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## Psychometric properties of the Arabic translation of the “healthy lifestyle and personal control questionnaire” in patients with diabetes

Nawel Zammit<sup>1</sup>✉, Hamza El Fekih<sup>2</sup>, Marwa Mhamed<sup>1</sup>, Rim Ghammem<sup>1</sup>, Ghada Saad<sup>2</sup>, Sihem Ben Fredj<sup>1</sup>, Asma Aloui<sup>3</sup>, Houda Kalboussi<sup>1</sup>, Wided Debbabi<sup>4</sup>, Imed Harrabi<sup>1</sup>, Maher Maoua<sup>1</sup> & Yosra Hasni<sup>1</sup>

To assess the effectiveness of health promotion programs among Arabic-speaking patients, it is essential to have valid and reliable assessment tools in Arabic. The objectives of this study were: to translate the “Healthy Lifestyle and Personal Control Questionnaire (HLCQ)” into Arabic; and to study the psychometric properties of this version in a sample of Tunisian patients with diabetes. A cross-sectional study was conducted among consecutive patients followed for diabetes in an Endocrinology clinic in Tunisia. The HLCQ was translated into Arabic by two bilingual translators and back-translated by two other bilingual translators. The translated version was then administered by a medical doctor to participants via phone interviews. Statistical analyses included reliability testing using Cronbach's alpha, content validity and exploratory factor analysis. A total of 300 responses were obtained. The median age of participants was 57.5 years (IQR: 45.2–66.0). Females represented 55%. Cronbach's alpha coefficients exceeded 0.7 for almost all subscales. Exploratory factor analysis revealed nine factors explaining 65.9% of the total variance. Overall, the Arabic version of the HLCQ has satisfactory validity and reliability indices. It could be used to assess adherence to a healthy lifestyle among Tunisian patients and in other Arab-speaking countries.

**Keywords** Surveys and questionnaires, Psychometrics, Reproducibility of results, Factor analysis, statistical, Life style, Arabic

Diabetes contributes to 11.3% of deaths worldwide<sup>1</sup>, with 46.2% of these deaths occurring in individuals under the age of 60<sup>1</sup>. In Tunisia, the prevalence of diabetes is higher than the global average<sup>2</sup>. Moreover, this prevalence has increased from 15.5% in 2016 to 23% in 2023<sup>3</sup>. Satisfactory glycemic control is achieved in less than one-third of Tunisian patients with diabetes<sup>4</sup>. Poor adherence to a healthy lifestyle, as well as suboptimal medication compliance, have been identified as key contributors to this lack of control<sup>5</sup>.

Effective diabetes management must be based on a multidisciplinary education program that promotes a healthy lifestyle, enhances medication adherence and facilitates early detection of complications<sup>6</sup>.

Before implementing such programs, it is essential to have valid and reliable tools for assessing their effectiveness. Some scales have been validated in Arabic to assess medication adherence<sup>7</sup> and chronic disease self-management activities<sup>8,9</sup>. However, few instruments are available in Arabic for evaluating lifestyle and dietary adherence in adults. These tools are either too lengthy<sup>10–12</sup> or designed specifically for adolescents or young adults<sup>11,12</sup>.

<sup>1</sup>Faculty of Medicine of Sousse, Department of Epidemiology, «LR19SP03», University Hospital Farhat Hached, University of Sousse, Sousse 4000, Tunisia. <sup>2</sup>Faculty of Medicine of Sousse, Department of Endocrinology, University Hospital Farhat Hached, University of Sousse, Sousse 4000, Tunisia. <sup>3</sup>Faculty of Medicine of Sousse, Department of Occupational Medicine, «LR19SP03», University Hospital Farhat Hached, University of Sousse, Sousse 4000, Tunisia. <sup>4</sup>Faculty of Medicine of Sousse, Department of Endocrinology, University Hospital Ibn El Jazzar, University of Sousse, Kairouan, Tunisia. ✉email: nawelzommit@gmail.com

The “Healthy Lifestyle and Personal Control Questionnaire (HLPCQ)”, developed in 2014 by C. Daviri et al., consists of 26 items assessing the degree of autonomy in lifestyle choices<sup>13</sup>. It is recommended for evaluating health promotion interventions that actively engage patients<sup>13,14</sup>.

To date, this tool remains the only instrument that evaluates both key determinants of health promotion: healthy lifestyle choices and personal control<sup>13</sup>. The psychometric properties of its translated versions have been satisfactory in several countries<sup>13,15,16</sup>.

A valid and reliable Arabic version of this scale would be valuable for assessing the effectiveness of future health promotion programs among Arab speaking patients.

The present study aimed to translate the HLPCQ into Arabic and evaluating its psychometric properties among a sample of Tunisian patients with diabetes.

## Methods

### Study design

A cross-sectional study was conducted among patients with diabetes attending the outpatient unit of the Endocrinology Department at Farhat Hached University Hospital in Sousse (Tunisia) between November 2023 and May 2024.

### Study population

For internal validity studies regarding sample size, it is recommended to use the ratio of the number of subjects (n) to the number of items (p)<sup>17</sup>. This ratio can vary from three to ten. Other researchers suggest that a range of 200–300 participants is appropriate for factor analysis (19). Given that the HLPCQ scale contains 26 items and assuming a ratio n/p of 10, a minimum of 260 participants was required for the study.

Considering the lack of specific and updated lists of patients with diabetes followed in our outpatient Endocrinology clinic, randomization was not possible. Accordingly, during the study period, participation in the study was suggested for every patient with diabetes who had an appointment for a medical check-up and responded to the inclusion and non-inclusion criteria. The inclusion criteria were:

- -providing informed consent.
- -being available for an interview by phone.

Non-inclusion criteria were:

- -having participated in the questionnaire pre-test.
- -having any sensory or mental disorders that could make a phone interview impossible.

### Data collection

During the medical check-up appointment in the outpatient clinic, collected data included:

- -Sociodemographic characteristics.
- -Anthropometric measurements (weight and height) taken barefoot with light clothing.
- -Systolic and diastolic blood pressure readings, obtained using a manual sphygmomanometer after a minimum of 15 min rest with the arm supported at heart level.
- -Biological test results (HbA1C, total cholesterol, LDL, HDL, triglycerides, urea, creatinine and albuminuria), performed two days prior to the consultation.
- -The latest fundoscopy results.

Subsequently, participants were called by phone within three days after the medical check-up to administer the Arabic version of the HLPCQ scale (annex). This scale assesses the frequency of adopting lifestyle habits. The responses are rated on a four-point scale (1 = Never or rarely, 2 = Sometimes, 3 = Often, 4 = Always). These 26 items are grouped into five subscales:

1. Healthy dietary choices: 7 items, maximum score of 28.
2. Avoidance of harmful food: 4 items, maximum score of 16.
3. Daily time management: 8 items, maximum score of 32.
4. Structured physical activity: 2 items, maximum score of 8.
5. Social and mental balance: 5 items, maximum score of 20.

Evaluation is based on the total score, where a higher score indicates a healthier lifestyle. Each subscale can also be assessed separately<sup>13</sup>. The maximum overall score is 104.

The translation of the HLPCQ scale into Arabic and back-translation process were conducted following Guillemin's methodology<sup>18</sup>. The original version was independently translated into Arabic by two bilingual translators (family medicine residency trainees) who had been informed about the study's aims. A consensus meeting involving the two translators and the study coordinator (an associate professor of preventive medicine) was held to finalize the Arabic version of each item.

This Arabic version was then independently back-translated into English by two other bilingual translators (two other family medicine residency trainees) without access to the original scale.

A multidisciplinary panel of four bilingual experts (a professor and an associate professor of Occupational Medicine and two associate professors of Preventive Medicine) verified the equivalence between the original and back-translated versions. They also ensured the semantic fidelity and comprehensibility of the translated items.

The Arabic version of the scale was pre-tested among 10 patients with diabetes who met the inclusion criteria, as recommended<sup>19</sup>. The administration time by phone ranged between 4 and 8 min.

### Variables definitions

- - Overweight was defined by a body mass index (BMI) comprised between 25 and 29.9 kg/m<sup>20</sup>.
- - Obesity was defined by a BMI  $\geq 30$  kg/m<sup>20</sup>.
- - Poorly controlled diabetes was defined by a Glycated haemoglobin (HbA1C)  $> 7.5\%$ <sup>21</sup>.
- - Total cholesterol level was considered high when  $> 2$  g/L<sup>22</sup>.
- - HDL cholesterol level was considered low when  $< 0.5$  g/L in women and  $< 0.4$  g/L in men<sup>22</sup>.
- - Diabetic nephropathy was defined by albuminuria  $\geq 30$  mg/24 h, an albumin-to-creatinine ratio  $> 30$  mg/g, or creatinine clearance  $< 60$  mL/min/1.73 m<sup>23</sup>.
- - Diabetic retinopathy was determined by an annual fundus examination conducted by an ophthalmologist<sup>24</sup>.

### Data analysis

Data entry and analysis were conducted using the SPSS (Statistical Package for Social Sciences) Statistics for Windows, version 18.0 (SPSS Inc., Chicago, Ill., USA). Quantitative variables were described using medians and interquartile ranges (IQR). Qualitative variables were described using frequencies and percentages.

Regarding face validity, the length, item wording, and response options were revised by the four expert members. Additionally, after pre-test, items that were incomprehensible to two participants or more were reformulated by the expert group. A final verification was conducted by the study coordinator to identify and correct any potential translation errors.

To ensure content validity, the content validity ratio (CVR) was calculated for each item. For this purpose, seven experts (three endocrinologists, two epidemiologists and two professors of occupational medicine familiar with research studies on lifestyle) were asked to give a score from 1 to 3 on a scale, where 1 means the item is not necessary, 2 means the item is useful but not essential, and 3 means the item is essential<sup>25</sup>. The formula to determine CVR is as follows:  $CVR = (Ne - N/2) / (N/2)$ : where  $Ne$  is the number of experts giving a score of 3, and  $N$  is the total number of experts. The CVR value ranges from -1 to 1. The closer the value to 1, the higher the agreement among experts and the greater the likelihood the items should be included in the instrument. Conversely, the closer the value is to -1, the lower the agreement; meaning the items need to be removed or revised<sup>25</sup>. The minimum CVR value for seven-panel experts involved is 0.99<sup>26</sup>.

In addition, experts were asked to assess independently the relevance and clarity of each item considering the Tunisian cultural context. A content validation form was used for this purpose. The relevance of each item was rated on a four-point scale (1 = Not relevant; 2 = Somewhat relevant; 3 = Quite relevant; and 4 = Highly relevant). The clarity rating followed the same 1–4 scale. To calculate the Item content validity index (I-CVI) for relevance or clarity, the proportion of experts who gave a rating of either 3 or 4 to an item was divided by the total number of experts<sup>25</sup>. To measure the Scale level Content Validity Index (S-CVI), the average of all I-CVIs was calculated for relevance and clarity<sup>25</sup>. Considering that seven experts were involved in assessing content validity, the scale was considered to have excellent content validity when I-CVI is above 0.78 and S-CVI is above 0.90<sup>25</sup>.

The representativeness of the H LPCQ domains was preserved. No items were added or removed during translation.

The reliability of the questionnaire was assessed using Cronbach's alpha coefficient, which measures the internal consistency of items. A value greater than 0.70 was considered acceptable<sup>27</sup>.

For studying construct validity, exploratory factor analysis (EFA) was employed. Before performing EFA, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were conducted to assess the suitability of the dataset for factor analysis<sup>28</sup>. A KMO value greater than 0.80 indicates an intelligible and stable factorial structure; values between 0.60 and 0.80 indicate a moderate structure; and values below 0.60 reflect a poor and unstable structure<sup>28</sup>.

A statistically significant Bartlett's test ( $p < 0.05$ ) indicates that sufficient correlations exist between the variables to continue with the analysis<sup>28</sup>.

Principal Component Analysis (PCA) was used to extract factors. The number of components was determined using two criteria: eigenvalues and Cattell's scree plot<sup>28</sup>.

An eigenvalue greater than 1 was considered indicative of a significant factor<sup>29</sup>.

To simplify factor interpretation, Varimax orthogonal rotation was applied<sup>28</sup>. Items were then reorganized according to their loadings on each factor.

The component matrix was used to determine the weight of each item per factor<sup>30</sup>. Each item was assigned to the factor with which it had the highest correlation. An item was considered to belong to a factor if its loading was  $\geq 0.30$  in absolute value<sup>31</sup>.

Once item groupings were finalized, each factor was labeled based on the common theme of its items.

### Ethical considerations

The current study was conducted in accordance with the ethical principles of the Declaration of Helsinki. All study procedures complied with relevant institutional and international guidelines and regulations. The research protocol was reviewed and approved by the Research Ethics Committee of University Hospital Farhat Hached.

Characteristics	n	%
Sex		
male	135	45,0
female	165	55,0
Educational level		
Primary	151	50,4
Secondary	114	38,0
University	35	11,7
Medical history		
Current tobacco use	64	21,3
High blood pressure	127	42,0
Occurrence of cardiovascular events	36	12,0
Results of the clinical and biological check-ups		
Overweight	104	34,7
Obesity	105	35,0
HbA1C > 7,5%	185	65,0
Hypercholesterolemia	71	26,0
Low HDL	107	39,2
Microalbuminuria	49	16,3
Diabetic retinopathy	106	35,3

**Table 1.** Sociodemographic, clinical and biological profile of the participants ( $n=300$ ).

Score	Median	IQR
Dietary healthy choices	15,0	13,0–18,0
Dietary harm avoidance	11,0	10,0–13,0
Daily routine	21,0	20,0–23,0
Organized physical exercise	2,0	2,0–3,0
Social and Mental Balance	13,0	12,0–15,0
Total Score/104	66,0	60,0–70,0

**Table 2.** Total and sub-dimensions scores of the HLPCQ scale among participants ( $n=300$ ).

Oral informed consent was obtained from all participants prior to enrollment. Participation was voluntary. No financial compensation was provided. All collected data were handled confidentially.

## Results

### Descriptive analysis

The number of participants was 300. Their median age was 57,5 years (IQR: 45,2–66,0). Females represented 55% of the patients. During the clinical check-up, current tobacco use, and weight excess were found among 21,3% and 69,7% of participants, respectively. In addition, 65% had poor control of their diabetes, and 65% had dyslipidemia. Furthermore, microalbuminuria, diabetic retinopathy and cardiovascular events were present in 16,3%, 35,3% and 12% of participants, respectively (Table 1).

Administration of the translated HLPCQ scale revealed that the physical activity items (I20 and I21) were not applicable to seven participants because of disability. Otherwise, half of the respondents scored below two out of eight on the subscale: “organized physical activity physical activity”. Median scores for the other HLPCQ subscales were as follows: healthy dietary choices: 15 out of 28, avoidance of unhealthy food habits: 11 of 26, daily time management: 21 of 32, social and mental balance: 13 of 20, and total HLPCQ score: 66 of 104 (Table 2).

### Psychometric properties of the HLPCQ scale

#### Face validity

The final version of the scale, including revisions of item length, wording, and response options based on expert review and pretesting, is presented in the annex.

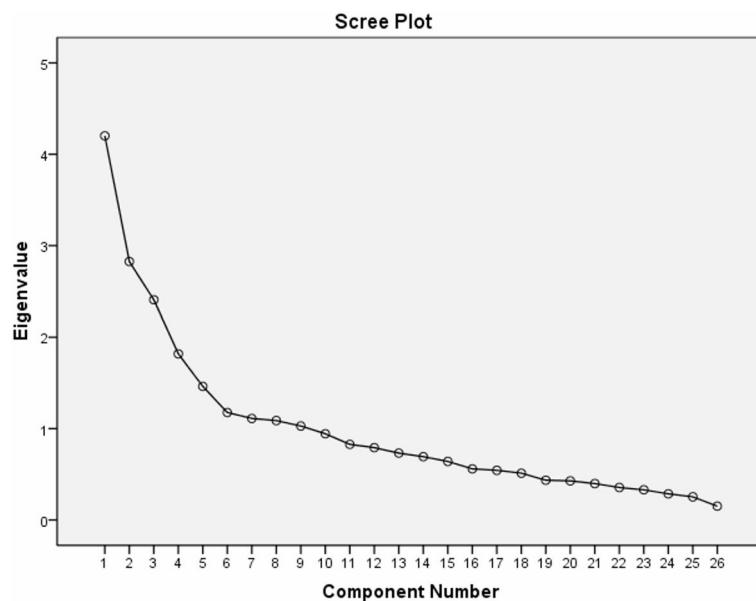
#### Content validity

The calculated CVRs for the 26 items were all equal to 1. In terms of relevance, the I-CVI calculated for the item 20: “Do you practice aerobic exercise for 20 or more minutes at least 3 times per week” was 0,86. This result indicates a necessary revision. The remaining items were appropriate.

Regarding clarity, the I-CVI related to item 20 was also 0,86. The experts proposed adding the following explanation: “Aerobic refers to exercises that increase breathing and heart rates”. Similarly, item 6: “Do you eat

Scale dimensions	Cronbach's coefficient $\alpha$
Dietary healthy choices	0.709
Dietary harm avoidance	0.712
Daily routine	0.769
Organized physical exercise	0.739
Social and Mental Balance	0.540
Overall scale	0.759

**Table 3.** Internal consistency analysis of the translated HLPCQ scale.



**Fig. 1.** Components eigenvalues of the translated HLPCQ Scale.

organic foods”, needed to be clearer ( $I\text{-CVI}=0.86$ ). Accordingly, the following explanation was added: “Foods naturally produced without artificial interventions”, to better explain the concept of “organic food”.

The S-CVI average scores were acceptable, with values of 0.994 for relevance and 0.989 for clarity.

#### Reliability

The HLPCQ scale showed acceptable overall reliability. For the total scale, the Cronbach's alpha coefficient was 0.759 which indicates good internal consistency among items (Table 4).

Subscale reliability analysis revealed Cronbach's alpha coefficients above 0.70 for four dimensions. However, for the social and mental balance subscale, reliability was lower ( $\alpha=0.540$ ) (Table 3).

#### Construct validity

Exploratory factor analysis resulted in a Kaiser-Meyer-Olkin (KMO) index of 0.716. Bartlett's test of sphericity was statistically significant ( $p<0.001$ ). Nine factors explaining 65.9% of the total variance were extracted (Fig. 1; Table 4). The nine factors identified were related to:

1. Food choices based on content.
2. Healthy lifestyle choices.
3. Avoidance of unhealthy foods.
4. Avoidance of situations conducive to unhealthy eating.
5. Eating rhythm.
6. Life rhythm.
7. Organized physical activity.
8. Social and mental balance.
9. Emotional openness.

After Varimax rotation, the component matrix showed that items I4, I7, I22 and I26 had loading values greater than 0.3 on two different factors (Table 4).

Items	Factors								
	1	2	3	4	5	6	7	8	9
I12	<b>0.826</b>								
I19	<b>0.803</b>								
I18	<b>0.738</b>								
I17	<b>0.683</b>								
I13	<b>0.666</b>								
I14	<b>0.342</b>								
I1		<b>0.844</b>							
I2		<b>0.735</b>							
I3		<b>0.582</b>							
I4		<b>0.490</b>		0.328					
I23			<b>0.787</b>						
I24			<b>0.760</b>						
I25			<b>0.639</b>						
I8				<b>0.856</b>					
I9				<b>0.856</b>					
I20					<b>0.854</b>				
I21					<b>0.835</b>				
I10						<b>0.855</b>			
I11						<b>0.845</b>			
I6							<b>0.756</b>		
I7		0.436					<b>0.676</b>		
I26				0.333		<b>0.443</b>			
I15							<b>0.740</b>		
I16							<b>0.730</b>		
I5								<b>0.829</b>	
I22			<b>0.476</b>						<b>0.578</b>

**Table 4.** Varimax-Rotated component matrix of the translated HLPCQ Scale. 1: Food choices based on content 2: Healthy lifestyle choices, 3: Avoidance of unhealthy foods, 4: Avoidance of situations conducive to unhealthy eating, 5: Eating rhythm, 6: Life rhythm, 7: Organized physical activity, 8: Social and mental balance, 9: Emotional openness.

## Discussion

The prevalence of diabetes has reached alarming levels in the Middle East and Tunisia<sup>32</sup>. Valid and reliable tools are required to assess the effectiveness of prevention programs for this condition.

We evaluated the validity and reliability of an Arabic-translated version of the HLPCQ, which assesses healthy lifestyle choices and the degree of autonomy in a sample of 300 Tunisian patients with diabetes. This version demonstrated satisfactory validity and reliability indices.

Descriptive analysis of our sample showed that 35.3% of participants had developed diabetic retinopathy, and 69.7% were overweight, with poor adherence to lifestyle recommendations. These findings align with the literature highlighting obesity, unhealthy diets, and sedentary lifestyle as major contributors to poor glycemic control<sup>5,33,34</sup>. However, these results remain concerning when compared to data from developed countries<sup>32</sup>. This gap may be attributed to limited access to therapeutic patient education, lack of multidisciplinary care and the current nutritional transition<sup>35</sup>.

Regarding content validity, the item: “Do you practice aerobic exercise for 20 or more minutes at least three times per week” required revision. It was necessary to clearly distinguish this item from the item “Do you exercise in an organized manner”. In fact, the term aerobic is sometimes inappropriately used even by coaches and sport scientist<sup>36</sup>. Furthermore, it has no direct equivalent in Arabic language and may be confusing for Arab-speaking people. Accordingly, the explanation “Exercises that increase breathing and heart rates” was added to the item.

The item 6: “Do you eat organic foods”, also required clarification. In line with the expert’s recommendation, a previous study underlined lack of information about organic products among Tunisian people<sup>37</sup>. Accordingly, the explanation “Foods naturally produced without artificial interventions” was added to better define the concept.

Internal consistency for the total scale and for four out of the five original subscales exceeded 0.70. This result is consistent with findings from the original Greek version<sup>13</sup>. The Polish version reported alpha coefficients ranging from 0.60 to 0.85<sup>38</sup> and the Indian version showed slightly higher internal consistency<sup>16</sup>.

The “Social and Mental Balance” subscale had a lower Cronbach’s alpha (0.5) in our study. This may be due to the multidimensional nature of its three items including cognitive, emotional and behavioral domains<sup>39</sup>. A reduced number of items in this subscale may also contribute to the lower alpha coefficient<sup>40</sup>.

The KMO index in our study was 0.716. While lower than the Polish version (0.899)<sup>38</sup>, it remains acceptable for conducting factor analysis. The original version, with a KMO of 0.797<sup>13</sup>, is close to our observed value. Bartlett's test of sphericity was significant in our study, as in other validation studies of the HLPCQ<sup>15,16,38</sup>. This finding reinforce the scale's construct validity across different populations.

Unlike the Greek<sup>13</sup>, Persian<sup>15</sup>, Polish<sup>38</sup> and Indian<sup>16</sup> studies, which identified five dimensions, our exploratory factor analysis resulted in nine factors after Varimax rotation. Additional dimensions emerged from the subdivision of initial constructs and the rearrangement of certain items. Specifically, we identified two distinct factors related to food choices, two related to avoidance behaviors, two concerning life and eating rhythms, and one relating to emotional openness. In fact, the structure of psychometric tools can vary with cultural contexts and the specific characteristics of the target population<sup>41</sup>. Some lifestyle aspects, possibly influenced by public health messaging, can split into subcomponents in other cultural contexts<sup>42</sup>. Additionally, characteristics specific to diabetic populations may affect how items are interpreted and grouped. This may explain the emergence of a distinct factor related to "Avoidance of contexts favoring unhealthy eating"<sup>43</sup>. This does not necessarily compromise the scale's validity but suggests that its use in new contexts may require recalibration of its factor structure.

Based on our results, the Arabic version of the HLPCQ could be considered as a suitable tool for assessing lifestyle behaviors among Arabic-speaking populations. It may support planning for health promotion and therapeutic education initiatives targeting people with metabolic disorders. Further psychometric validation studies of this tool in other Arabic-speaking populations would allow for better cultural adaptation.

The findings of this study should be interpreted considering some methodological limitations. First, sampling method was not probabilistic. Additionally, items related to physical activity were not applicable to some participants due to physical constraints, resulting in missing data for seven participants. However, the inclusion of participants in a consecutive manner, with a sample size of 300, likely reduced possible selection bias. Second, translation was not performed by professional translators but by medical doctors. This decision was based on the fact the medical doctors involved were bilingual, familiar with medical terminology and experienced in communicating with chronically ill patients. Finally, although the Tunisian dialect is easier to use when communicating with Tunisian patients, the translation was conducted in Modern Standard Arabic. This choice aimed to ensure neutrality across regional dialects and to facilitate later broader future use of the scale in the Arab world.

## Conclusion

The present translated version of the HLPCQ in Arabic demonstrated a different structure from the original version but showed satisfactory validity and reliability indices. This Arabic version is suitable for assessing future health promotion programs in Arabic-speaking populations.

## Data availability

The data used to reach the findings of this article are not publicly accessible because of ethical approval constraints concerning the data and the anonymity of our participants. However, the corresponding author can provide the datasets upon reasonable request.

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## References

1. World Health organisation. Noncommunicable diseases. at <https://www.who.int/news-room/detail/noncommunicable-diseases>
2. Mbarki, S. et al. Epidemiology of diabetes mellitus in Tunisia. HSHS 2 study (Hammam Sousse Sahloul heart Study). *Tunis Med.* **100**, 229–240 (2022).
3. Jemaa, R. et al. Prevalence of diabetes in the Tunisian population: results of the ATERA-survey. *Arch. Cardiovasc. Dis. Suppl.* **15**, 131 (2023).
4. World health organisation. Tunisia Analysis and dissemination of the Tunisian Health Examination Survey 2016 | UHC Live Monitoring, at <https://extranet.who.int/uhcpartnershiplivemonitoring/activity/tunisia-analysis-and-dissemination-tunisian-health-examination-survey-2016>
5. Achouri, M. Y., Tounsi, F., Messaoud, M. & Senoussaoui, A. Ben Abdelaziz, A. Prevalence of poor medication adherence in type 2 diabetics in North Africa. Systematic review and meta-analysis. *Tunis Med.* **99**, 932–945 (2021).
6. Darmon, P. et al. Prise de position de La Société Francophone du Diabète (SFD) Sur Les stratégies d'utilisation des traitements anti-hyperglycémants Dans Le diabète de type 2-2023. *Médecine Mal Métaboliques*. **17**, 664–693 (2023).
7. Ashur, S. T., Shamsuddin, K., Shah, S. A., Bosseri, S. & Morisky, D. E. Reliability and known-group validity of the Arabic version of the 8-item Morisky medication adherence scale among type 2 diabetes mellitus patients. *East. Mediterr. Health J.* **21**, 722–728 (2015).
8. AlJohani, K. A., Kendall, G. E. & Snider, P. D. Psychometric evaluation of the summary of diabetes Self-Care Activities–Arabic (SDSCA–Arabic): translation and analysis process. *J. Transcult Nurs.* **27**, 65–72 (2016).
9. Alsaqer, K., Bebis, H., Cross-Cultural & Adaptation Validity, and reliability of the Arabic version of the Self-care of hypertension inventory scale among older adults. *J. Cardiovasc. Nurs.* **36**, 430–436 (2021).
10. Haddad, L. G., Al-Ma'aitah, R. M., Cameron, S. J. & Armstrong-Stassen, M. An Arabic Language version of the health promotion lifestyle profile. *Public. Health Nurs.* **15**, 74–81 (1998).
11. Al-sheyab, N. A., Alomari, M. A., Hayajneh, A. A. & Shah, S. Attitudes and perceived barriers toward healthy lifestyle behaviors in Jordanian adolescents: a developing country perspective. *Adolesc. Health Med. Ther.* **10**, 39–47 (2019).
12. Al-Hazzaa, H. M., Al-Sobayel, H. I. & Musaiger, A. O. Convergent validity of the Arab teens lifestyle study (ATLS) physical activity questionnaire. *Int. J. Environ. Res. Public. Health.* **8**, 3810–3820 (2011).
13. Darviri, C. et al. The healthy lifestyle and personal control questionnaire (HLPCQ): a novel tool for assessing self-empowerment through a constellation of daily activities. *BMC Public. Health.* **14**, 995 (2014).

14. Battersby, W., Ask, M., Reece, A. M., Markwick, M. J., Collins, P. & M. & The partners in health scale: the development and psychometric properties of a generic assessment scale for chronic condition self-management. *Aust J. Prim. Health.* **9**, 41 (2003).
15. Zahra, D. & Habibeh, A. Persian version of healthy lifestyle and personal control questionnaire (H LPCQ): A confirmatory factor analysis. *J. Prev. Med. Care.* **2**, 15–19 (2018).
16. Goyal, H. & Aleem, S. Confirmatory factor analysis (CFA) and psychometric validation of healthy lifestyle and personal control questionnaire (H LPCQ) in India. *Indian J. Community Med.* **48**, 430–435 (2023).
17. Rouquette, A. & Falissard, B. Sample size requirements for the internal validation of psychiatric scales. *Int. J. Methods Psychiatr Res.* **20**, 235–249 (2011).
18. Guillemin, F., Bombardier, C. & Beaton, D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J. Clin. Epidemiol.* **46**, 1417–1432 (1993).
19. Sousa, V. D. & Rojanasirirat, W. Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: a clear and user-friendly guideline. *J. Eval Clin. Pract.* **17**, 268–274 (2011).
20. World health organisation. Obesity and overweight. at <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>
21. ElSayed, N. A. et al. 2. Classification and diagnosis of diabetes: *Standards of care in Diabetes—2023. Diabetes Care.* **46**, S19–S40 (2023).
22. Visseren, F. L. J. et al. ESC Guidelines on cardiovascular disease prevention in clinical practice. *Eur. Heart J.* **42**, 3227–3337 (2021).
23. Jungers, P., Man, N., Legendre, C. & Joly, D. *L'insuffisance rénale chronique: prévention et traitement* (Lavoisier, 2011).
24. Leclerc-Collet, A. et al. Classification simplifiée de La rétinopathie diabétique adaptée Au dépistage par photographies du fond d'œil. *J. Fr. Ophtalmol.* **30**, 674–687 (2007).
25. Polit, D. F., Beck, C. T. & Owen, S. V. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Res. Nurs. Health.* **30**, 459–467 (2007).
26. Lawshe, C. H. A QUANTITATIVE APPROACH TO CONTENT VALIDITY<sup>1</sup>. *Pers. Psychol.* **28**, 563–575 (1975).
27. Hébert, R., Guay, J. H., Williams-Jones, B. & Seppey, M. Validation d'un questionnaire auto-administré Sur les valeurs En politique publique de santé. *Can. J. Public. Health.* **109**, 891–899 (2018).
28. Berger, J. L. Analyse factorielle exploratoire et analyse en composantes principales: guide pratique. (2021). <https://doi.org/10.13140/RG.2.2.16206.18246>
29. Klin, P. *An easy guide to factor analysis*. (London, Routledge, 1994).
30. Bourque, J., Poulin, N. & Cleaver, A. Évaluation de l'utilisation et de La présentation des résultats d'analyses factorielles et d'analyses En composantes principales En éducation. *Rev. Sci. L'éducation.* **32**, 325–344 (2006).
31. Tavakol, M. & Wetzel, A. Factor analysis: a means for theory and instrument development in support of construct validity. *Int. J. Med. Educ.* **11**, 245–247 (2020).
32. Ong, K. L. et al. Global, regional, and National burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the global burden of disease study 2021. *Lancet* **402**, 203–234 (2023).
33. Ben Romdhane, H. et al. [Epidemiological transition and health impact of cardiovascular disease in Tunisia]. *Tunis Med.* **83** (Suppl 5), 1–7 (2005).
34. Musaiger, A. O. Overweight and obesity in the Eastern mediterranean region: can we control it? *East. Mediterr. Health J. Rev. Sante Mediterr. Orient. Al-Majallah Al-Sihhiyah Li-Sharq Al-Mutawassit.* **10**, 789–793 (2004).
35. Powers, M. A. et al. Diabetes Self-Management education and support in type 2 diabetes: A joint position statement of the American diabetes association, the American association of diabetes Educators, and the academy of nutrition and dietetics. *J. Acad. Nutr. Diet.* **115**, 1323–1334 (2015).
36. Chamari, K. & Padulo, J. Aerobic' and 'Anaerobic' terms used in exercise physiology: a critical terminology reflection. *Sports Med. - Open.* **1**, 9 (2015).
37. Mtinet, N., Souissi, A. & Mhamdi, N. Tunisian consumers perception and behavior towards organic food products. *New. Medit.* **19**, 3–18 (2020).
38. Czapla, M. et al. Psychometric properties and cultural adaptation of the Polish version of the healthy lifestyle and personal control questionnaire (H LPCQ). *Int. J. Environ. Res. Public. Health.* **18**, 9190 (2021).
39. Tavakol, M. & Dennick, R. Making sense of cronbach's alpha. *Int. J. Med. Educ.* **2**, 53–55 (2011).
40. Cortina, J. M. What is coefficient alpha? An examination of theory and applications. *J. Appl. Psychol.* **78**, 98–104 (1993).
41. van de Vijver, F. J. R. & Leung, K. *Methods and Data Analysis for cross-cultural Research* (Sage, 1997).
42. Flaherty, J. A. et al. Developing instruments for cross-cultural psychiatric research. *J. Nerv. Ment Dis.* **176**, 257–263 (1988).
43. Glasgow, R. E., Strycker, L. A., Toobert, D. J. & Eakin, E. A Social-Ecologic approach to assessing support for disease Self-Management: the chronic illness resources survey. *J. Behav. Med.* **23**, 559–583 (2000).

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## Author contributions

The study was designed by the authors NZ, MMA and YH. HE, MMo participated in the data acquisition and analysis. RG, SBF, GS, WD, AA, HK and IH contributed to the interpretation of data. NZ drafted the work. All authors have given their approval for the final version of the manuscript and have taken responsibility for individual contributions and ensure that all questions all parts of the work are appropriately investigated. NZ, HE, and MMA revised the manuscript critically.

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## Declarations

### Competing interests

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### Additional information

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**Correspondence** and requests for materials should be addressed to N.Z.

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