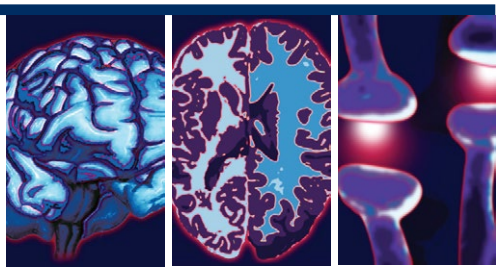

Assessment of the Chinese Version of the Form C of the MHLC scales in Glucose intolerant subjects in Taiwan

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Abstract

The purpose of this study is to develop a Chinese version the Form C of the Multidimensional Health Locus of Control (CMHLC form C) scale using two-way translation and then examined reliability and validity. This study executed in two phases. In the first, the researchers translated the English version MHLC form C scale into Chinese using forward and backward translation. In the second, this study was to establish internal consistency and construct validity data for the CMHLC form C scale in community-dwelling adults with glucose intolerant subjects. The CMHLC Form C scale consisted of 17-item and revealed a clear pattern of loading across the three factors named 'chance', 'internal' and 'other people' with good internal consistency (0.82). Confirmatory factor analysis was performed and results showed that χ^2=229.49 (*df*=116, *p*=0.00), χ^2=1.978 and GFI=0.89 were somewhat below expectation; however, the CFI of 0.94, the IFI of 0.94, and RMSEA of 0.068 were indicative of good model fit. Results suggest that the CMHLC Form C scale can be a reliable and valid outcome assessment tool for using in community-based studies of glucose intolerant subjects. Also, this scale is very useful in understanding the health behavior control in diabetic patients in Chinese people in Taiwan.

Keywords

CMHLC Form C scale, Glucose intolerant subjects, Health belief

Introduction

Diabetes is a chronic diseases and common health problem in the general population. Impaired glucose tolerance (IGT) and impaired fasting glycaemia (IFG) are intermediate conditions in the transition between normality and diabetes. People with IGT or IFG are at high risk of progressing to type II diabetes, although this is not inevitable. The WHO indicated that diabetes patients had 80 million in 1990 and 170 million in 2000; however, 347 million people worldwide have diabetes in 2011 [1]. In 2004, an estimated 3.4 million people died from consequences of fasting high blood sugar [2]. A similar number of deaths have been estimated for 2010. More than 80% of diabetes deaths occur in low- and middle-income countries [3]. WHO projects that diabetes will be the 7th leading cause of death in 2030.

Both sustained lifestyle changes in diet and physical activity can reduce the risk of developing type II diabetes [4]. Adults with diabetes should be advised to perform at least 150 min/week of moderate-intensity aerobic physical activity (50–70% of maximum heart rate), spread over at least 3 days/week with no more than 2 consecutive days without exercise [5]. Previous study had demonstrated regular exercise can increased vascular density in skeletal muscle, and thus enhance insulin-stimulated glucose conductor (glucose transporter, Glu-4) transport in sensitive muscle fibers cause increased intracellular

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increase glycolytic and oxidative activity of meat on the back of an animal [6]. Recent studies have examined the effects of began on pancreatic β-cell function, found moderate-intensity aerobic exercise can improve the pancreatic β cell function in patients with the [7-9]. Therefore, regular exercise is a key factor in preventing the occurrence of diabetes complications and control of diabetes progression. Although most patients with diabetes understand the importance of regular exercise, but the actual implementation situation is not good. According to the US Third National Health and Nutrition Examination Survey (NHANES) reports that patients with type II diabetes diet 1/3 do not regular exercise, and the case law of motion, 38 % less movement the American Diabetes Association (ADA) of the recommended amount, that is at least 150 minutes per week or three days a week of moderate-intensity aerobic exercise [10]. In Taiwan, diabetes, according to a total treatment strategy to promote the network also found that diabetics motion less than ideal adherence, 67.3% of patients exercise less than three times a week [11].

Health locus of control is an important doctor-patient communication and the relationship between health behavior and personal health-related behavior through cognitive and behavioral motivation [12]. In the doctor-patient communication, the higher the patient has a high level of commitment and internal control, with fewer physicians' control, the patient presented a better health [13]. Therefore, clinicians and researchers need to assess health locus control to identify diabetes' think about health locus of control for developing treatment plans.

The original MHLC scale (forms A & B) was developed by Wallston, Wallston and DeVellis [14]. In 1973, the MHLC scale splits externality into two distinct dimensions – powerful others and chance [15] to be the Form C of the MHLC (MHLC Form C) scale which contains four subscales: internal (6-item), chance (6-item), other people (3-item), and doctors (3-item). It is a condition-specific locus of control scale to measure personal beliefs and easily be adapted for use any medical or health-related condition, including rheumatoid arthritis, chronic pain, diabetes, or cancer. The 18-item MHLC Form C scale uses a 6-point Likert response format ranging from strongly disagree (1) to strongly agree (6). Higher scores indicate greater belief in that subscale domain in relation to health.

The MHLC Form C scale has been used extensively in a variety of clinical populations. The original authors have established the good reliability and validity of the resultant four subscales [12,15]. Apart from the original articles, other studies have evaluated the psychometric properties of the MHLC Form C scale and reported good reliability and validity [16,17]. The MHLC Form C scale translated to Chinese version (C-MHLC-C) in 2001 and applied to test Chinese haemodialysis patients' health behavior in Hong Kong [18], and then the C-MHLC-C scale (Hong Kong) was used to examine psychometric evaluation in the third trimester of pregnancy in Hong Kong. Unfortunately, the C-MHLC-C scale (Hong Kong) was failed in a valid and reliable measure of locus of control (LOC) in pregnant Chinese women in Hong Kong [19]. However, published psychometric data on the use of the CMHLC Form C scale in Chinese patients would not find in Taiwan, and also cannot use the C-MHLC-C scale (Hong Kong) to examine Chinese patients in Taiwan because culture and using language are different in Chinese between Taiwan and Hong Kong. It is important that this is first paper to translate the MHLC Form C scale into Chinese using two-way translation (forward and backward translation) and to test reliability and validity.

We developed the CMHLC Form C scale after obtaining permission from the original authors of the MHLC Form C. The purpose of this study is to develop a Chinese version the Form C of the Multidimensional Health Locus of Control using two-way translation and then examined the scale's psychometric properties including reliability, convergent, and discriminant validity.

Methods

■ Participants and ethical issues

The study was based on data from the grand of a series of studies investigating the exercise behavior model and exploring the effectiveness of interventions among pre-diabetes, type I, and type II diabetes, which was approved by the IRB of Taipei Medical University (TMU-JIRB: approval No. 201205036). Participants were informed about the study's purpose and the confidentiality of their individual data. Participants were also advised of their right to withdraw from the research study by simply failing to complete the questionnaire. We recruited 213 participants from Catholic

Cardinal Tien Hospital in North of Taiwan in 2013. The participants who were diagnosis of diabetes were included. The CMHLC Form C scale was filled out by participants with the assistance from a research assistant.

■ Translation of the CMHLC Form C

The Form C of the MHLC scale was first translated into Mandarin Chinese (the Form C of the MHLC) by a bilingual researcher (Chiu EC). An independent bilingual researcher (Li CP) then translated back the first version of the Form C of the MHLC into English for content comparison. The author (Lee SF) who is also proficient in both English and Mandarin Chinese compared the content of each item in this back translated version with its corresponding item in the original English version. The content of the final CMHLC Form C scale was further verified by back translation procedure until both translated and back-translated versions were considered completely interchangeable, conceptually, and linguistically.

■ Statistical analyses

In this study, exploratory factor analysis (EFA) using principal component factor analysis with an oblique and varimax rotations explored the initial factor solution. The original MHLC Form C scale consists four subscales; therefore, we fixed factor's number as four to extract. The resulting factor solutions were evaluated against the following criteria: (1) unrotated factors were required to satisfy Kaiser's (1958) criterion of eigenvalues >1.00; (2) accepted configurations had to account for an appreciable percentage of total score variance; (3) each rotated factor should include at least two appreciable factor loadings (i.e., ≧0.4); (4) no items should load on more than one factor; and (5) resultant dimensions should demonstrate good internal consistency [20].

The confirmatory factor analysis (CFA) was produced that examined validity of the fear of crime scale. The criteria of good-fit-index were (1) the relative chi-square criterion for acceptance ranging from less than 2 to less than 5 [21,22]; (2) comparative fit index, CFI) was >0.9, [23,24]; (3) the incremental fit index (IFI) was >0.9 for avoiding the underestimation of fit in small samples [21]; (4) the goodness of fit index (GFI) should be more than 0.5 and it is more realistic goodness fit when numbers of parameters are more [25]; and (5) the root mean square error of approximation (RMSEA) values ≤0.05 as a good fit; 0.05-0.07 as an adequate fit; 0.08-0.10 as mediocre fit; and >0.1 indicating not acceptable [26].

It is absolutely necessary to establish convergent and discriminant validity, as well as reliability, when doing a CFA. The reliability in CFA was measured by the Composite Reliability (CR). The convergent validity examined how individual items are related to their own factor and was assessed using the Composite Reliability (CR) and Average Variance Extracted (AVE) values [27]. Hair, *et al.* suggested that CR>AVE and AVE>0.5 [28].

The discriminant validity was assessed by comparing the square root of the AVE associated with a particular construct must be greater than its correlations with other constructs [27]. In addition to reporting CR and AVE, maximum shared variance (MSV) and average shared variance were also reported. MSV reports the maximum of the variances shared between a factor and the other factors with which it shares variance. In contrast, ASV is the average of the variances shared between a factor and other factors with which it shares variance. Hair, *et al.* suggested that CR>AVE; MSV<AVE; and ASV<AVE, all indices are positive; therefore, the total test results would tend to support discriminant validity [28].

Exploratory factor analysis was performed using SPSS 18.0 with the principal components analysis (PCA) and confirmatory factor analyses were conducted by using the LISREL 8.80 program with maximum likelihood estimation with standardized factor loadings to report statistical estimates of the free parameters.

Results

A total of 213 participants ranged from 19 to 88 years of age with a mean age of 55.7 years and included 102 (47.9%) male and 111 female (52.1%). The characteristics of the participants are shown in **Table 1**. Participants were more likely to be female, married, elementary school, full-time work, no drinking, no smoking, having diabetes family history, having chronic history, and rated health to be fair.

■ Internal consistency

Principal component factor analysis obtained a KMO value of 0.819, indicating the sample size was of good for factor analysis. In this study, we fixed factor's number as four to extract and

Table 1: Descriptive statistics.

Variables	N	%	Mean	SD
Age	213		55.70	11.03
Gender				
Male	102	47.9		
Female	111	52.1		
Marital status				
Unmarried	31	14.6		
Married	160	75.1		
Others	22	10.3		
Education				
Elementary school	94	44.2		
High school	88	41.3		
High school above	31	14.5		
Working status				
None	75	35.2		
Part-time	33	15.5		
Full-time	105	49.3		
Socio-economic status				
High	81	38.0		
Medium	57	26.8		
Low	81	35.2		
Drinking				
No	155	72.80		
Quit	22	10.3		
Yes	36	16.9		
Smoking				
No	137	64.3		
Quit	38	17.8		
Yes	38	17.8		
Exercise stage				
Pre-contemplation Stage	32	15.0		
Contemplation Stage	93	43.7		
Preparation Stage	30	14.1		
Action Stage	46	21.6		
Maintenance Stage	12	5.6		
Diabetes family history				
No	41	19.2		
Yes	172	80.8		
Chronic history				
No	48	22.5		
Yes	165	77.5		
Self-rated health				
Poor	49	23.0		
Fair	137	64.3		
Good	27	12.7		
HbA1c			8.05	1.46
Good	46	21.6		
Fair	117	54.9		
Poor	50	23.5		

it did not successful, and then we tried three factors to refine scale as first-order analysis. The random eigenvalues and scree plot presented three factors, thus we decided to use three factors [29]. However, only the item 10 (In order for my glycerol control to improve, it is up to other people to see that the right things happen.) had factor loading value below 0.4 and became an independent factor; most of the coefficients are higher or closer to the benchmark of 0.4. Thus, the item 10 was dropped from the scale.

The 17-item CMHLC Form C which measure 3 underlying dimensions of health locus of control and the results revealed a clear pattern of item loading across the three factors named 'internal' (8-item), 'chance' (6-item), and 'other people' (3-item) and satisfied Kaiser's eigenvalue criterion as presented in **Table 2** [30]. Three factors explain 46.30% of the variance in the 17-item. The Cronbach's reliability tests were show on the CMHLC Form C (17 items) was 0.63, factor 'internal' was 0.76, factor 'chance' was 0.75, and factor 'other people' was 0.65. [31]. The alpha values of scale reliability resulted in acceptable levels of internal consistency.

Validity

CFA was assessed in order to examine the validity of the items and underlying constructs in the measurement model. The factor model tested and the fit indices are shown in **Table 3**. The loadings of the items on their respective factors in the first-order model range from 0.20 to 0.79 and second-order model range from 0.26 to 0.87 with all being significant at the 0.05% level **(Table 3)**. Standardized estimates for fully first-order model were χ^2=229.49 (*df*=116, *p*<0.00, χ^2=1.978); CFI=0.94; IFI=0.94; GFI=0.89; and RMSEA=0.068, and second-order model were χ^2=323.41 (*df*=119, *p*<0.00, χ^2=2.718); CFI=0.84; IFI=0.84; GFI=0.84; and RMSEA=0.09. Not surprise, the study's chi-square was significant; the model is regarded as unacceptable. However, the relative chi-square for the study was 1.978 and 2.718 which fitted the criterion is less than 5 [21,22]. Although chi-square and the GFI were somewhat below expectation, the relative chi-square, CFI, IFI, and RMSEA were indicative of good model fit in this sample.

The reliability in CFA was measured by the CR for three factors were 0.78 (internal), 0.77 (chance), and 0.65 (other people) as shown in **Table 4**. In this study, AVE ranged were 0.33 and 0.39 and did not match the recommended threshold of 0.5 [31]; however, Hair, *et al.* suggested that CR>AVE, MSV<AVE, and ASV<AVE. In this study, all indices matched this criterion, indicated modest convergent validity for each construct, and also support discriminant validity [28].

Table 2: EFA factor loadings for the Form C of the MHLC Scales using CPA (Varimax with Kaiser Normalization).

		Item	F1	F2	F3
Internal	1.	If my glycerol control worsens, it is my own behavior which determines how soon I will feel better again.	.42		
	3.	If I see my doctor regularly, I am less likely to have problems with my glycerol control.	.58		
	5.	Whenever my glycerol control worsens, I should consult a medically trained professional.	.60		
	6.	I am directly responsible for my glycerol control getting better or worse.	.70		
	8.	Whatever goes wrong with my glycerol control is my own fault.	.49		
	12.	The main thing which affects my glycerol control is what I myself do.	.59		
	14.	Following doctor's orders to the letter is the best way to keep my glycerol control from getting any worse.	.76		
	17.	If my glycerol control takes a turn for the worse, it is because I have not been taking proper care of myself.	.69		
Chance	2.	As to my glycerol control, what will be will be.		.45	
	4.	Most things that affect my glycerol control happen to me by chance.		.51	
	9.	Luck plays a big part in determining how my glycerol control improves.		.70	
	11.	Whatever improvement occurs with my glycerol control is largely a matter of good fortune.		.67	
	15.	If my glycerol control worsens, it's a matter of fate.		.65	
	16.	If I am lucky, my glycerol control will get better.		.75	
Other people	7.	Other people play a big role in whether my glycerol control improves, stays the same, or gets worse.			.67
	13.	I deserve the credit when my glycerol control improves and the blame when it gets worse.			.70
	18.	The type of help I receive from other people determines how soon my glycerol control improves.			.76
Eigenvalues			3.49	3.01	1.84
Percentage of variance			19.4%	16.7%	10.2%
Cumulative percentage of variance			19.4%	36.1%	46.3%
Cronbach's Alpha			.76	.75	.65

Table 3: CFA for the Form C of the MHLC Scales in first and second order.

		Item	First-order		Second-order	
			λ	ε	λ	ε
Internal	1.	If my glycerol control worsens, it is my own behavior which determines how soon I will feel better again.	.43	.82	.76	.42
	3.	If I see my doctor regularly, I am less likely to have problems with my glycerol control.	.37	.87	.46	.79
	5.	Whenever my glycerol control worsens, I should consult a medically trained professional.	.39	.85	.48	.77
	6.	I am directly responsible for my glycerol control getting better or worse.	.63	.60	.71	.50
	8.	Whatever goes wrong with my glycerol control is my own fault.	.43	.81	.53	.72
	12.	The main thing which affects my glycerol control is what I myself do.	.70	.52	.75	.43
	14.	Following doctor's orders to the letter is the best way to keep my glycerol control from getting any worse.	.71	.50	.79	.37
	17.	If my glycerol control takes a turn for the worse, it is because I have not been taking proper care of myself.	.75	.43	80	.35
Chance	2.	As to my glycerol control, what will be will be.	.54	.70	.74	.45
	4.	Most things that affect my glycerol control happen to me by chance.	.20	.96	.26	.93
	9.	Luck plays a big part in determining how my glycerol control improves.	.62	.62	.67	.55
	11.	Whatever improvement occurs with my glycerol control is largely a matter of good fortune.	.64	.59	.69	.53
	15.	If my glycerol control worsens, it's a matter of fate.	.75	.43	.79	.37
	16.	If I am lucky, my glycerol control will get better.	.79	.38	.86	.30
Other people	7.	Other people play a big role in whether my glycerol control improves, stays the same, or gets worse.	.67	.55	.87	.25
	13.	I deserve the credit when my glycerol control improves and the blame when it gets worse.	.52	.73	.43	.81
	18.	The type of help I receive from other people determines how soon my glycerol control improves.	.66	.56	.57	.67
Goodness of fit statistics						

First order
χ^2=229.49 (p=0.00); df=116; (χ^2/df=1.978); CFI=0.94; IFI=0.94; GFI=0.89; RMSEA=0.068
Second order
χ^2 = 323.41 (p =0.00); df=119; (χ^2/df = 2.718); CFI = 0.84; IFI = 0.84; GFI = 0.84; RMSEA = 0.09

Table 4: Results of reliability, convergent and discriminant validity for the Form C of the MHLC Scales in first order.

	Variance and Reliability						Factor Correlations		
	CR	AVE	MSV	ASV	Convergent Validity CR>AVE	Discriminant Validity MSV<AVE ASV<AVE	Internal	Chance	Other people
Internal	.78 (.87)[b]	.33 (.46)[b]	.27	.21	Yes	Yes	**.11**[a]		
Chance	.77 (.84)[b]	.39 (.48)[b]	.14	.08	Yes	Yes	-.52	**.15**[a]	
Other people	.65 (.67)[b]	.39 (.42)[b]	.02	.15	Yes	Yes	.15	.38	**.15**[a]

[a]Square root of AVE in bold on diagonals.
[b]CFA second order.

Discussion

The present research examined the psychometric properties of the CMHLC Form C as an instrument of choice for testing locus of control in Chinese diabetes patients in Taiwan. This study modified the MHLC Form C to the CMHLC Form C with 17-item (three factors: internal, chance, and other people). It is essential to create and identify the CMHLC Form C scale that is valid, reliable, and consistent measure of LOC in diabetes patients in Taiwan because the CMHLC Form C scale has not been systematically validated in a Chinese population. There is only a full validation of the measurement will allow insights into the impact of cultural factors on LOC during pregnancy; furthermore, the other study also examined the C-MHLC-C scale in pregnancy in Hong Kong. Indeed, on the subject of the CMHLC Form C scale needs further researches in the Chinese community-based engaging in health services in general.

The CMHLC Form C scale translated and modified from the MHLC Form C scale but had some changed according to Chinese culture and linguistic barriers. In the CMHLC Form C scale, there has only 6-item in 'chance' factor the same as Wallston's research [12]. Compared to Wallston's research, the 'internal' factor has 8-item because item 13 moved to 'other people' factor and added items 3, 5, and 14 from original factor 'doctor'; and then 'other people' factor kept item 7 and 18, added item 13, and dropped item 10 in the CMHLC Form C scale [12].

The need to consider cultural factors in the care of diabetes patients has been identified for several decades. Our study showed that Chinese patients are unique to their cultures. For example, patients used traditional treatments and the use of herbal medicine either before seeing a medical doctor or concurrently. In addition to patients who do not follow directions given by health practitioners as being a part of ineffective patient-doctor communication. However, whether seeing a medical doctor or not became personal belief and decision. Thus, items 3, 5, and 14 from original factor 'doctor' moved to 'internal' factor.

The item 10 was dropped from the CMHLC Form C scale attributable to whether adherence failure or successful is the patient's problem and nothing to do with others in Chinese culture. The item 13 moved to 'other people' factor may cause by patient's health condition interfere with social or personal activities of daily living and how diabetes patients are perceived and treated by their family. Some Chinese people may believe that family support is a blessing related wealth and prosperity.

The finding from this study revealed three subscales showed to match the criteria for acceptability in internal consistency analysis. The CFA revealed that the best fit to the data was offered by the three-factor correlated model and confirmed second-order model of CMHLC Form C; however, this finding does not consistent with the validation of the original MHLC Form C scale. Overall, the results from reliability, convergent, and discriminant validity suggest that the CMHLC Form C scale is a valid, reliable, and consistent measure of health LOC in diabetes patients in Taiwan.

Although the results of the study are significant, it is worth considering some of the limitations of the present study. First, although the sample has good explanatory model, a larger sample could help to reveal small population effects. Second limitation of this study model is the absence of other diseases and health people. Since there may a heterogeneous sample from different locations in Taiwan may help to understand the LOC in

people. Third, this study is limited to linguistic barriers in translation and presented different meaning between Western people and Chinese people. Although we are bilingual person but not professional interpreters or native speaker; however, the two-way translation could result in inaccurate translations between English and Chinese.

Conclusion

In conclusion, the results from this study demonstrated that the proposed CMHLC Form C scale can be a useful tool to help nurses or other medical professionals in understanding the health and behavior in controlling diabetic patients even though there may be room for modification of the scale measurement. Therefore, use of the CMHLC Form C scale should help to provide a better understanding of Taiwanese health beliefs and behaviors and could also be beneficial for developing and modifying effective diabetes education programs.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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