

Confirmatory Factor Analysis (CFA) and Psychometric Validation of Healthy Lifestyle and Personal Control Questionnaire (HLPCQ) in India

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Abstract

Background: The silent epidemic of chronic illness has become a significant public health challenge worldwide. The prevention and management of these deadliest health conditions primarily require empowering the individual to make healthy choices every day, e.g., healthy eating, physical exercise, etc., The first step in designing an intervention for this comprises measuring the health empowerment-related factor. However, severe scarcity of practical tools is noted. **Objective:** The present study aimed at the evaluation of psychometric properties of a healthy lifestyle and personal control questionnaire (HLPCQ)'s English Version in the Indian population. **Method:** For this, a cross-sectional study was conducted on 618 people enlisted from the Northern state of India with the help of convenience sampling strategy. Data is collected by sharing the google form of HLPCQ through various online platforms. **Results:** The value of Cronbach alpha and MacDonald's Omega, was $>.70$, suggesting HLPCQ has good reliability in the Indian population. While confirmatory factor analysis result shows that the final model with 24 items has a good fit to the data (RMSEA = 0.04, CFI = 0.97, TLI = 0.96, SRMR = 0.03) which implies that HLPCQ has acceptable structural and cultural validity. While the value of average variance extracted (AVE) and composite reliability (CR) for each factor were found to be more than .50 and .70 respectively, indicating the presence of convergent and discriminant validity for HLPCQ. **Conclusion:** These findings indicate that the HLPCQ has sound psychometric properties and can be used in the Indian population.

Keywords: Confirmatory factor analysis, healthy lifestyle, personal control, psychometric properties

INTRODUCTION

Healthy lifestyle choices like regular physical activity, healthy eating, etc., have a crucial role in averting chronic or lifestyle illnesses like heart diseases, strokes, diabetes, etc., by up to 80%.^[1,2] Together, these diseases constitute the leading cause of death, killing an estimated 41 million people per year, accounting for seven out of ten death globally.^[3]

India is not different, according to its annual health report 2020–2021, the economic burden due to chronic illnesses has surpassed that of infectious diseases such as TB, HIV, etc., and comprises 60% of all deaths.^[4] Based on another study, researchers estimate that between 2012 and 2030, the economic burden of these illnesses will reach \$ 6.2 trillion, nearly nine times as much as the previous 19 years total health expenditure.

These diseases are primarily attributable to unhealthy lifestyle choices, such as poor diet, lack of exercise, etc.,^[1-4]

Therefore, the prevention, treatment, and management of these deadliest illnesses rely heavily on lifestyle modification and making healthy choices in everyday life.^[1-3] It implies that substantial management of emerging health issues cannot be executed merely via biomedical interventions and requires the integration of health promotion programs into public health policies.^[1,3,5]

The interventions under the health promotion Programs were supposed to emphasize lifestyle modification by

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empowering individuals to have personal control over their life circumstances and make healthy choices in everyday life.^[1,5] However, these programs focus haphazardly on healthy choices and disregard personal control training, thereby failing to produce the desired results in lifestyle modification and chronic disease management.^[1,5]

Although, personal control is found to have a fundamental role in making and shaping daily life choices.^[6] It is evident from various studies that making healthy choices even in a supportive and conducive environment is difficult for individuals if they lack control over their circumstances.^[7,8] Additionally, the current stressful environment has made decision-making and self-control practices more challenging.^[8] Work requirements, family development, and technological progress have exposed individuals to a variety of stressors and to alleviate this stress, they are compelled to favor the choices of immediate physical rewards and indulgence in unhealthy lifestyles.^[9]

Thus, it becomes imperative to design health promotion interventions that encourage both personal control training and making healthy choices in everyday life. The initial step in this direction entails measuring both lifestyle choices and personal control simultaneously. According to a review of the relevant literature, all available instruments assess either personal control or lifestyle choices. None of them measures these two factors simultaneously. For instance, the multidimensional health locus of control scale,^[10] self-esteem scale,^[11] etc., measure individual control. In contrast, the healthy lifestyle scale^[12] the healthy lifestyle screening instrument,^[13] etc., measure healthy lifestyle decisions.

To date, only one instrument, the healthy lifestyle and personal control questionnaire (HLPCQ) has been developed to assess the twin determinants of health promotion, namely healthy lifestyle choices and personal control.^[1] Initially, this instrument was developed in the Greek language. But, due to the ubiquitous need for health promotion interventions for the management of chronic illnesses, this tool was validated very soon in other cultures also, e.g. Persian,^[14] English,^[15] and Polish.^[16] The validation of the tool in desired cultures should be preferred over developing a new one as it reduces costs and time.^[17]

Furthermore, Indian health care researchers also have an urgent need for effective health promotion interventions to control the unprecedented rise in chronic illnesses.^[4] Consequently, HLPCQ's psychometric properties are required to be evaluated in Indian culture also. To ensure the quality of results, an instrument must have sound psychometric properties, which have been estimated by evaluating its reliability and validity.^[18] Provided this, the present research aims to test the following hypothesis.

Hypothesis 1: HLPCQ and its all dimensions would have significant construct validity (i.e., structural, cultural, convergent, and discriminant validity) in the Indian population.

Hypothesis 2: HLPCQ and its five dimensions have significant reliability, (i.e., internal consistency) in the Indian population.

MATERIALS AND METHODS

Ethics

The present study was carried out following ethical standards of seeking informed consent from each participant.

Setting and participants

In this cross-sectional research, participants are enlisted from North India, mainly Delhi-NCR, Dehradun, Lucknow, etc., using a convenience sampling strategy. The age of the participants varies from 20-60 years, with a mean (M) =32.34 years and standard deviation (SD) =9.52. The other socio-demographic characteristics of the participants are listed in Table 1.

Procedure

The data is collected by sharing the google form of the questionnaire to 700 individuals through academic groups available on various social networking platforms like What's App, Facebook, electronic mail, etc. Out of this, 618 respondents matched the criteria for final analysis.

Measures

The scale used in this study assesses healthy lifestyle choices and personal control simultaneously with the help of 26 positively stated sentences.^[1] The items are divided into five different dimensions - dietary health choices (DHC), dietary harm avoidance (DHA), daily routine (DR), organized physical activity (OPA), and social and mental balance (SMB) with 7, 4, 2, 8 and 5 items, respectively.^[1]

Responses to each item are recorded on a 4-point Likert Scale (1 = never, 2 = sometimes, 3 = often, 4 = always.). Reliability, i.e. Cronbach alpha coefficient of each subscale of the questionnaire's original version, i.e. DHC, DHA, DR, OPA, and SMB, is found to be 0.75, 0.65, 0.81, 0.78, and 0.63 respectively.^[1] Total scores and the score of each dimension of this questionnaire were calculated by summing the

Table 1: Socio-demographic characteristics of the sample

Variable	Category	Number of respondents in each category	Percentage (%) of total respondents (n=618)
Gender	Male	348	56.3
	Female	266	43.0
	Other	4	0.6
Education	Postgraduate	482	78.0
	Undergraduate	110	17.8
	Intermediate	18	2.9
	High School	8	1.3
Employment Status	Professional	395	63.9
	Semi-professional	107	17.3
	Skilled worker	58	9.4
	Semi-skilled worker	5	0.8
	Other	28	4.5
	Unemployed	25	4

scores. Higher scores indicated a healthier lifestyle or higher empowerment to have personal control and make healthy daily life choices.^[1]

Statistical analysis

First, the data were screened to check outliers, normality, and multicollinearity with the help of SPSS-21. After this, reliability assessment is done by using Cronbach’s alpha and Macdonald’s Omega. Afterward, confirmatory factor analysis for the specification and testing of best model fit, and calculation of Average Variance Extracted (AVE) and Composite Reliability (CR) is done to assess HLPCQ’s construct validity by providing evidence of structural, cultural, convergent and discriminant validity in the Indian population by using AMOS 22.

RESULTS

Initially, the data was screened to test the hypotheses of outliers via using leverage indices for each participant; multicollinearity via tolerance and variance inflation factor (VIF), and normality via kurtosis value.^[19] Sample adequacy was assessed using the Kaiser-Meyer-Olkein measure.^[19] The results of all these tests verify the suitability of data to run further appropriate statistical analyses to estimate measurement properties like confirmatory factor analysis (CFA).

Validity estimation

The validity ensures the accuracy of an instrument, and it has been estimated in the present research through construct validity by testing its evidence i.e. structural, and cultural validity and convergent and discriminant validity.^[18] For this CFA with maximum likelihood method is used as researchers have enough information on the dimensionality of HLPCQ, thus CFA with maximum likelihood method is used to test all evidence of construct validity^[18,20]

Structural and cultural validity

According to the previous literature, the measurement model of this scale has 26 observed variables, which are further divided into five latent variables, i.e. DHC, DHA, DR, OPA, and SMB with 7, 4, 8, 2, and 5 observed (indicator) variable respectively.^[1,14-16] To assess the consistency of hypothesized factorial structure in the Indian population, structural and cultural validity is estimated by evaluating standardized factor loading and fit indices.^[18,20]

The result of the initial parameter estimation given in Figure 1 shows that two items (DHC 6 and DHC 7) have low standardized factor loading compared to an acceptable cut-off value >.60.^[20] Both the items were removed sequentially, and the parameter estimation is rerun for the measurement model with 24 items. The results presented in Figure 2 show that each of the 24 items has factor loading above the accepted value of .60.^[21]

Afterwards, model fit for both models, one with 26 items and another with 24 items, were compared using multiple fit

indicators i.e., absolute fit indices assessed via Chi-square statistics, SRMR (Standardized Root Mean Square Residual), and GFI (Goodness of Fit Index) (GFI); adjusted for parsimony indices assessed with RMSEA (Root Mean Square Error of Approximation); relative fit indices which was assessed using CFI (Comparative Fit Index) and TLI (Tucker Lewis Index).^[19,21] Adequate model fit is defined using an established threshold value for each fit indicator given in Table 2.

The results in Table 2 suggest that both the models have good to acceptable model fit values. But after removing two items with very low factor loadings, the five-factor model with 24 items shows an equally better model fit value as compared to other one.^[19,21] This indicates that in the Indian population HLPCQ with 24 items with five factors has acceptable structural and cultural validity.

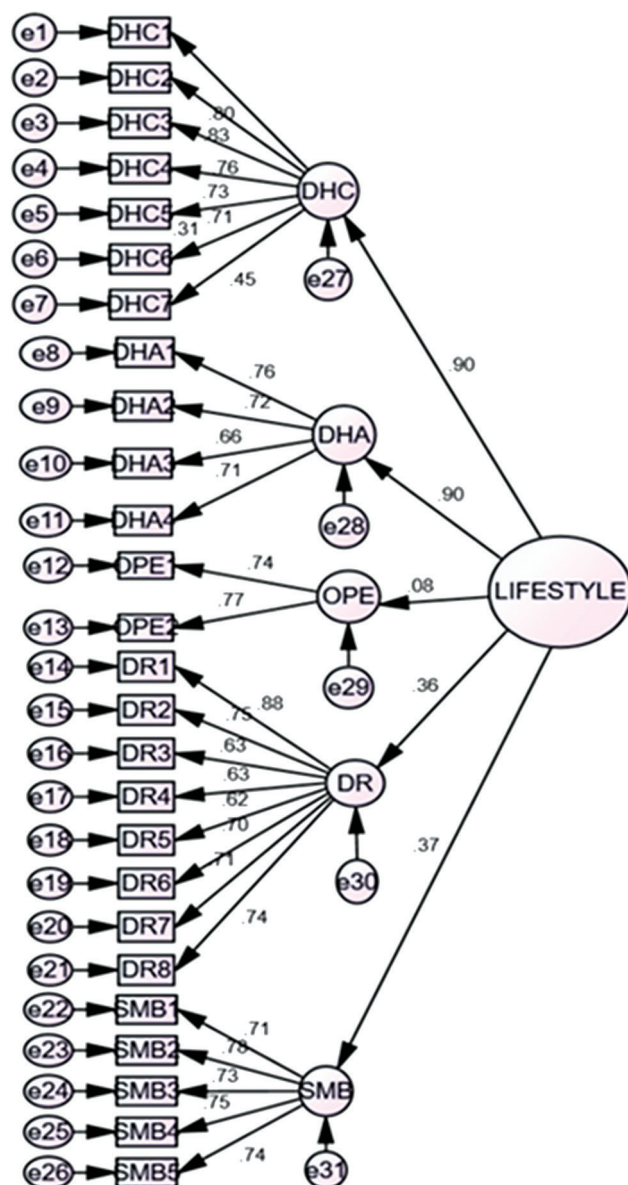


Figure 1: Measurement model of HLPCQ with 26 items

Convergent and discriminant validity

Convergent validity ensures that latent constructs meant for measuring the underlying factor are related as they are expected to be related theoretically.^[22] While discriminant validity ensures that latent constructs should differ empirically at the same time.^[22] Both types of validity are assessed by using the Fornell-Larcker criterion i.e., by estimating AVE (average variance extracted) and CR (composite reliability) calculated by using factor loading of each item.^[23] To observe the convergent validity the threshold value of AVE and CR should be ≥ 0.50 and ≥ 0.70 respectively.^[23,24] Referring to the results in Table 3, the AVE and CR values of each latent factor are ≥ 0.50 and ≥ 0.70 which implies that HLPCQ has good convergent validity.^[25]

According to Fornell-Larcker criterion discriminant validity is assessed by comparing the square root of each AVE given in the diagonal with the correlation coefficients (off-diagonal) for each construct.^[22,23] The results in Table 3 show that the square root value of AVE for each latent factor is high compared to its correlation value with other factors. It suggests that the latent construct of the proposed measurement model has significant discriminant validity.^[25] Results suggest that hypothesis 2 is also accepted as all four evidence of construct validity demonstrate that HLPCQ has good validity.

Reliability estimation

The scale's reliability is assessed through internal consistency by using Cronbach's alpha (α)^[26] and Omega coefficient (ω total)^[21] as each has its limitation and strength. Internal consistency signifies that items of a scale are interrelated and can reflect the underlying construct.^[27] It has been the most used measure to assess reliability.^[27] The results given in Table 3 show that the value of alpha and omega for each

latent factor is ≥ 0.70 , suggesting that hypothesis 1 is verified, HLPCQ has good internal consistency i.e., reliability in the Indian population.^[25,27]

DISCUSSION

A standardized and valid research instrument is the first requirement to get psychometrically relevant results.^[18,28] But construction and validation of a new tool each time involves a complex process and consumes much time and resources.^[28] Thus, the current research is conducted to assess model fit and psychometric validation of the already available tool HLPCQ in the Indian population for designing and evaluating health promotion programs.

This scale is reported to have adequate empirical and theoretical evidence, thus carried directly to CFA without running EFA.^[29] CFA represents a theory-driven technique that tests how the proposed factor structure can be replicated in another sample.^[30] The HLPCQ is a novel and robust tool developed initially in Greek and later adapted and validated in Persian, Polish, and U.S cultures.^[14-16] But these studies have overlooked the detailed estimation of psychometric properties. For instance, only HLPCQ's Persian version opted for CFA to estimate the validity.^[14] However, in the present study detailed analysis of psychometric properties was carried out to ensure its usability in Indian culture.

For this, concerning hypothesis 1 the reliability of HLPCQ in Indian culture is calculated using the Cronbach alpha and Omega coefficient.^[24,26] The previous studies have intensely articulated the limitation of Cronbach alpha and suggested using other better options such as the Omega coefficient.^[31] From the reliability analysis results given in Table 3, it is estimated that

Table 2: Goodness of fit index and cut-off values

	Model 1 5 Factor Model (With 26 variables)	Model 2 5 Factor Model (With 24 variables)	Good fit value	Acceptable fit Value
Chi square	1.9	1.8	0 < Chi square/df < 2	2 < Chi square/df < 3
SRMR	0.04	0.03	0 < SRMR < 0.05	0.05 SRMR < 0.08
GFI	0.93	0.94	0.95 < GFI < 1.00	0.90 < GFI < 0.95
RMSEA	0.05	0.04	0.00 < RMSEA < 0.05	0.05 < RMSEA < 0.08
CFI	0.96	0.97	0.95 < CFI < 1.00	0.90 < CFI < 0.95
TLI	0.95	0.96	0.95 < TLI < 1.00	0.90 < TLI < 1.00

Reference: Kline (2015) Standardized Root Mean Square Residual (SRMR), Goodness of Fit Index (GFI); Root Mean Square Error of Approximation (RMSEA); Comparative Fit Index (CFI) and Tucker Lewis Index (TLI)

Table 3: Results for Cronbach alpha, Omega coefficient, Composite reliability (CR); Average variance extracted (AVE), square root of the AVE (in bold), and correlations between constructs (off-diagonal)

Factors	Omega	Cronbach alpha	CR	AVE	DHC	DHA	DR	OPA	SMB
DHC	0.88	0.88	0.87	0.59	0.77				
DHA	0.81	0.80	0.81	0.51	0.58	0.71			
DR	0.89	0.89	0.89	0.52	0.29	0.25	0.72		
OPA	0.73	0.73	0.72	0.57	0.09	0.07	0.14	0.75	
SMB	0.86	0.86	0.85	0.55	0.26	0.28	0.27	0.06	0.74

DHC- Dietary harm control; DHA- Dietary harm avoidance; DR- Daily routine; OPA-Organised physical activity; SMB- Social and mental balance



Figure 2: Measurement model of HLPCQ with 24 items

the value of Cronbach alpha and Omega coefficient for all the subscales DHC, DHA, DR, OPE, and SMB is .88, .80, .89, .73, .86 and .88, .81, .89, .73, .86 respectively. It suggests that all the subscales have good reliability in the Indian population compared to its other versions such as Greek, Persian, and Polish, in which values range from .60 to .85.^[14-16]

Afterwards, to evaluate the second hypothesis i.e., to estimate all the four evidences of construct validity i.e., structural and cultural validity and convergent and discriminant validity, CFA was performed using two five-factor models: one with 26 items [Figure 1] and the second with 24 items [Figure 2].

Results of parameter estimation from Figure 1 show that two items under Dietary Health Control (DHC) factor, DHC 6 and DHC 7, have low factor loadings of .31 and .47 compared to the acceptable value of .60 or higher.^[21] It suggests that these two items are incongruent with Indian culture. For instance, cooking is seen as a female job in India and has been supported intensely by various religious and social factors. Thus, item DHC 6 (Do you like cooking) might have biased responses.^[32] While concerning item DHC 7 (Do you eat products with whole grains), a recent report of ICMR has found that Indians are essentially not familiar with the taste, texture, appearance, and nutritional value of whole grains.^[33] It hints that both the items are not consistent with Indian culture and thus have been removed subsequently.

Furthermore, the results of fit indices from Table 2 show that the value of fit indicators for both models lies in the good to an acceptable range. But the model with 24 items has slightly better fit (Chi-square = 1.8; SRMR = 0.04; GFI = 0.95; RMSEA = .03; CFI = .97; TLI = .96 in comparison to model with 26 items (Chi-square = 1.9; SRMR = .05; GFI = .93; RMSEA = .04; CFI = .95; TLI = .94.^[19,25] It suggests that item removal does not have any effect on model fit. Also, shortening the questionnaire was reported to have a positive effect in increasing the responses.^[34] Thus, the HLPCQ with 24 items is accepted to be used in Indian culture.

The values of model fit indicators for the model with 24 items agree with values in HLPCQ’s Persian version. However, the HLPCQ’s Persian version has not investigated the parameter estimation, which is imperative to know the strength of items.^[14,17] Afterward, the convergent validity results from Table 3 showed that the AVE and CR values for all five subscales exceeded the threshold value of >.50 and >.70 which suggests that HLPCQ has good convergent validity in the Indian population.

To establish the discriminant validity, the square root value of AVE for each latent variable should have a higher value than the correlation value with any other latent variable.^[23] The results given in Table 3 showed that the square roots of AVE for all the five latent variables were .77, .71, .72, .75, and .74 which were higher than the value of inter-construct correlation. It suggests that the subscales of HLPCQ have also fulfilled discriminant validity criteria.^[22,23]

However, in most validation studies of HLPCQ, a detailed discussion on construct validity i.e., on the suitability of its structure in respective culture is not given. Its English version validated on the nursing population in U.S culture and reported good convergent and discriminant validity.^[15] The original version of HLPCQ found criterion validity, which cannot be considered a substitute for construct validity.^[1,17]

In the present research, a detailed analysis of HLPCQ’s measurement properties is conducted to assess the scope of its applicability in Indian culture. The findings suggest that HLPCQ has good reliability and construct validity

i.e., structural, cultural, convergent, and discriminant validity in the Indian population. Thus, public health researchers and clinicians can consider using this tool in the Indian population to assess the individual's health empowerment via measuring their healthy choices and ability to have personal control in daily life.

It will help to conduct epidemiological studies, design interventions for lifestyle modification under the health promotion program and to evaluate the future outcome of these interventions. This study covers approximately all parameters required to establish the sound psychometric properties of an instrument.^[18] But in the future, behavioral medicine researchers should consider assessing the psychometric properties of a questionnaire consistent with globally accepted COSMIN guidelines to ensure the better quality of the measurement tool.

Acronym list: Healthy lifestyle choices and personal control questionnaire (HLPCQ), Dietary Harm control (DHC), Dietary harm avoidance (DHA), Organised physical activity (OPA), Social and mental balance (SMB), Daily routine (DR).

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Conflicts of interest

There are no conflicts of interest.

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