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RESEARCH ARTICLE

Psychometric properties of multidimensional health locus of control scale, form C among Iranian type 2 diabetes

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Abstract

Objective This study aimed at examining the psychometric properties of Persian version of Multidimensional Health Locus of Control scale, form C (MHLC-C) among Iranian type 2 diabetes.

Method This cross sectional study was conducted on 557 type 2 diabetes in eastern city of Iran in 2022. Participants were selected by proportional stratified sampling. The validity of MHLC-C was tested by face validity, content validity, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA).Reliability of MHLC-C was assessed by McDonald omega coefficient, Cronbach's alpha coefficient, and Intraclass Correlation Coefficient.

Results Based on the results of EFA, 4 factors with eigenvalues greater than 1 were extracted, which explained 61.66% of the variance. In EFA, a question was removed. In CFA, the factor loading of all questions was more than 0.4 and the indexes of the goodness-of-fit were acceptable (for example: $X^2/df = 4.457$, RMSEA: 0.079, CFI = 0.904, and PGFI = 0.663). McDonald omega coefficient and Cronbach's alpha coefficient of MHLC-C were 0.869 and 0.866. The Intraclass Correlation Coefficient of MHLC-C was 0.817. Finally, the MHLC-C with 17 questions and 4 factors of chance (6 items), internal (5 items), other powerful people (3 items), and doctors (3 items) was approved.

Conclusions The Persian version of the MHLC-C questionnaire, with 17 questions and four factors, is a valid and reliable scale for Iranian type 2 diabetes to assess their health locus of control status.

Keywords Validity · Reliability · Psychometric · Health Locus of Control scales form C · Factor analysis · Type 2 diabetes

Abbreviations

χ2	Chi-square indicators
AGFI	Adjusted goodness of fit index
BTS	Bartlett's test of Sphericity
CFA	Confirmatory factor analysis
CFI	Comparative fit index
df	Degree of freedom
EFA	Exploratory factor analysis
F1	Chance
F2	Internal

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F3	Other powerful people
F4	Doctors
GFI	Goodness of fit index
HLOC	Health Locus of Control
ICC	Intraclass Correlation Coefficient
IDF	International Diabetes Federation
IFI	Incremental fit index
KMO	Kaiser-Meyer-Olkin
MHLC-C	Multidimensional Health Locus of Control scale, form C
PCFI	Parsimony comparative fit index
PGFI	Parsimony goodness of fit index
PNFI	Parsimonious normed fit index
RMSEA	Root mean square error of approximation

Introduction

Diabetes is one of the most serious and common chronic diseases that threaten life, increases healthcare costs, disabling complications, and reduces life expectancy [1, 2]. Global prevalence of diabetes according to International Diabetes Federation (IDF) was reported 9% (463 million adults), in 2019, and expected to increase the prevalence of diabetes to 700 million by 2045 [3]. Also in 2019, IDF ranked the Middle East and North Africa as areas with the highest global prevalence of diabetes [3]. According to a systematic review study in Iran, the prevalence of type 2 diabetes is estimated at 24%, that increases 0.4% each year after the age of 20 [4]. In 2017, approximately five million adults in Iran had diabetes and it is estimated that by 2030, 9.2 million people in Iran will have diabetes [5].

In patients with diabetes, psychosocial properties, mainly caused by emotional stress associated with diabetes, may interfere with self-care behaviors and lead to poor blood sugar control and worsen diabetes over time [6, 7]. It is also believed that these psychological properties may be related to the perceived Health Locus of Control (HLOC) [6, 7]. One of the factors affecting self-care behavior is HLOC. In diabetics, changes in HLOC may precede changes in self-care behaviors. In fact, several previous studies have shown that type 2 diabetic with internal HLOC showed better diabetic diet adaptation, better adherence to self-care behaviors, and better glycemic control [6, 8].

HLOC is in fact the degree of belief that the health of diabetic patients is under control of Internal or external factors [9, 10]. People with internal HLOCs believe that their health directly depends on their actions and behaviors, whereas those with external HLOCs believe their health is related to factors such as doctors, chance, and other powerful people [9, 10]. Multidimensional Health Locus of Control scale is designed and evaluated by Wallston et al. This scale has three versions of form A, form B, and form C. Form C is designed to evaluate the HLOC with any medical condition (13). According to Wallston et al. form C is used for special situations and can be used instead of form A or B for people with health and medical problems such as diabetes, cancer, etc. [9, 10]. Form C was designed and evaluated in 1994; contains 18 questions, four subscales of chance with 6 items, internal with 6 items, other powerful people with 3 items, and doctors with 3 items [9].

The availability of a valid and reliable tool is an important part of any study; it helps researchers to collect accurate and more credible information. Accurate collection of information in any target group can help a better design and implementation of preventive programs [11–13]. Therefore, it is necessary to examine the psychometric properties of each instrument before conducting an analytical study [11–13]. The psychometric properties of form C have been evaluated for various target groups in different regions of the world [14–18]. Given that this form has not been studied in type 2 diabetic patients, this study aimed to determine the psychometric properties of Multidimensional Health Locus of Control scale, form C among Iranian type 2 diabetes.

Methods

This cross sectional study was aimed to survey the validity and reliability if Persian version of Multidimensional Health Locus of Control scale, form C on 557 type 2 diabetes in eastern city of Iran in 2022.

Sample size

To conduct the exploratory factor analysis, a sample size of 100 is weak, 200 is relatively good, 300 is good, 500 is very good, and 1000 or more is excellent [19, 20]. In this study, EFA was tested on 306 participants and CFA was tested on 557 participants.

Sampling method

Participants entered the study by proportional stratified sampling. At first, all of health centers were determined and each health center was considered as a stratum. Then, the required sample size was selected by simple random sampling based on the population of each stratum. In this study, the inclusion criteria were people who had tendency to participate the study, people who have been diagnosed as type 2 diabetes based on the laboratory result, and participants who had type 2 diabetic more than 1 year.

Instruments

1) ***Demographic questionnaire***: In this section, questions of participant's age, age of the beginning of diabetes, duration of the diabetes, education level, gender, marital status, and job status were surveyed.
2) ***Multidimensional Health Locus of Control scale, form C (MHLC-C)***: This scale was designed and evaluated by Wallston in 1994. This scale contains 18 questions, four subscales of chance (6 items), internal (6 items), other powerful people (3 items), and doctors (3 items). All questions are measured by the 6-scale Likert (completely agreement to completely disagreement) [9]. Based on the results of Wallston study, EFA showed 4 factors with 18 questions and explained 57.6% of the variance. The amount of Cronbach's alpha coefficient in all factors were more than 0.70 [9].

Translation and cultural adaptation

Three steps were performed to investigate the translation and cultural adaptation of the questionnaire. At first, the original English version of the tools was translated by two experts to Persian language. Then, two translated questionnaires were reviewed and compared, and a Persian version was extracted. After that, again, the Persian version was translated by two experts to English version. This translated English version was compared with the original English version. Finally, the English version was finalized and translated into Persian.

Validity

Resource suggests that translated questionnaires do not need to assess quantitative face validity and quantitative content validity [21]. In this study, using original and standard questionnaires, only qualitative face validity and content validity were investigated.

Face and content validity

To check the qualitative face validity, the scale will be evaluated among numbers of type 2 diabetes in terms of difficulty, relevance, ambiguity, and suitability of each question and the required correction will be made. Also, the face validity and content validity will be evaluated by 10 specialists in field of health education and health promotion and filed of public health in terms of the use of appropriate words, grammar the words, the importance of items, placement of items in the proper place, time required to answer each question and the required correction will be made.

EFA phase

The $SPSS_{V22}$ software was used for conducted EFA. At first, to check adequacy of the sample and the suitability of data, the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of Sphericity (BTS) were used [22, 23]. In EFA stage, to explore the number of potential underlying factors, the minimum factor loading of 0.4, scree plot, and eigenvalues more than 1 were used [24, 25]. In EFA, it explains at least of 60% of the variance by extracted factors is acceptable [26, 27].

CFA phase

The AMOS $_{v24}$ software was used for conducted CFA. In CFA, the outlier's data were assessed by Mahalanobis statistical index. The data normality were checked by skewness and kurtosis. To survey the goodness-of-fit of the model, the beloved indicators were used. These indicators consist of chi-square ratio to degree of freedom ($x2/df < 5$), goodness of fit index ($GFI > 0.9$), root mean square error of approximation ($RMSEA < 0.08$), incremental fit index ($IFI > 0.9$), comparative fit index ($CFI > 0.9$), adjusted goodness of fit index ($AGFI > 0.8$), parsimony comparative fit index ($PCFI > 0.5$), parsimony goodness-of-fit index ($PGFI > 0.5$), and parsimonious normed fit index ($PNFI > 0.5$) [28–31].

Reliability

To assess the internal consistency of the questionnaire in this study, the McDonald omega coefficient, and Cronbach's alpha coefficient were used. The score of Cronbach's alpha coefficient between 0.70 and 0.95 is acceptable [32, 33]. Test-retest reliability was used to investigate the stability of a measurement over time. To evaluate test-retest in this study, Intraclass Correlation Coefficient (ICC) was used. The score of ICC more than 0.80 is acceptable [34].

Results

Descriptive characteristics

The mean (± standard deviation) age of patients was 55.88 (± 13.14). The mean (± SD) age of the beginning of diabetes and duration of the diabetes were 46.70 (± 12.36) and 9.10 (± 7.26), respectively. Based on the results of Table 1, most of the participants were females (n = 358, 64.3%), housewives (n = 300, 53.9%), married (n = 546, 98%), and had elementary education (n = 202, 36.3%). Other demographic information is mentioned in Table 1.

Table 1 Frequency distribution of demographic characteristics (n = 557)

Variables		N	%
Sex	Men	199	35.7
	Women	358	64.3
Marital status	Married	546	98
	Single	11	2
Education level	Illiterate	25	4.5
	Elementary	202	36.3
	Middle school	87	15.6
	High school	43	7.7
	Diploma	100	18
	Associate or Bachelor's Degree	85	15.3
	Master's degree or High degree	15	2.7
Job	Housewife	300	53.9
	Employed	93	16.7
	Self-employed	98	17.6
	Unemployed	4	0.7
	labor	11	2
	Retired	51	9.2

EFA phase

Based on the results of KMO and BTS, the sample size was sufficient (KMO = 0.856, BTS: $p < 0.001$, $\chi 2 = 2310.622$, df = 153). In the EFA stage, 4 factors with eigenvalues greater than 1 were extracted, and these factors explained 61.66% of the variance. EFA results showed that these extracted factors were the same as the original scale factors (the original questionnaire had 4 factors). In this study, only one question (N18: When my diabetes improves, I deserve encouragement and I deserve to blame when it gets worse) was deleted (Tables 2 and 3). The Scree plot of factor analysis in EFA is shown in Fig. 1.

Table 3 Rotated Factor Matrix of the Persian version of MHLC-C

Rotated Component Matrix[a]				
Items	Component			
	F1: Chance	F2: Internal	F3: Other powerful people	F4: Doctors
N1	**0.838**	0.099	0.041	0.024
N2	**0.771**	0.082	0.028	0.196
N3	**0.738**	0.158	−0.104	0.179
N4	**0.719**	−0.022	−0.001	0.383
N5	**0.718**	0.247	−0.024	−0.057
N6	**0.429**	0.365	−0.211	0.335
N7	0.170	**0.828**	0.061	0.143
N8	0.113	**0.786**	0.227	0.190
N9	0.075	**0.769**	−0.088	0.072
N10	0.145	**0.716**	0.186	0.246
N11	0.294	**0.550**	0.275	0.277
N12	−0.170	−0.007	**0.827**	0.062
N13	−0.005	0.083	**0.811**	0.088
N14	0.092	0.259	**0.769**	0.040
N15	0.268	0.207	0.012	**0.728**
N16	0.335	0.047	−0.018	**0.681**
N17	0.066	0.360	0.188	**0.626**
N18	−0.093	0.304	0.191	**0.445**

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 6 iterations.

Table 2 The fourfactor structure of the Persian version of MHLC-C

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.701	31.674	31.674	5.701	31.674	31.674	3.447	19.150	19.150
2	2.727	15.152	46.826	2.727	15.152	46.826	3.286	18.258	37.408
3	1.563	8.686	55.512	1.563	8.686	55.512	2.237	12.426	49.834
4	1.107	6.150	61.662	1.107	6.150	61.662	2.129	11.828	61.662
5	0.918	5.102	66.764						
6	0.796	4.422	71.186						
7	0.704	3.911	75.097						
8	0.641	3.559	78.656						
9	0.584	3.246	81.901						
10	0.490	2.723	84.625						
11	0.462	2.568	87.192						
12	0.414	2.298	89.490						
13	0.410	2.277	91.767						
14	0.360	1.999	93.766						
15	0.319	1.775	95.541						
16	0.300	1.668	97.209						
17	0.270	1.501	98.710						
18	0.232	1.290	100.000						

Extraction Method: Principal Component Analysis

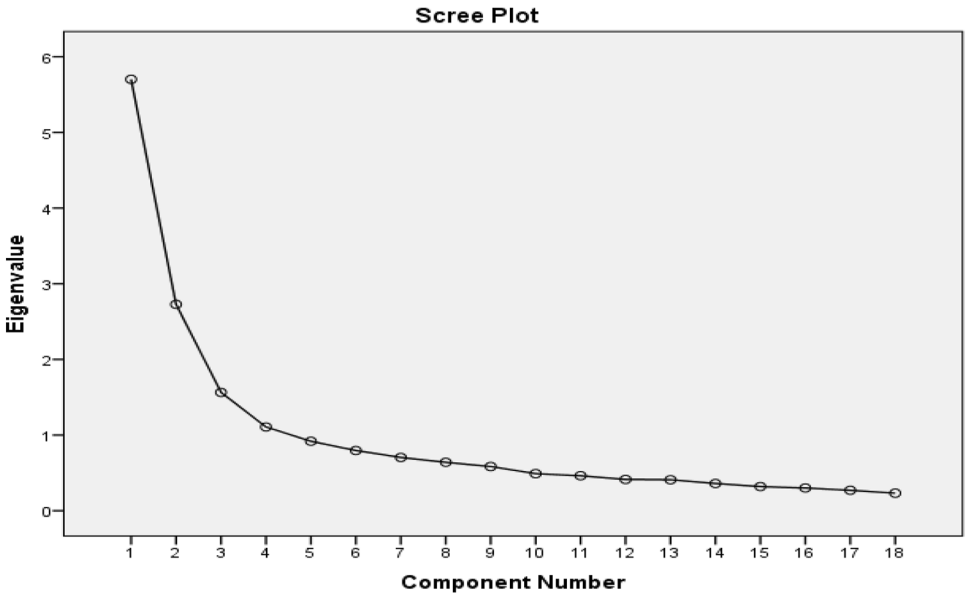

Fig. 1 Scree plot of the factor analysis of the Persian version of MHLC-C

Table 4 The model fit indicators of the Persian version of MHLC-C

Goodness of fit indices	Confirmatory factor analysis	Acceptable value
X^2	499.221	-
df	112	-
X^2/df	4.457	< 5
P-value	< 0.001	P > 0.05
CFI	0.904	> 0.9
GFI	0.905	> 0.9
RMSEA	0.079	< 0.08
IFI	0.904	> 0.9
PNFI	0.725	> 0.5
PCFI	0.744	> 0.5
PGFI	0.663	> 0.5
AGFI	0.870	> 0.8

CFA phase

The four factors extracted in EFA were entered in CFA and none of the questions were removed. The indexes of the goodness-of-fit were acceptable and the final model with 17 questions and the 4 factors of chance (6 items), internal (5 items), other powerful people (3 items), and doctors (3 items) were approved (Table 4). Also, the factor loading of all questions was more than 0.4 (Table 5; Fig. 2).

Reliability

McDonald omega coefficient and Cronbach's alpha coefficient of MHLC-C were 0.869 and 0.866. Cronbach's alpha coefficient of chance, internal, other powerful people, and doctors were 0.879, 0.820, 0.766, and 0.651, respectively (Table 6). The ICC of MHLC-C was 0.817. The ICC of chance, internal, other powerful people, and doctors were 0.832, 0.836, 0.946, and 0.925, respectively (Table 6).

Discussion

The purpose of this study was to investigate the validity and reliability of MHLC-C to provide a proper tool among Iranian type 2 diabetes. The results of EFA in this study showed that the four components extracted from MHLC-C in EFA explained 61.66% of the variance, indicating that these factors extracted in EFA were acceptable. In this study, 4 factors of chance with 6 items, internal with 5 items, other powerful people with 3 items, and doctors with 3 items were extracted in EFA stage. Only one item (Q18) was deleted, because it was placed in the incorrect factor. In original questionnaire [9], this question was related to internal factor, but in this study, this question was placed in the doctors factor. The results of this study were also similar with the results of other studies in the various target groups [15, 18, 35]. In this study, 4 factor extracted in EFA with 17 items were approved in CFA.

Based on the results of Lundgren's study, 4 factors of chance with 6 items, internal with 6 items, other powerful people with 3 items, and doctors with 3 items were extracted [17]. In Mani's study, 4 factors of chance with 6 items, internal with 6 items, other powerful people with 3 items, and doctors with 3 items were extracted and explained 60% of the variance [14]. Also in Mirzania's study, 4 factors extracted and explained 51% of the variance [18]. Results of Pereira's study showed 4 factors (chance HLOC, internal HLOC, healthcare professionals HLOC, and other people

Table 5 Factor loadings of the Persian version of MHLC-C

Components	Items	Factor loadings
Factor 1: Chance	N1: Chances play a major role in how my diabetes improves	0.889
	N2: If I'm lucky, my diabetes will get better	0.753
	N3: If my diabetes gets worse, it is because of my fate	0.727
	N4: Most of the things that affect my diabetes are a chance to me.	0.765
	N5: Whatever happens to improve my diabetes is a lot of my luck	0.801
	N6: Whatever happens for my diabetes illness, it will be the same, I and no one else can affect it	0.481
Factor 2: Internal	N7: I am blamed for worsening my diabetes disease	0.767
	N8: I am directly responsible for better or worse my diabetes	0.798
	N9: If my diabetes gets worse, it is because I didn't take care of myself well.	0.634
	N10: It is my own behavior that has an important effect on my diabetes	0.699
	N11: If my diabetes gets worse, it is my own behavior that determines that I will get better again soon	0.562
Factor3: Other powerful people	N12: Others play an important role in improving my diabetes	0.724
	N13: Improving my diabetes depends on the type of help I receive from others	0.682
	N14: Other people play an important role in my diabetes to improve, stay constant or worsen	0.757
Factor4: Doctors	N15: If I see a doctor regularly, I will probably have fewer problems with my diabetic disease	0.652
	N16: Whenever my diabetes gets worse, I should consult a specialist physician.	0.632
	N17: Following doctor's instructions is the best way to prevent my diabetes from getting worse	0.580
N18: When my diabetes improves, I deserve encouragement and I deserve to blame when it gets worse		Deleted

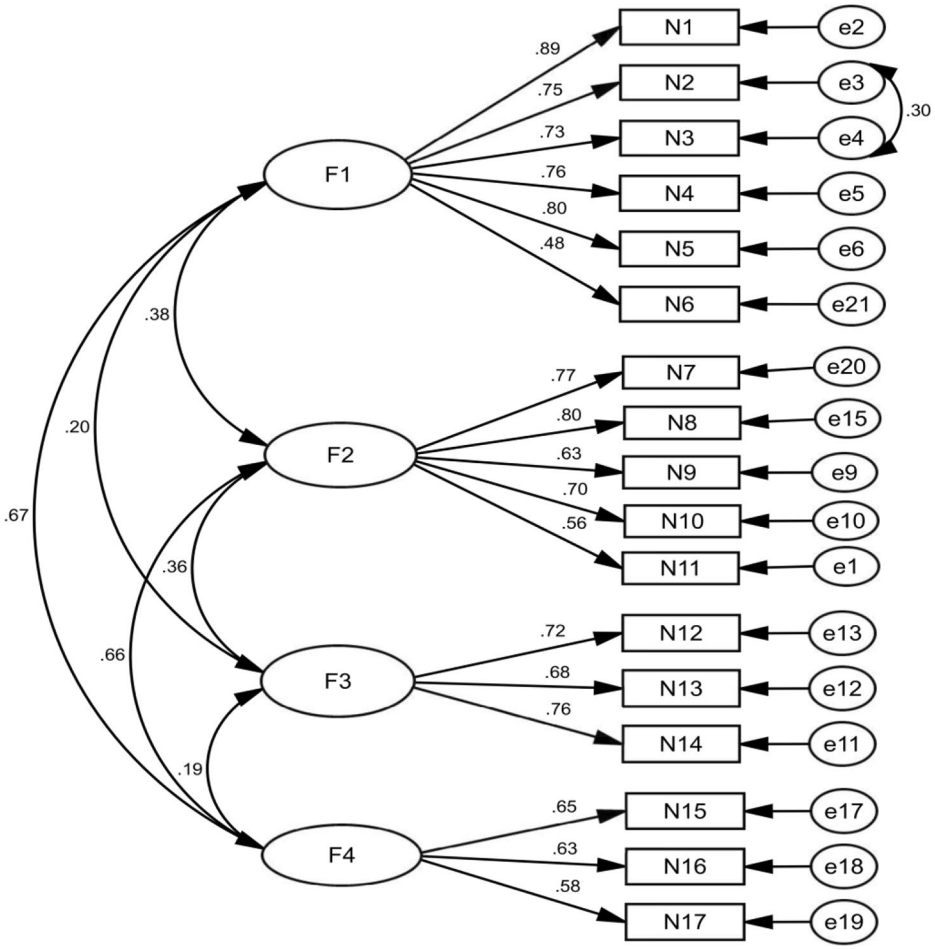

Fig. 2 Standardized parameter estimates for the factor structure of MHLC-C (F1: Chance, F2: Internal, F3: Other powerful people, F4: Doctors)

HLOC) with 18 items and explained 48.7% of the variance [15].

In this study the Cronbach's alpha coefficient and ICC of MHLC-C were 0.866 and 0.817, respectively. In Mani's

Table 6 Descriptive statistics of the Persian version of MHLC-C

Components	Item	Range	Cronbach's alpha coefficients	McDonald's omega coefficients	Intraclass Correlation Coefficient (ICC)	95% Confidence Interval		P-value
						Lower Bound	Upper Bound	
Factor 1: Chance	6	6–36	0.879	0.884	0.832	0.651	0.920	< 0.001
Factor 2: Internal	5	5–30	0.820	0.823	0.836	0.656	0.922	< 0.001
Factor 3: Other powerful people	3	3–18	0.766	0.767	0.946	0.887	0.974	< 0.001
Factor 4: Doctors	3	3–18	0.651	0.655	0.925	0.844	0.964	< 0.001
Total MHLC-C	17	17–102	0.866	0.869	0.817	0.619	0.912	< 0.001

study, the Cronbach's alpha coefficient of MHLC-C was 0.849 [14]. The Pereira's study, the value of 0.748 was reported for Cronbach's alpha coefficient of MHLC-C [15]. The results of this study showed a significant positive correlation among the factors, similar to the results of Wallston's study [9]. Psychometric experts mentioned that strong correlations between factors indicate good internal cohesion and appropriate credibility [32].

The first factor of this questionnaire is chance HLOC. This factor refers to the degree of one's belief in the fact that their health is due to luck and fortune [10]. This factor was approved by 6 questions, McDonald omega coefficient 0.884, ICC 0.832, Cronbach's alpha coefficient 0.879, and factor loading 0.481 to 0.889. In Mani's study, the chance factor with 6 questions and Cronbach's alpha coefficient 0.79 was approved [14]. The results of Lundgren's study indicated that the chance factor with 6 questions, Cronbach's alpha coefficient 0.82, and ICC 0.76 was approved [17]. In another study, Cronbach's alpha coefficient of chance factor was reported 0.90 [18].

The second factor of this questionnaire is internal HLOC. This factor refers to the degree of belief in the fact that the individual's internal HLOC and their behaviors are responsible for their illness and health [10]. This factor was approved by 5 questions, McDonald omega coefficient 0.823, ICC 0.836, Cronbach's alpha coefficient 0.820, and factor loading 0.562 to 0.798. The results of a study indicated that the internal HLOC with 6 questions, Cronbach's alpha coefficient 0.81, and ICC 0.78 was approved [17]. In another study, the internal HLOC with 6 questions and Cronbach's alpha coefficient 0.77 was approved [14]. In Mirzania's study, Cronbach's alpha coefficient of internal HLOC was reported as 0.82 [18].

The third factor of this questionnaire is other powerful people HLOC. This factor refers to the degree of belief in the fact that their health is determined by other powerful people and that the individual has no effect on this regard [10]. This factor was approved by 3 questions, McDonald omega coefficient 0.767, ICC 0.946, Cronbach's alpha coefficient 0.766, and factor loading 0.682 to 0.757. The results of Lundgren's study indicated that the other powerful people HLOC with 3 questions, Cronbach's alpha coefficient 0.61, and ICC 0.68 was approved [17]. In another study, the other powerful people HLOC with 6 questions and Cronbach's alpha coefficient 0.63 was approved [14]. Results a study reported that the Cronbach's alpha coefficient of other powerful people HLOC was 0.75 [18].

The fourth factor of this questionnaire is doctors HLOC. This factor refers to the degree of belief in the fact that their health is determined by doctors and that the individual has no effect on this regard [10].This factor was approved by 3 questions, McDonald omega coefficient 0.655, ICC 0.925, Cronbach's alpha coefficient 0.651, and factor loading 0.580 to 0.652. The results of a study indicated that the doctors HLOC with 3 questions, Cronbach's alpha coefficient 0.71, and ICC 0.66 was approved [17]. In another study, the doctors HLOC with 6 questions and Cronbach's alpha coefficient 0.66 was approved [14].

Strengths and limitations

The COVID-19 pandemic has made it difficult to collect information. Also, because the information is complemented by the questionnaire and self-report, it may have some error. In Self -report studies at the time of filling the questionnaire are inherently biased by one's emotions. One of the strengths of this study was performed the validity stage by using content validity, face validity, EFA, and CFA. Also, to evaluate the reliability, McDonald's omega coefficient Cronbach's alpha coefficient, and test-retest (ICC) were used. The large sample size and adequate different sample size for performed EFA and CFA were another strength of this study.

Conclusion

The Persian version of the MHLC-C with 17 questions and the 4 factors of chance with 6 items, internal with 5 items, other powerful people with 3 items, and doctors with 3 items is a valid and reliable scale and can be used among Iranian type 2 diabetes to assess their HLOC status.

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Declarations

Ethical consideration This study is based on a research project approved by Ethics Committee of Gonabad University of Medical Sciences with the code of ethics IR.GMU.REC.1401.018. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable. Written Informed Consent was obtained from all subjects.

Conflict of Interest The authors declare that they have no competing interests.

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