Original Article

JHSMR Journal of Health Science and Medical Research

Development of a New Tool for Monitoring the Eating, Exercise, and Medication Use among Diabetes Persons with Hypertension

Patcharee Numsang, Ph.D. (Nursing), R.N.[1], Sureeporn Thanasilp, D.N.S., R.N., Dip. APMSN[2], Ratsiri Thato, Ph.D., R.N.[3]

[1]Faculty of Nursing, Chulalongkorn University, Pathum Wan, Bangkok 10300, Thailand.

[2]Asian Wisdom Care Research Unit, Faculty of Nursing, Chulalongkorn University, Pathum Wan, Bangkok 10300, Thailand.

[3]Research Unit for Enhancing Well-being in Vulnerable and Chronic illness Populations, Faculty of Nursing, Chulalongkorn University, Pathum Wan, Bangkok 10300, Thailand.

Received 11 July 2024 ● Revised 23 July 2024 ● Accepted 28 July 2024 ● Published online 9 January 2025

Abstract:

Objective: To develop and test a novel health behavior monitoring instrument designed for diabetes persons with hypertension.

Material and Methods: This study was designed to develop and test an instrument in four phases: item generation, content validity assessment, pilot testing, and full study. The Eating, Exercise, and Medication Use Questionnaire (EEMQ) was generated based on evidence available in literature reviews. The content validity of the indices of item objective congruence (IOC) was assessed by five experts face validity was piloted in a convenience sample of 10 individuals, and reliability was assessed by the full study in 30 participants with diabetes and hypertension.

Results: The content validity assessment by five experts yielded a high content validity index (IOC=0.97), indicating that the items were relevant. Following the compilation of questionnaire items, content experts provided feedback on the content and appearance of the preliminary tool. The questionnaire demonstrated feasibility for monitoring health behavior, showing good exploratory values of validity. The self-efficacy scale of EEMQ exhibited a Cronbach's alpha coefficient of 0.923, indicating satisfactory to excellent reliability in evaluating the internal consistency of the instruments.

Conclusion: The Eating, Exercise, and Medication Use Questionnaire (EEMQ) has emerged as a suitable and comprehensive tool. It has been validated for content, face validity, and acceptable reliability. It is ready for use in

Contact: Assoc. Prof. Sureeporn Thanasilp, D.N.S., R.N., Dip. APMSN
Asian Wisdom Care Research Unit, Faculty of Nursing,
Chulalongkorn University, Pathum Wan, Bangkok 10300, Thailand.
E-mail: s_thanasilp@hotmail.com, sureeporn.t@chula.ac.th

J Health Sci Med Res 2025;43(4):e20251139
doi: 10.31584/jhsmr.20251139
www.jhsmr.org

monitoring health behavior related to diet, exercise, and medication use, particularly within behavior modification programs based on the Information–Motivation–Behavioral Skills (IMB) model for diabetes patients with hypertension.

Keywords: behavior modification, diabetes type 2, hypertension, IMB model, scale development

Introduction

Diabetes (DM) and hypertension (HT) comorbidity represent chronic and lifestyle diseases associated with significant serious potential complications and adverse impact on quality of life[1]. Management of diabetes and hypertension typically begins with lifestyle modifications, including a low-sodium diet, weight management, regular exercise or increased physical activity, moderation of alcohol consumption, avoidance of smoking, and control of hyperglycemia and dyslipidemia[2,3].

Lifestyle management necessitates non-pharmacological interventions and behavioral changes, which are linked to a reduced risk of complications and mortality[4]. Maintaining a proper diet, engaging in regular exercise, and adhering to medication use significantly influence the progression of diabetes and the onset of complications. Dietary modifications, in particular, can have a profound impact on blood pressure, potentially reducing or eliminating the need for blood pressure-lowering medications[5].

Behavior modification strategies based on the Information–Motivation–Behavioral Skills (IMB) model have been conceptually developed to assess the effectiveness of health behavior among diabetes persons and/or hypertension. The IMB model asserts that the performance of health behaviors for behavior change can be promoted and sustained through adequate information, motivation, and enhanced behavioral skills[6]. According to the literature review, self-management based on behavioral change using the IMB model has proven effective and is essential for comprehensively evaluating the impact of behavior, and represents a suitable approach for improving glycemic control and self-care behaviors among patients with diabetes[7,8]. Intervention studies have predominantly employed the IMB model to enhance lifestyle modifications and improve self-management activities, including glycemic control[7], blood pressure control[9], and clinical outcomes both blood glucose and blood pressure[10].

The lack of sensitive and relevant tools for monitoring health behavior is a significant reason for lifestyle modification, particularly among populations affected by diabetes and hypertension. Currently, there are various instruments available for monitoring health behavior among diabetes persons with hypertension. However, most of these tools used in lifestyle management research, such as the self-efficacy for hypertension treatment adherence (SE-HTA) instrument focusing on diet self-efficacy (DSE), exercise self-efficacy (ESE), and medication self-efficacy (MSE)[11], the Diabetic Self-Management Scale[12], and the Diabetes Self-Efficacy Scale[13] for lifestyle change, are not comprehensive. They often exclusively address diet, exercise, or use of medication behavior or have incongruent theoretical frameworks or inadequate psychometric quality. Prior to the development of the EEMQ, there were no readily available instruments for monitoring diet, exercise, and use of medication.

Given this situation, there is a clear need for tools that enable health professionals to monitor and assess their patients' dietary intake, exercise, and medication use. Behavior modification programs based on the Information-Motivation-Behavioral Skills Model (IMB) can be effective with respect to eating, exercise, and medication use practices for individuals suffering from diabetes and hypertension.

Nevertheless, there is still a need for a culturally and contextually specific instrument to monitor these lifestyle behaviors. Consequently, researchers planned to develop a tool aimed at monitoring health behavior, specifically assessing ability and confidence related to eating, engaging in regular exercise, and appropriately using medication to induce behavioral change among individuals with diabetes and hypertension.

Material and Methods

The development of the EEMQ is grounded in two frameworks (Figure 1). The IMB model[6] was chosen as the framework to offer context and meaning for the development of the EEMQ, which is intended and designed to monitor health behavior across three domains –– information, motivation, and behavioral skills –– among diabetes persons with hypertension. This model was selected as the theoretical foundation for the EEMQ tools because it emphasizes health behaviors related to behavior change needed to successfully adhere to lifestyle recommendations for controlling blood glucose and blood pressure, specifically focusing on diet, exercise, and medication use.

Methods

This study follows a cross-sectional design. This methodological study was conducted in four phases designed to construct and validate the instrument. The first phase involved using frameworks to guide the development of the EEMQ for monitoring health behavior, drawing on a literature review beyond the IMB model for conceptual definition and item generation. The second phase entailed the process of scale development for the new tool, including content validation by a panel of 5 experts. The third phase comprised a cognitive pilot test to confirm feasibility and applicability. Finally, the fourth phase involved the full study of 30 samples, where their internal consistency was evaluated through Cronbach's method[14].

The researchers developed and validated the EEMQ scale by assessing its validity. Given that there is no existing valid scale for monitoring ability and confidence regarding diet, exercise, and medication use from the perspectives of information, motivation, and behavioral skills among in diabetes persons with hypertension, the EEMQ was developed as the outcome of interest-based on the IMB model. The study proceeded in four phases, extending

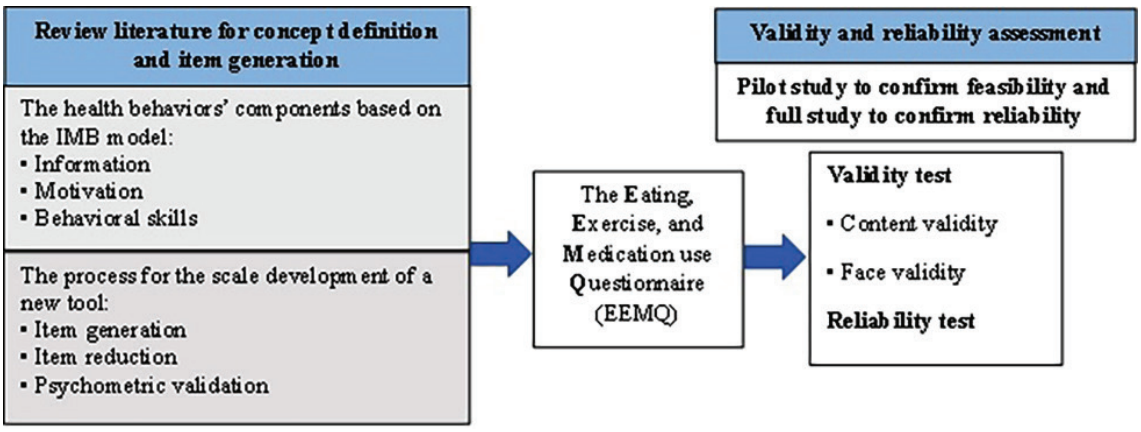

Figure 1 Conceptual framework for development and testing

beyond the standard iterative questionnaire development and validation method. These phases include conceptual definition, item generation, content validation, a pilot study to evaluate face validity, and a full study to measure reliability[15].

Stage 1 Generation of Items: literature review for concept definition and item generation

This phase involved developing a preliminary version of the EEMQ specifically tailored to be contextually and culturally specific for diabetes persons with hypertension in Thailand. The construction of the questionnaire was grounded in the concept of health behavior derived from the IMB model. This health behavior was defined as "the ability and self-confidence to use the information, motivation, and behavioral skills needed to perform activities within the scope of eating diet, exercise, and taking appropriate medications at an acceptable skill level". In practical terms, patients were required to demonstrate self-efficacy in activities or perception of abilities to perform behaviors such as reading a food label, checking the amount of sugar-oil-salt per teaspoon, assessing glycemic index and carb counting, engaging in appropriate exercise, and correctly taking medication.

The ability and self-confidence assessed by this tool encompass three domains -- eating, exercise, and medication use -- helping determine a patient's self-efficacy. For each of the three domains, the questionnaire consisted of two parts. The dietary skills section included 15 items in a checklist response format, while the three domains had a total of 23 items, each measured on a three-point rating scale, with '3' indicating "Very confident," '2' for "Moderately confident," and '1' for "Not confident". The items for each domain were constructed based on evidence available in the literature and input from experts. The study developed competency items for each concept, such as 6-6-1 diet recipes (S-O-S), dance exercises, and medication use. These items include the ability to categorize foods into low sweet-fat-salt groups, read food labels, check the amount of sweet, fat, and salt per teaspoon, perform carb counting, check the glycemic index, select low-sugar-oil-salt foods in the grocery store using guideline daily amounts (GDA) labels, track sweet-fat-salt intake, and demonstrate knowledge, skills, and self-confidence in maintaining a healthy diet, engaging in appropriate dance exercise, and using medication use (refer to Table 1). The content was aligned with international and Thai guidelines for diabetes and hypertension management[16-19].

Stage 2 Item reduction and psychometric validation: content validity assessment by expert opinion

The psychometric properties of the newly developed EEMQ instrument were examined for content validity. This stage is crucial in refining a scale to improve its psychometric characteristics and eliminate redundant items. The content validity of the instrument was assessed through an expert panel review[15,20], and the retained items constituted the initial version of the newly developed EEMQ instrument.

Content validity

The questionnaire underwent evaluation by five content experts to assess the adequacy of items in covering the desired domains. The expert group comprised individuals from diverse disciplines, including an internal medicine, a professor, a chronic care manager, a public health nurse, an advanced practice nurse (APN), and a culture expert. The data collection for content validity took place between June 2023 and August 2023, with each of the five experts being approached and invited to participate in the review.

For the content validity assessment, each expert received a content validity rating form and was instructed to evaluate each item of the EEMQ-1.0 in terms of its

relevance in assessing lifestyle behavior. The rating was done on a three-point scale (0=neither agree nor disagree/not sure/unclear objective; 1=highly relevant/appropriate/clearly measuring objective, and -1=not relevant/appropriate/unclear objective). Additionally, the rating form included an open-ended question prompting experts to provide comments on the relevance of the items in capturing EEMQ and the adequacy of the scale in measuring the overall construct.

Stage 3 Pilot testing to confirm feasibility

The method used to assess face validity involved obtaining participant feedback from diabetes persons with hypertension, along with evaluating item performance[15,20].

Face validity

Adjustments and additions to items were made based on insights from content experts. Participants, specifically diabetes persons with hypertension, were then given the questionnaire to complete.

Stage 4 Full study to establish reliability

During the full study phase, the EEMQ served as an instrument that aimed at measuring abilities and self-efficacy in relation to diet, exercise, and use of medication, which were assessed by examining their internal consistency using Cronbach's method and item analysis.

Table 1 Knowledge and skills necessary for successful lifestyle behavior

Source	Knowledge and skills
Diet	• Application of a Mediterranean or dietary approaches to stop hypertension (DASH) eating pattern, including reducing sodium and increasing potassium intake, moderation of alcohol intake, carb/carbohydrate counting • Reduction of saturated fat and trans fat • Increase of dietary -3 fatty acids, viscous fiber, and plant stanols/sterols intake • Eating vegetables, whole grains, nuts, fruit, and low-fat dairy • Avoiding all sweet drinks, sorbitol, xylitol, mannitol, and alcohol • Reducing the sugar amount to less than 3-6 teaspoons per day • Carb counting (1 carb serving is about 15 grams of carbohydrate) • Avoidance of trans-fat, and increase in foods rich in omega-3 fatty acids, e.g., fish and chicken • Choosing food with a low glycemic index and load • Reading food labels, such as guideline daily amount (GDA) labels • Limiting sodium intake (<2,000 mg/day) • Setting dietary goals and rewards for adherence • Monitoring sodium intake • Eating food in a 2:1:1 proportion in one plate (Vegetables 2 serving: carbohydrate 1 serving: protein 1 serving) • Eating a diet low in sodium, saturated fat, cholesterol • Eating a diet high in potassium, calcium, fiber, and fruits • Avoiding herbs or supplements, e.g., Chinese ephedra/Ma Huang, Glycyrrhiza glabra
Exercise	• Increased physical activity to improve the lipid profile and reduce the risk of developing cardiovascular disease • Setting exercise goals and rewards for adherence • Avoiding extreme exercise • Performing moderate aerobic exercise for at least 30 minutes per day, 3-5 days per week • Not stopping exercise for more than two consecutive days • Precaution in heart disease • Performing moderate aerobic exercise at least five days per week • Avoiding extreme exercise and isometric exercise
Medication use	• Providing information on both actions of anti-diabetic medicine and insulin (i.e., the name of the drug, dosage, actions, drug interaction, and side effects). • Providing information about the actions of anti-hypertensive medicine, drug interaction, and side effects.

Participants

Purposive sampling was employed to select ten participants for the face validity assessment, and the same method was used to recruit participants exclusively for the pilot study. All selected individuals met the primary inclusion criterion of being 40 years or older, a requirement for participation in the behavior modification program. Informed consent was obtained from all participants. The interviews were scheduled to take place either in a meeting room or in a private room within the Hospital's Primary Care Unit (PCU) during November 2023 or December 2023.

Item analyses were performed on data collected from both pilot and full study samples. Thirty participants were randomly selected from the PCU, comprising outpatients attending their initial appointments with a PCU nurse for blood pressure and HbA1c training and monitoring. The reliability assessment from the full studies conducted in January 2024.

Ethical considerations

This study is part of a culturally tailored behavior modification program addressing HbA1c and blood pressure management among diabetes persons with comorbid hypertension. Funding for this program was provided by the 90th Anniversary of Chulalongkorn University Fund, and ethical approval for the study was granted by the Research Ethics Committees of Mahasarakham Hospital (reference codes COA no. 66/064). During the pilot study and full study phase, all participants formally signed consent forms prior to the commencement of data collection. Each participant was explicitly informed of his or her right to withdraw from the study at any time.

Statistical analysis

Each questionnaire item was analyzed individually, and the data analysis extended to an exploration of the potential formation of three potential scales, namely diet, exercise, and medication use.

Content validity of the items

Descriptive statistics, encompassing frequency distributions, were utilized to present the relevance of each item, and any written or verbal comments were conveyed in a narrative format. To qualitatively measure content experts' judgments of items, the item objective congruence (IOC) method introduced by Rovinelli & Hambleton[21] was employed. IOC indices were computed for each item and each objective, representing the number of experts rating an item as "highly relevant" divided by the total number of experts[22]. The overall IOC was then determined by averaging across all items within the scale. A criterion level of IOC greater than or equal to 0.80 was deemed necessary to indicate the content validity of the instrument.

Face validity of the items

To establish face validity, individuals were asked to evaluate the items, ensuring their comprehensibility and acceptability[15,20].

Reliability

Internal consistency refers to the stability of results over time and across different contexts when an instrument measures the same characteristic[15,20]. In the full study, this aspect was evaluated through alpha coefficients based on the gathered data. Cronbach's alpha, the prevalent test for assessing internal consistency, produces a result within the range of 0 to 1. Typically, an alpha level of 0.07 or greater is considered acceptable[23].

Results

Following a thorough review of the literature and examination of international and Thai clinical practice guidelines for diabetes and hypertension management, researchers developed the two parts of the EEMQ tool. The first part consisted of a 15-item checklist to assess dietary skills, while the second part comprised 23 items across three domains with a rating scale response format.

The questionnaire, included 23 items measuring self-efficacy and assessment skills (ability and self-confidence) related to dietary practices, exercise, and medication use. These items were further divided into three subscales: diet, exercise, and medication use.

The conceptual framework of the EEMQ is based on Fisher et al.'s[6] IMB model. According to this model, persistent behavioral changes result from enhancing health-related knowledge/information, motivation, and behavioral skills to increase self-efficacy. This, in turn, leads to positive health behavior outcomes and promotes a healthier lifestyle. The behavioral skills component of the questionnaire focuses on ability and perceived self-efficacy for engaging in the sequence of lifestyle behaviors associated with preferred diet, exercise, and medication use.

Table 2 The relevance ratings on the item scale by five experts

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert in agreement	IOC	UA
Part I: Skills of dietary calculation								
1	0	1	1	1	1	4	0.8	0
2	0	1	1	1	1	4	0.8	0
3	0	1	1	1	1	4	0.8	0
4	1	1	1	1	1	5	1	1
5	1	1	1	1	1	5	1	1
6	1	1	1	1	1	5	1	1
7	1	1	1	1	1	5	1	1
8	1	1	1	1	1	5	1	1
9	1	1	1	1	1	5	1	1
10.1	1	1	1	1	1	5	1	1
10.2	1	1	1	1	1	5	1	1
10.3	1	1	1	1	1	5	1	1
11	1	1	1	1	1	5	1	1
12	1	1	1	0	1	4	0.8	0
13	1	1	1	1	1	5	1	1
14	1	1	1	1	1	5	1	1
15	1	1	1	1	1	5	1	1
Part II: Self-Efficacy of diet, exercise, medication use								
16	1	1	1	1	1	5	1	1
17	1	1	1	1	1	5	1	1
18	1	1	1	1	1	5	1	1
19	1	1	1	1	1	5	1	1
20	1	1	1	1	1	5	1	1
21	1	1	1	1	1	5	1	1
23	1	1	1	1	1	5	1	1
24	1	1	1	1	1	5	1	1
25	1	1	1	1	1	5	1	1
26	1	1	1	1	1	5	1	1
Proportion relevance	0.88	1	1	0.96	1	Total IOC	0.97	0.84

IOC=item objective congruence, UA=universal agreement

Content validity

Before the pilot test initiation, the items of the EEMQ underwent a content validity review by an expert panel. This panel comprised a physician with expertise in internal medicine and diabetes and hypertension treatment, three nurses recognized for their expertise in patient care for individuals with diabetes and hypertension, and one cultural expert specializing in the culture of Isan/northeastern Thailand. The experts were tasked with rating the items on an ordinal scale: −1 denoting "irrelevant/not appropriate/not clearly objective" content, 0 signifying "not sure/somewhat relevant/unclear objective" content, and 1 representing "quite/extremely relevant/clear objective" content.

IOC was computed for each item and for the overall tool (Table 2). IOC for each item represents the proportion of expert agreement, indicating the extent to which experts rated the item as content-valid in terms of relevance and clarity. The IOC values can range between zero and one, with an item-level content validity index calculated for each item. This index signifies the percentage of experts who rated the item as zero or above, reflecting the degree of consensus on the item's validity.

Table 3 Question items included in version 2 of the EEMQ

Items	Contents of each question item
Part I: Skills of dietary calculation	
Eating less sweet than 6 teaspoons (24 g) per day, checking the glycemic index, and carb counting	
1	Cultivated banana 1 unit or golden banana 1/2 unit (1 carb)
2	Watermelon or pineapple or papaya 6–8 pieces (1 carb)
3	Durian ½ medium seed or ripe mango ½ unit or tamarind 3 pods (1 carb)
4	Coke 1 glass (250 cc) or Pepsi 1 can (1 carb)
5	Plain rice 1 ladle or glutinous rice ½ ladle (1 carb)
6	Sweet baoloy 1/2 small cup (1 carb)
7	Three in one of coffee 1 can
Eating less fat/vegetable oils than 6 teaspoons (24 g) per day	
8	Ripe pork or beef 1 cup
9	Ripe squid or shell or shrimp 1 plate
10	Ripe catfish meat (add 1 tablespoon of vegetable oil)
11	Rice noodles and coconut milk in red curry (add 2 tablespoons of coconut milk)
Eating less salt/sodium than 1 teaspoon (<2,000 mg) per day/fish sauce less than 4 teaspoons	
12	Isan papaya salad 1 plate (100 g) (add 1 teaspoon of monosodium glutamate (MSG), 1 tablespoon of fish sauce, 1 tablespoon of fermented fish sauce)
13	Egg noodle with grilled red pork 1 bowl (350 g) (add 1 teaspoon of MSG, 1 tablespoon of fish sauce)
14	Isan rice noodle with fish curry sauce 1 bowl (435 gram) (add 1 teaspoon of MSG, 1 tablespoon of fish sauce)
15	From sweet-fat-salt labels/nutrition labels/guideline daily amount (GDA), which shows the amount of sugar as 5 g, the amount of fat as 13 g, and the amount of sodium as 560 mg.
	15.1 How many teaspoons of sugar do you get when you eat 1 box?
	15.2 How many teaspoons of fat do you get when you eat 1 box?
	15.3 How many teaspoons of sodium/salt do you get when you eat 1 box?
Part II Self-efficacy of diet, exercise, medication use	
Section I: The 6-6-1 healthy diet	
1	In one day, you should not consume more than 2 carbs of carbohydrate groups, equivalent to 6 teaspoons of sugar. Avoid foods that cause your blood sugar to become very high, especially at dinner time; you should reduce the amount of sticky rice.
2	You should eat leafy/green vegetables that are high in fiber, such as cabbage, kale, and gourd, and unsweetened fruits, such as guava, apple, orange, semi-raw banana, raw mango, and dragon fruit, according to 1 recommended carb.

Table 3 (continued)

Items	Contents of each question item
3	You should avoid food in the market that is high in blood sugar and fat, such as mango sticky rice with durian with coconut milk (contains flour, sugar, and fat), etc.
4	In one day, you should not consume more than 6 teaspoons of fat or oil and stop eating these 4 things that have high cholesterol levels: trans fats, animal fat/saturated fat, fish eggs, and three in one coffee.
5	In one day, you should reduce eating foods that contain more than 1 teaspoon or 2,000 mg of sodium salt such as soup, MSG, seasoning powder, soup cubes, baking powder, sauces, etc.
6	For food in convenience stores, you should always read the GDA or sweet–fatty–salty labels before consuming.
7	You should reduce eating 6 groups of high triglycerides: –Desserts and ice cream –Rice and noodles –Bread, bakery, pizza –Smoothies, fruit juices, bubble tea –Very sweet fruit –Alcoholic beverages
Section II: 30 minutes of physical activity 5 days per week	
8	You should always check and measure the blood pressure and pulse rate before and after exercise.
9	You should always monitor abnormal signs and symptoms during exercise related to heart and respiratory system/problems. Hold exercise immediately after having problems, such as shortness of breath, rapid or irregular heartbeat, chest tightness, reduced ability to exercise, and fainting or others.
10	If blood pressure is above 140/90 mmHg, you should do this activity. Stop exercise to prevent complications, such as cerebrovascular disease.
11	Please follow safe exercise techniques (according to 3 principles "do not") –Do not exercise too hard or feel too exhausted –Do not exercise for too long or not more than 60 minutes per day –Do not exercise in a low head position or change position quickly
12	Avoid exercises that require you to hold your breath during exercise, for example, lifting weights, planks, and push–ups.
13	Do not skip the warm–up and cool down after exercise to prevent heart–pumping overload and muscle injury.
14	Always check your blood sugar (BS) levels before, during, and after exercise, and monitor hypoglycemia during exercise. Controlling your BS levels to the normal range before, during, and after exercise. If your blood sugar is less than 80 mg%, drink juice or eat food containing 15 g of carbohydrates, such as 1 glass of milk, 1 glass of orange juice, 1 slice of bread, or others.
15	If your blood sugar is above 290 mg%, avoid exercising until the BS level returns to normal and you feel better than before exercise.
16	Avoid injecting insulin into a site local to exercising muscles such as the thigh muscle and hamstring on both sites.
17	Avoid exercising or doing activities in extremely hot or cold temperatures. Drink plenty of water before, during, and after exercising to prevent dehydration.
18	Wear well–fitting socks and shoes, and always check your feet after exercise to prevent foot injuries and infections.
Section III: Taking medications or injections regularly as doctor's order plan	
19	You should know about taking medication, both the right drugs, dosage, method, and time, including reading the drug label every time.
20	Take up medicine to 30 minutes before meals and do not forget or skip food after taking medicine to prevent hypoglycemia causing dizziness, fainting, and syncope.
21	Take pills daily as the doctor prescribes; do not stop or adjust the dosage yourself without consulting with doctors. Follow up regularly with your doctors.
22	In case of forgetting to take pills, do not take the missed dose and double the next one. It would be best if you went back to your regular dosage schedule.
23	It would help if you masked a medication timetable for getting help from family members/relatives/friends/village health volunteers to remind and prevent forgetting to take medicines.

Item generation

Items in the EEMQ questionnaire were drawn from various sources, as detailed in Table 3, providing a comprehensive overview of the content and sources of the full questionnaire. In summary, the 23 items that were initially generated underwent a content validation process; the IOC results for item relevance were deemed satisfactory for all items.

Subsequently, a total of 38 items were developed and included in the EEMQ to enhance clarity. Regarding the response format, a 3-point rating scale garnered general support from the expert panel. Twenty-six items remained unchanged, and another twelve items related to diet, focusing on special dietary considerations or enjoyable delicacies, were incorporated based on narrative comments from the experts. With these revisions, the updated version was labeled EEMQ, comprising a total of 38 items (Table 3).

Face validity

Pilot study patient characteristics

A total of 10 diabetes patients participated in the pilot study. Four of the patients were male; the ten patients had an average age of 59.50 years (±8.63). Participants were asked to identify any questions or sentences whose wording they found unclear. They then completed the questionnaire and offered feedback on the clarity of the questions and whether the targeted topic of each item was adequately addressed. Based on observations recorded by the patients, three items in Part I (items 8-11) and Part II (items 1-7) were modified for enhanced clarity, resulting in version 2 of the questionnaire (Table 3).

Table 4 Full study item analysis and Cronbach's alpha if removed (n=30)

Items	Corrected item-total correlation	Cronbach's alpha if item deleted
Section I: The 6-6-1 healthy diet		
1. In one day, you should not consume more than 2 carbs of carbohydrate groups, equivalent to 6 teaspoons of sugar. Avoid foods that cause your blood sugar to become very high, especially at dinner time; you should reduce the amount of sticky rice.	-0.149	0.930
2. You should eat leafy/green vegetables that are high in fiber (i.e., cabbage, kale, gourd) and unsweetened fruits, such as guava, apple, orange, semi-raw banana.	0.464	0.921
3. You should avoid food in the market that is high in blood sugar and fat, such as mango sticky rice with durian with coconut milk (contains flour, sugar, and fat), etc.	0.624	0.919
4. In one day, you should not consume more than 6 teaspoons of fat or oil and stop eating these 4 things that have high cholesterol levels: trans fats, animal fat/saturated fat, fish eggs, and three in one coffee.	0.517	0.920
5. In one day, you should reduce eating foods that contain more than 1 teaspoon or 2,000 milligrams of sodium salt such as soup, monosodium glutamate (MSG), seasoning powder, soup cubes, baking powder, sauces, etc.	0.091	0.928
6. For food in convenience stores, you should always read the guideline daily amount (GDA) or sweet-fatty-salty labels before consuming.	0.475	0.921
7. You should reduce eating 6 groups of high triglycerides: -Desserts and ice cream -Rice and noodles -Bread, bakery, pizza -Smoothies, fruit juices, bubble tea -Very sweet fruit -Alcoholic beverages	0.327	0.923

Table 4 (continued)

Items	Corrected item–total correlation	Cronbach's alpha if item deleted
Section II: 30 minutes of physical activity 5 days per week		
8. You should always check and measure the blood pressure and pulse rate before and after exercise.	0.262	0.926
9. You should always monitor abnormal signs and symptoms during exercise related to heart and respiratory system/problems. Hold exercise immediately after having problems, such as shortness of breath, rapid or irregular heartbeat, chest tightness, reduced ability to exercise, and fainting or others.	0.797	0.916
10. If blood pressure is above 140/90 mmHg, you should do this activity. Stop exercise to prevent complications, such as cerebrovascular disease.	0.793	0.915
11. Please follow safe exercise techniques (according to 3 principles "do not") –Do not exercise too hard or feel too exhausted –Do not exercise for too long or not more than 60 minutes per day –Do not exercise in a low head position or change position quickly	0.748	0.916
12. Avoid exercises that require you to hold your breath during exercise, for example, lifting weights, planks, and push–ups.	0.693	0.917
13. Do not skip the warm–up and cool down after exercise to prevent heart–pumping overload and muscle injury.	0.597	0.919
14. Always check your blood sugar (BS) levels before, during, and after exercise, and monitor hypoglycemia during exercise. Controlling your BS levels to the normal range before, during, and after exercise. If your blood sugar is less than 80 mg%, drink juice or eat food containing 15 grams of carbohydrates, such as 1 glass of milk, 1 glass of orange juice, 1 slice of bread, or others.	0.599	0.919
15. If your blood sugar is above 290 mg%, avoid exercising until the BS level returns to normal and you feel better than before exercise.	0.628	0.919
16. Avoid injecting insulin into a site local to exercising muscles such as the thigh muscle and hamstring on both sites.	0.764	0.916
17. Avoid exercising or doing activities in extremely hot or cold temperatures. Drink plenty of water before, during, and after exercising to prevent dehydration.	0.712	0.917
18. Wear well–fitting socks and shoes, and always check your feet after exercise to prevent foot injuries and infections.	0.620	0.919
Section III: Taking medications or injections regularly as doctor's order plan		
19. You should know about taking medication, both the right drugs, dosage, method, and time, including reading the drug label every time.	0.697	0.917
20. Take up medicine to 30 minutes before meals and do not forget or skip food after taking medicine to prevent hypoglycemia causing dizziness, fainting, and syncope.	0.821	0.914
21. Take pills daily as the doctor prescribes; do not stop or adjust the dosage yourself without consulting with doctors. Follow up regularly with your doctors.	0.837	0.914
22. In case of forgetting to take pills, do not take the missed dose and double the next one. It would be best if you went back to your regular dosage schedule.	0.789	0.916
23. It would help if you masked a medication timetable for getting help from family members/relatives/friends/village health volunteers to remind and prevent forgetting to take medicines.	0.276	0.926

Full study

Demographic information was obtained from the 30 participants. The internal consistency reliability coefficient for the EEMQ (comprising 38 items) scores within the full study sample (consisting of 30 participants) was substantiated by an acceptable Cronbach's alpha value of 0.923 for the overall scale (Table 4).

Discussion

In this study, a novel instrument was developed to monitor health behavior based on the IMB model, specifically tailored to the Thai population. The instrument focuses on monitoring dietary habits, exercise, and medication usage. The final scale comprises 38 items distributed across three domains, demonstrating a commendable IOC of 0.97. The pilot study to evaluate face validity revealed acceptable feasibility and applicability for monitoring patients' progress across various clinical settings. Overall, the results indicate that the EEMQ exhibits robust psychometric properties.

In the developmental stage involving concept definition and item generation, it was crucial to consider both conceptual and operational definitions of the constructs to be measured. The conceptual definitions are theory-based (derived from the researchers' experience and then confirmed by existing literature)[15,20], and serve as the foundational principles for instrument development. These definitions articulate the theoretical framework that guided the construction of the instrument.

On the other hand, operational definitions are pivotal for content validation, providing a framework for the instrument developer to select items from the content domain identified by the conceptual definitions[20] for behavior skills, and a sense of self-efficacy served as the measurement in the current study. These operational definitions translate abstract concepts into measurable variables or observable indicators, ensuring clarity and precision in the development process.

The clinical validation of the EEMQ instrument holds significant importance for its application in clinical practice, providing direct benefits for individuals dealing with diabetes and hypertension who seek to modify their behavior for effective control of blood glucose and blood pressure. Given that behavior modification programs targeting individuals with diabetes and hypertension are prevalent in primary care settings and hospitals, having an instrument for monitoring patients' health behavior is essential.

This instrument plays a crucial role in such programs, positively impacting the knowledge, motivation, and behavioral skills of diabetes patients and ultimately contributing to the achievement of proper glycemic control, blood pressure management[7,8], and diabetes self-care behaviors based on the IMB model[23]. Its clinical validation ensures its effectiveness as a valuable tool in the healthcare domain.

The overall values of the IOC suggest that the instrument exhibits good relevance and representativeness for monitoring health behavior. The potential benefits of using this tool are evident in the data obtained from the pilot testing conducted among diabetes persons with hypertension. The scale was found to be relatively user-friendly, requiring only 20-30 minutes for completion. According to feedback from our pilot testing, the tool demonstrated effectiveness as a measurement instrument across three domains: diet, exercise, and medication use. This effectiveness was expressed in terms of comprehension and application. All of the instruments exhibited satisfactory to excellent validity and reliability, leading to the conclusion that the instrument is suitable for use among diabetes persons with hypertension.

A notable limitation is the relatively small sample size and the fact that the sources of the samples are somewhat concentrated. It is advisable to augment the overall sample size and broaden the scope of sample selection in future research endeavors. This expansion would contribute to a more robust examination of the questionnaire's validity including Confirmatory Factor Analysis (CFA), providing a more comprehensive understanding of its performance across diverse populations and settings.

Conclusion

This study introduces a novel tool, the EEMQ, designed for monitoring health behavior in the domains of diet, exercise, and medication use among diabetes persons with hypertension. The development of this tool was informed by a thorough review of existing literature,

particularly drawing upon the IMB model. The EEMQ comprises 38 items distributed across three domains, providing a comprehensive reflection of a patient's health behavior. The demonstrated good validity and reliability suggest that this newly developed tool can be effectively employed for monitoring health behavior in diabetes persons with hypertension.

Acknowledgement

This study was conducted to partially fulfill the requirements for a Ph.D. degree in Nursing, which was funded by the 90th Anniversary of Chulalongkorn University Scholarship. The authors thank the 90th Anniversary of Chulalongkorn University Fund and the Faculty of Nursing, Chulalongkorn University, for supporting this doctoral course study. We also express our deepest thanks to the Samakkee Primary Care Units and the Burapa Community Medical Center, Primary Care Units, Mahasarakham Hospital, and its patients for their cooperation.

Funding sources

This research is funded by the 90th Anniversary of Chulalongkorn University Scholarship (Ratchadaphiseksomphot Endowment Fund).

Conflict of interest

The authors have no conflict of interest to declare.

References

1. ElSayed NA, Aleppo G, Aroda VR, Bannuru RR, Brown FM, Bruemmer D, et al. 5. Facilitating positive health behaviors and well-being to improve health outcomes: standards of care in diabetes-2023. Diabetes Care 2023;46(Suppl 1):S68–96. doi: 10.2337/dc23-S005.
2. Matarid SM. Diabetes mellitus control and chronic kidney disease. Am J Chem Pharm 2023;2:9-14. doi: 10.54536/ajcp.v2i2.1612.
3. Valenzuela PL, Santos-Lozano A, Castillo-García A, Ruilope LM, Lucia A. Diabetes, hypertension, and the mediating role of lifestyle: A cross-sectional analysis in a large cohort of adults. Am J Prev Med 2022;63:e21–9. doi: 10.1016/j.amepre.2022.01.014.
4. Kumar V, Agarwal S, Saboo B, Makkar B. RSSDI Guidelines for the management of hypertension in patients with diabetes mellitus. Int J Diabetes Dev Ctries 2022. doi: 10.1007/s13410-022-01143-7.
5. American Diabetes Association. 5. Facilitating positive health behaviors and well-being to improve health outcomes: Standards of care in diabetes-2024. Diabetes Care 2024;47(Suppl 1):S77–110. doi: org/10.2337/dc24-S005.
6. Fisher WA, Fisher JD, Harman J. The information-motivation-behavioral skills model: a general social psychological approach to understanding and promoting health behavior. In: Suls J, Wallston KA, editors. Social psychological foundations of health and illness. Malden, MA: Blackwell Publishing; 2003. doi: 10.1002/9780470753552.ch4.
7. Kasar KS, Asiret GD, Yilmaz CK, Canlar S. The effect of model-based telephone counseling on HbA1c and self-management for individuals with type 2 diabetes: a randomized controlled trial. Primary Care Diabetes 2022;16:41-8. doi: 10.1016/j.pcd.2021.09.005.
8. Kim Y, Lee H, Seo JM. Integrated diabetes self-management program using smartphone application: a randomized controlled trial. West J Nurs Res 2022;44:383–94. doi: 10.1177/0193945921994912.
9. Avegno KS, Roberson KB, Onsomu EO, Edwards MF, Dean EL, Bertoni AG. Evaluating a telephone and home blood pressure monitoring intervention to improve blood pressure control and self-care behaviors in adults with low-socioeconomic status. Int J Environ Res Public Health 2023;20:1-15. doi: 10.3390/ijerph20075287.
10. Suvamat J, Powwattana A, Thaingtham W, Pichayapinyo P, Boonlue S. Effectiveness of program to slow progression of chronic kidney disease among T2DM with HT with CKD 3 in the community: a randomized controlled trial. J Prim Care Community Health 2023;14:1–8. doi: 10.1177/21501319231210619.
11. Zhao M, Rodrigueza MA, Wanga B, Anae EJS, Friedberga J, Fangd Y, Allegranteg JP, Natarajana S. Validity and reliability of a short self-efficacy instrument for hypertension treatment adherence among adults with uncontrolled hypertension. Patient Educ Couns 2020:104:1781-8. doi: 10.1016/j.pec.2020.12.029.

12. Dai Z, Jing S, Liu X, Zhang H, Wu Y, Wang H, et al. Development and validation of the diabetic self-management scale based on information-motivation-behavioral skills theory. Front Public Health 2023;11:1-10. doi: 10.3389/fpubh.2023.1109158.
13. Kerari A. The psychometric properties of the Diabetes Self-Efficacy Scale in Saudis with type 2 diabetes. Nurs Open 2023; 10:6408–15. doi:10.1002/nop2.1890.
14. Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika 1951;16:297–334.
15. Streiner DL, Norman GR. Health measurement scales: a practical guide to their development and use. Oxford: Oxford University Press; 2015;7-29.
16. American Diabetes Association. 10. Cardiovascular disease and risk management: standards of care in diabetes-2024. Diabetes Care 2024;47(Suppl 1):S179–218. doi: 10.2337/dc24-S010.
17. Diabetes Association of Thailand. Clinical practice guideline for diabetes 2023. Bangkok: Srimuang Printing; 2023.
18. Diabetes Association of Thailand. Carb counting. Bangkok: Diabetes Association of Thailand; 2019.
19. Thai Hypertension Society. 2019 Thai guidelines on the treatment of hypertension. Bangkok: Thai Hypertension Society; 2019.
20. Swan K, Speyer R, Scharitzer M, Farneti D, Brown T, Woisard V, et al. Measuring what matters in healthcare: a practical guide to psychometric principles and instrument development. Front Psychol 2023;14:1-18. doi: 10.3389/fpsyg.2023.1225850.
21. Rovinelli RJ, Hambleton RK. On the use of content specialists in the assessment of criterion-referenced test item validity. The Annual Meeting of the American Educational Research Association, San Francisco; 1976.
22. Turner RC, Carlson L. Indexes of item-objective congruence for multidimensional items. Int J Test 2003;3:163-171.
23. Greco LM, O'Boyle EH, Cockburn BS, Yuan Z. Meta-analysis of coefficient alpha: a reliability generalization study. J Manag Stud 2018;55:583-618. doi:10.1111/joms.12328.
24. Gao J, Wang J, Zhu Y, Yu J. Validation of an information–motivation–behavioral skills model of self-care among Chinese adults with type 2 diabetes. BMC Public Health 2013;13:1-6. doi: 10.1186/1471-2458-13-100.