefs about medications drive non-adherence or if non-adherent behaviors lead patients to change their beliefs. Future longitudinal research needs to explore how beliefs about diabetic medications evolve over time and their impact on patients' adherence to prescribed medications.

Second, participants were recruited from five community pharmacies in northern and central Taiwan, which may not reflect the broader population in Taiwan. The convenience sampling approach, while practical, could bias the sample toward individuals already engaged with healthcare services, potentially underrepresenting non-adherent or marginalized groups. Patients who regularly refill prescriptions may also engage in other health-promoting behaviors, suggesting that those who completed the translated BMQ-Specific may have higher adherence than the general population. As a result, individuals obtaining medications from hospital pharmacies or not refilling prescriptions at all may have been excluded, limiting the generalizability of the findings across diverse healthcare settings and populations in Taiwan. Further studies should aim for more diverse and representative samples to enhance external validity.

Third, this study focused exclusively on diabetic medications without considering comorbidities and other medications that may have shaped participants' overall treatment beliefs. The potential impact of such factors on belief patterns

could not be assessed. Furthermore, while the instrument demonstrated good internal consistency, it was not subjected to test-retest reliability, leaving its stability over time unexamined. Future research should include longitudinal reliability assessments.

The high average scores observed on the necessity subscale may also indicate a ceiling effect, which reduces the sensitivity of the instrument to detect differences or changes among participants with already strong adherence-related beliefs. To address this, future scale refinements could include more nuanced items or a wider response range to enhance discriminatory capacity. In addition, applying analytic methods such as item response theory may better capture subtle variations in belief strength. Finally, the possibility of non-response bias cannot be ruled out. Not all invited patients agreed to participate, which may have lead to the exclusion of certain groups and further affected the representativeness of the results.

Implications

Our findings affirm the value of the Traditional Chinese version of the BMQ-Specific as a quick and easy-to-use screening tool for assessing patients' beliefs about medications. This instrument holds important clinical implications, particularly in informing the design of personalized interventions to improve medication adherence. By identifying belief-related barriers, it can support constructive dialogue between patients and healthcare providers regarding disease management and treatment concerns. Medication beliefs are well-established predictors of adherence,[18] especially in the context of chronic disease management. The translated BMQ-Specific can help identify patients at risk of medication non-adherence, enabling timely support and intervention. Clinicians can leverage the results to initiate discussions around adherence challenges. Addressing misconceptions or fears (eg, concerns about side effects) can foster trust and promote shared decision-making.[64]

Patients with low necessity beliefs may benefit from educational interventions that emphasize the benefits of medication in preventing complications, while those with high concerns may require reassurance, dose adjustments, or alternative treatment options.[18,65] Engaging patients in conversations about treatment goals, side effect management, and alternative therapies can enhance adherence, ultimately improving patient satisfaction and long-term treatment outcomes.[66] Additionally, the BMQ-Specific serves as a suitable foundation for psychological interventions, such as motivational interviewing and cognitive behavioral therapy.[67] Understanding patients' belief profiles can guide the use of tailored strategies to address specific concerns or strengthen perceived necessity.[68–71] Comprehensive diabetes management now includes diet, exercise, pharmacotherapy, and adjunctive approaches such as dietary supplements, medical foods, and emerging therapies like engineered probiotics.[68–71] These evolving options may influence patients' beliefs about medications, which in turn affect adherence and treatment engagement. In this increasingly personalized care environment, gaining insight into patients' medication beliefs is crucial for supporting effective, patient-centered treatment strategies.

Conclusions

The Traditional Chinese version of the BMQ-Specific demonstrated good reliability and validity for assessing medication beliefs among patients with T2D in Taiwan. It can be effectively integrated into clinical practice for screening and follow-up, enhancing communication between healthcare professionals and patients. Future research could explore culturally-specific beliefs about medications and develop interventions to foster more positive beliefs within the context of Taiwan's healthcare system. Additionally, further studies could include longitudinal research to track changes in medication beliefs and adherence over time, intervention studies to examine whether addressing concerns improves adherence, and comparisons with other chronic diseases to determine the broader applicability of these findings.

Data Sharing Statement

The detailed data analyses during the study are available from the corresponding author (YMH) upon reasonable request.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work. Yen-Ming Huang and Hsun-Yu Chan contributed equally to this work as corresponding authors.

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Disclosure

The authors have no competing interest to report.

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