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Arabic translation and cultural adaptation of Hill-Bone compliance to high blood pressure therapy scale

Ibrahim Sales [a], Yazed AlRuthia [a,b,*]

[a] Department of Clinical Pharmacy, College of Pharmacy, Riyadh, Saudi Arabia
[b] Pharmacoeconomics Research Unit, Department of Clinical Pharmacy, College of Pharmacy, King Saud University, Riyadh, Saudi Arabia

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ABSTRACT

Background: Adherence to prescription medications is vital to the success of any treatment plan, especially for chronic health conditions, such as hypertension (HTN). Although there are different scales used in assessing adherence to prescription medications, most if not all, of those scales are not available in Arabic. The absence of essential assessment tools makes the appraisal of adherence to prescription medications very difficult for native Arabic speakers. Therefore, this study aimed to translate and validate the Hill-Bone Compliance to High Blood Pressure Therapy (CHBPT) scale, which is commonly used to assess adherence to antihypertensive medications, among a sample of Arabic-speaking patients with HTN.

Methods: This was a single-center cross-sectional study that took place at a university-affiliated hospital. It interviewed adult (≥18 years) patients with HTN who were visiting the primary care clinics between January and November 2020. Non-Arabic speakers, those under 18 years of age, individuals without a diagnosis of HTN, and patients without any previously filled prescription medications for HTN within the past three months were excluded. The forward–backward translation method was used after receiving permission from the originators of the questionnaire to translate their scale to Arabic. Test-retest and Cronbach alpha methods were used to assess the reliability. Principal component analysis with varimax rotation was used to examine the construct validity.

Results: One hundred and forty-one patients consented and participated in the study. Most of the patients were ≥ 50 years old (75 %), male (72 %), and had another chronic health condition besides HTN (99 %). The translated scale had good internal consistency (Cronbach alpha = 0.83) and reliability (intraclass correlation coefficient of 0.9). The Kaiser-Meyer-Oklin was 0.82 indicating adequate sampling to conduct factor analysis; hence, three factors (e.g., subscales) were extracted similar to the original scale. The mean scores for appointment keeping, medication taking, and reducing sodium intake subscales, as well as for the overall scale were 5.62 ± 1.39, 33.94 ± 3.87, 9.73 ± 2.1, and 49.29 ± 5.21, respectively.

Conclusion: The translated version of the Hill-Bone CHBPT scale has both good reliability and validity and will hopefully help healthcare providers assess and monitor HTN patients' adherence to their antihypertensive medication regimens. Multicenter studies should be conducted to verify the validity and reliability of the translated questionnaire among different Arabic-speaking patient populations with HTN.

1. Introduction

The World Health Organization (WHO) considers hypertension (HTN) to be a public health problem with approximately 1.4 billion individuals affected and less than 15 % controlled (Al-Makki, DiPette et al., 2022). In the United States, approximately 47 % of adults have HTN, with only 24 % of patients with HTN have their blood pressure controlled (Jaeger, Chen et al., 2023). The prevalence of HTN in Saudi Arabia is estimated to be 9.2 % among adults aged 15 years and older according to a household health survey conducted by the Saudi General Authority for Statistics in 2017 (Alenazi and Alqahtani, 2023). However, the prevalence rates of HTN rose to 55 % and 48 % among women and men, respectively, aged 65 years and older (Alenazi and Alqahtani, 2023). Only 43 % of individuals aged 14 years and older were aware that they had HTN according to a *meta*-analysis of studies that investigated the prevalence, awareness, treatment, and control of HTN in Saudi

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* Corresponding author.
E-mail address: Yazeed@ksu.edu.sa (Y. AlRuthia).

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Arabia. Moreover, 65 % out of 264,817 individuals with HTN aged 14 years and older had uncontrolled HTN (Alshammari, Alshammari et al., 2023).

Medication non-adherence has been identified as one of the most important barriers leading to uncontrolled HTN and subsequent cardiovascular and renal sequelae.(Granger, Swedberg et al., 2005, Hamdidouche, Jullien et al., 2017). Reasons for medication non-adherence in patients with HTN are multifactorial; however, Vrijens et al. reported that only half of patients remain adherent to their HTN medications after one year of therapy (Vrijens, Vincze et al., 2008). Several risk factors may be associated with non-adherence, such as low health literacy, financial insecurity, complexity of the medication regimen, duration of therapy, lack of immediate therapeutic benefit, adverse drug reactions, impersonal clinician-patient relationships, poor clinician communication skills, physical impairments, and severity of symptoms (Ferdinand, Senatore et al., 2017, Neiman, Ruppar et al., 2018). Furthermore, the WHO considers deficiencies in medication adherence to be related to five categories: socioeconomic (poverty, illiteracy, unemployment, etc.), healthcare system related (health care provider incompetence, the absence of medication adherence and intervention to remedy it, etc.), therapy-related (complex medication regimens, adverse reactions, etc.), condition-related (disease-induced disabilities, disease progression and severity, etc.), and patient-related factors (lack of health literacy, poor adherence, etc.) (Sabate, 2016).

Non-adherence can be assessed by both direct and indirect methods (Hamrahian, 2020). Direct methods include physically witnessing medication administration, electronic medication monitoring systems, laboratory testing, and digital medicine which can be expensive, time-consuming, and not applicable to all medications (Anghel, Farcas et al., 2019). Indirect methods include pill counts, prescription refill data, patient interviews, and self-reported questionnaires (Anghel, Farcas et al., 2019). Although associated with overestimation, indirect methods are usually less expensive and more generalizable when polypharmacy exists (Nguyen, La Caze et al., 2014).

The 14-item Hill-Bone Compliance to High Blood Pressure Therapy (CHBPT) scale, which was originally developed in English and validated into different languages including Nepalese, Chinese, and Portugese (Kim et al., 2000, Nogueira-Silva et al., 2016, Pan et al., 2020, Shakya et al., 2022), consists of three subscales (medication taking, reducing sodium intake, and appointment keeping) and has been widely used to assess medication adherence among patients with HTN. There have been two published studies that translated the Hill-Bone CHBPT scale into the Arabic language (Alsolami, Hou et al., 2013, Al-Daken and Eshah, 2017). Alsolami et al. conducted a cross-sectional study of Saudi patients with HTN. They administered an 11-item version of the Hill-Bone CHBPT scale by excluding the three items related to salt intake; however, this version did not have acceptable reliable (Cronbach's alpha = 0.633). When they removed the two items related to appointment keeping, they concluded that the Cronbach's alpha was 0.760 for the medication adherence subscale only (Alsolami, Hou et al., 2013). Aldaken and Eshah translated the 14-item Hill-Bone CHBPT scale for use in a cross-sectional descriptive comparison study among Jordanian patients in a single ambulatory healthcare center. The Cronbach's alpha was 0.79 indicating good internal consistency; however, neither study was designed to determine the construct validity of the Hill-Bone CHBPT scale nor did they conduct factor analysis of this assessment tool (Al-Daken and Eshah, 2017).

Although there have been a few medication generic and disease-specific adherence scales translated and validated into the Arabic language besides the Hill-Bone CHBPT scale, none of these scales were specifically designed to assess patient adherence to HTN medications (Ashur, Shamsuddin et al., 2015, Shilbayeh and Ibrahim, 2020, Souaiby, Kazour et al., 2020, Alammari, Alhazzani et al., 2021, Alhazzani, AlAmmari et al., 2021, Ibrahim, Schommer et al., 2021, Islam, Nisa et al., 2021, Mahmoud, Islam et al., 2021, Awwad, AlMuhaissen et al., 2022). Shahin et al. utilized Arabic versions of the Beliefs about Medicine Questionnaire (BMQ) and the Medication Adherence Questionnaire in Middle Eastern refugees and migrants with HTN in Australia to determine the association between medication beliefs and adherence (Shahin, Kennedy et al., 2020). Refugees were defined as individuals who were forced to leave their countries of origin due to fear of persecution. Migrants, however, left their countries seeking to improve their lives in the country of migration without fear of retribution. The participants were equally distributed among males and females, and the majority were from Iraq, Syria, and Lebanon. Refugees had both significantly lower adherence and levels of necessity beliefs and higher concern beliefs than migrants. The Medication Adherence Questionnaire has been validated to assesses medication adherence in a variety of disease states. Although the participants in this study were all diagnosed with HTN, the assessment tools were not specific to patients with HTN (Shahin, Kennedy et al., 2020). Therefore, there is a need for a validated Arabic scale to assess medication adherence among patients with HTN in Arabic-speaking populations. The aim of this study was to translate into Arabic and validate the Hill-Bone CHBPT scale among patients with HTN in Saudi Arabia.

2. Methods

2.1. Study design and population

This was a single-center cross-sectional study in which Arabic-speaking adult patients (≥18 yrs.) with HTN who had at least one prescription medication for HTN filled within the past three months were identified through the electronic medical records in a university-affiliated tertiary care center. While waiting for their appointments or their prescription medications to be filled from the outpatient pharmacy in the same institution, the patients were approached by two pharmacy interns. Convenience sampling was used to recruit patients due to time and budget constraints. Those who consented to participate were given the questionnaire to be filled out. The questionnaire consisted of questions on the patient's sociodemographic characteristics (age, gender, educational level, employment status, and monthly income). Health literacy was also assessed using the Arabic version of the single-item literacy screener. This consisted of a single question asking individuals about their ability to read and comprehend a prescription medication leaflet without the need of someone else with five possible choices (never, rarely, sometimes, most of the time, always). Individuals who answered this question with "sometimes", "most of the time", and "always" were considered to have limited/marginal health literacy as this was validated using gold standard health literacy tools, such as the short version of the Functional Health Literacy Test for Adults (S-TOFHLA) and the Rapid Estimate of Adult Literacy in Medicine (REALM) (Fadda, Kanj et al., 2016). Moreover, information on patients' medical conditions, number of prescription medications, and whether the patients had supplemental private health insurance besides the public healthcare coverage were collected. Native speakers aged 18 years or older and taking at least one prescription medication for HTN were included in the study. Patients younger than 18 years of age, those without a diagnosis of HTN, and patients without any previously filled prescription medication for HTN in the past three months were excluded.

2.2. Translation and cultural adaptation of the Hill-Bone compliance to high blood pressure therapy scale

The original Hill-Bone CHBPT scale was obtained from the original authors with permission to translate and culturally adapt it into Arabic (Kim, Hill et al., 2000). The scales consisted of 14 items with three subscales (9-item medication taking subscale, 3-item reducing sodium intake subscale, and 2-item appointment keeping subscale) with four possible choices (1. All of the time, 2. Most of the time, 3. Some of the Time, 4. None of the time). Forward translation was performed by a health outcomes and policy researcher whose native language is Arabic

and has a vast experience in the development and validation of patient-reported outcome scales. The backward translation was performed by a bilingual healthcare practitioner whose native language is English, and is working in an academic healthcare institution. The authors involved in the forward and backward translations of the Hill-Bone CHBPT scale had previous experience in using different medication adherence scales to assess medication adherence among English and Arabic speaking patient populations. Authors adhered to good practices for the translation, cultural adaptation, and validation of patient-reported outcomes (McKown, Acquadro et al., 2020). Four clinicians and academics reviewed and critiqued the translated Arabic version and only minor changes were made. After revising the questionnaire to address the comments raised by the reviewers, the questionnaire was sent back again to the reviewers to check if further changes were needed. All the reviewers approved the final version of the questionnaire. The Arabic version of Hill-Bone CHBPT scale was administered to a pilot of 25 adult patients (≥18 yrs.) with a confirmed diagnosis of HTN in order to check the readability and understandability of the Arabic-translated version of Hill-Bone (CHBPT) scale, and no major issues were found.

2.3. Statistical analysis

The minimum sample size needed for this study was approximately 100 patients based on the best practices for validating patient-reported outcome measures in which a subject to item ratio of at least 7 was chosen to ensure the sampling adequacy for the 14-item Hill-Bone (CHBPT) scale (Anthoine, Moret et al., 2014). Descriptive statistics using frequencies and percentages were used to present the baseline characteristics of the patients. The individual as well as the total scores of the 14-item Hill-Bone CHBPT subscales were presented as mean plus or minus the standard deviation. Test-retest method was used to check the reliability of the translated scale using an intraclass correlation coefficient (ICC) of 0.9 as a cut-off point (Koo and Li, 2016). The internal consistency of the translated scale was checked using the Cronbach-alpha method with a cut-off point of 0.7 (Tavakol and Dennick, 2011). Exploratory and confirmatory factor analyses were conducted to check the construct validity of the translated scale. In order to check the sampling adequacy for factor analysis, Kaiser–Meyer–Olkin (KMO) test was performed. Moreover, Bentler-Bonett Normed Fit Index (NFI) was checked for the goodness of fit of the data for factor analysis. Univariate and multiple linear regression analyses were conducted to examine the relationship between gender, income, education, marital status, age, and health literacy with the Arabic version of the Hill-Bone CHBPT scale score. All statistical analyses were performed using SAS version 9.4 (SAS® institute, Cary, NC, USA).

2.4. Ethical considerations

Only patients who consented to participate were included in the study, and no personal identifiers, such as names, medical record number, address, or national identification number, were collected. Participants were informed of their right to withdraw from the study at any time. The study adhered to the ethical principles of the Helsinki declaration (Goodyear, Krleza-Jeric et al., 2007).

3. Results

Out of 202 patients with HTN who were approached by the pharmacy interns, 141 met the inclusion criteria and consented to participate. The majority of the participants were male (71.63 %), aged 50 years and above (75.17 %), married (80.14 %), had at least secondary school diploma or a higher degree (67.37 %), were retired or unemployed (67.38 %), had a family monthly income of SAR 10,000 a month or lower, and had adequate health literacy (78.01 %) as shown in Table 1. Besides HTN, most participants had another chronic health condition, such as diabetes and dyslipidemia, and most were taking six prescription medications or more (68.79 %) as shown in Table 2.

Table 1
Study participants' sociodemographic characteristics (n = 141).

Characteristic	N(%)
Gender	
Male	101(71.63)
Female	40 (28.37)
Age group (years)	
18–25	7 (4.96)
26–33	6 (4.26)
34–41	5 (3.55)
42–49	17 (12.06)
50–57	25 (17.73)
58–65	49 (34.75)
66–73	24 (17.02)
≥ 74	8 (5.67)
Marital status	
Single	10 (7.09)
Married	113(80.14)
Divorced	6 (4.26)
Widowed	12 (8.51)
Educational level	
No official education	21 (14.89)
Completed few years of elementary school	7 (4.96)
Elementary school diploma	8 (5.67)
Middle school diploma	10 (7.09)
Secondary school diploma or equivalent (industrial or commercial diplomas)	28 (19.86)
Post-secondary school diploma or technical college	12 (8.51)
University degree	46 (32.62)
Graduate degree or equivalent (masters, doctorate, medical fellowship)	9 (6.38)
Employment status	
Government sector employee	35 (24.82)
Private sector employee	7 (4.96)
Freelancer	4 (2.84)
Retired	54 (38.30)
Unemployed	41 (29.08)
Monthly income*	
Less than 5,000	32 (22.70)
5,000 – 10,000	58 (41.13)
10,000 – 15,000	28 (19.86)
15,000 – 20,000	17 (12.06)
More than 20,000	6 (4.26)
Health literacy	
Adequate	110 (78.01)
Marginal\limited	31 (21.99)

* Presented in Saudi Arabian Riyals (3.75 SAR = 1 USD).

The mean scores for each of the 14 items of the Hill-Bone compliance scale are shown in Table 3. The mean scores of the appointment keeping, medication taking, and reducing sodium intake subscales were 5.62 ± 1.39, 33.94 ± 3.87, and 9.73 ± 2.1, respectively, while the mean score

Table 2
Participants' medical characteristics (n = 141).

Number of medications taken	N(%)
One	7 (4.96)
Two	6 (4.26)
Three	7 (4.96)
Four	11 (7.80)
Five	13 (9.22)
Six and more	97 (68.79)
Chronic Diseases	
Hypothyroidism	21 (10.4)
Cardiovascular disease	11 (7.80)
Dyslipidemia	80 (56.74)
Diabetes mellitus type I	48 (34.08)
Diabetes mellitus type II (no insulin use)	83 (58.87)
Diabetes mellitus type II (with insulin use)	4 (2.84)
Psychiatric disorders	1 (0.71)
Pulmonary diseases	9 (6.38)
Others	17 (12.05)

Table 3
Item Analysis of Hill-Bone HBP Compliance Scale.

Item	Mean ± SD	Item-total correlation	Cronbach's alpha if item removed
1. How often do you forget to take your HBP medicine?	3.76 ± 0.55	0.612	0.817
2. How often do you decide NOT to take your HBP medicine?	3.76 ± 0.56	0.667	0.814
3. How often do you eat salty food?	3.08 ± 0.91	0.348	0.835
4. How often do you shake salt on your food before you eat it?	3.22 ± 0.91	0.362	0.834
5. How often do you eat fast food?	3.41 ± 0.69	0.293	0.838
6. How often do you make the next appointment before you leave the doctor's office? *	3.67 ± 0.62	0.432	0.829
7. How often do you miss scheduled appointment?	1.95 ± 1.31	0.111	0.862
8. How often do you forget to get prescriptions filled?	3.67 ± 0.68	0.523	0.823
9. How often do you run out of HBP pills?	3.68 ± 0.72	0.587	0.819
10. How often do you skip your HBP medicine before you go to the doctor?	3.79 ± 0.60	0.656	0.814
11. How often do you miss taking your HBP pills when you feel better?	3.79 ± 0.59	0.661	0.814
12. How often do you miss taking your HBP pills when you feel sick?	3.82 ± 0.54	0.457	0.827
13. How often do you take someone else's HBP pills?	3.86 ± 0.54	0.527	0.823
14. How often do you miss taking your HBP pills when you are careless?	3.76 ± 0.67	0.657	0.814

*Item with reverse coding.

Table 4
Factor Analysis of the Arabic version of Hill-Bone HBP Compliance Scale.

Items	**Factor 1**	**Factor 2**	**Factor 3**
1. How often do you forget to take your HBP medicine?	0.71293		
2. How often do you decide NOT to take your HBP medicine?	0.78316		
3. How often do you eat salty food?		0.68151	
4. How often do you shake salt on your food before you eat it?		0.78537	
5. How often do you eat fast food?		0.68796	
6. How often do you make the next appointment before you leave the doctor's office?			0.69515
7. How often do you miss scheduled appointment?			0.47571
8. How often do you forget to get prescriptions filled?	0.61931		
9. How often do you run out of HBP pills?	0.68317		
10. How often do you skip your HBP medicine before you go to the doctor?	0.74885		
11. How often do you miss taking your HBP pills when you feel better?	0.79609		
12. How often do you miss taking your HBP pills when you feel sick?	0.62409		
13. How often do you take someone else's HBP pills?	0.62364		
14. How often do you miss taking your HBP pills when you are careless?	0.80819		
Percentage (%) of variance explained by each factor	50.65 %	26.51 %	22.84 %

of the Hill-Bone scale was 49.29 ± 5.21. The standardized Cronbach alpha coefficient for the Hill-Bone scale was 0.84 indicating acceptable internal consistency, and the ICC was 0.91 indicating acceptable reliability. The Kaiser-Meyer-Oklin (KMO) value was 0.82 indicating the suitability of the data to conduct factor analysis. Three factors were extracted based on eigenvalues of ≥ 1. The three extracted factors, which represented the three subscales, consisted of the same items predicted in the original scale (Table 4). All items showed factor loadings > 0.4. The Bentler-Bonett NFI was close to one (0.99) indicating acceptable model fit and the root mean square error of approximation (RMSEA) was < 0.001. Parameter estimates for the three extracted factors had t-values exceeding 1.96 with p-values lower than 0.05 confirming the three extracted factors with an average variance extracted above 0.9 confirming convergent validity. Moreover, the three extracted factors had low correlation between one another (≤0.3) with a model Chi-Square p-value < 0.0001 indicating acceptable discriminant validity.

The univariate linear regression showed age to be a significant predictor of higher level of Hill-Bone CHBPT scale with each unit (year) increase in age associated with 0.698 increase in the Hill-Bone CHBPT scale score (β = 0.698, p-value = 0.0067, 95 % CI [0.197–1.200]). However, this significant relationship between the Hill-Bone CHBPT scale score and age disappeared after controlling for gender, presence of other chronic health conditions, number of prescription medications, health literacy, marital status, employment status, family monthly income, and educational level (β = 0.448, p-value = 0.198, 95 % CI [–0.238–1.135]). Male gender was negatively associated with the Hill-Bone compliance scale and this negative relationship remained significant even after controlling for age, presence of other chronic health conditions, number of prescription medications, health literacy, marital status, employment status, family monthly income, and educational level (β= – 3.856, p-value = 0.002, 95 % CI [– 6.271 - – 1.442]). Patients with other chronic health conditions, such as dyslipidemia, diabetes, and cardiovascular disease, were positively associated with Hill-Bone CHBPT scale score and remained significant even after controlling for age, gender, number of prescription medications, health literacy, marital status, employment status, family monthly income, and educational level (β = 16.421, p-value = 0.001, 95 % CI [6.742—–26.099]). The number of prescription medications was positively associated with the Hill-Bone CHBPT scale score with each additional prescription medication associated with 0.778 higher Hill-Bone CHBPT scale score (β = 0.778, p-value = 0.0059, 95 % CI [0.229—–1.329]). However, the positive relationship between the number of prescription medications and the Hill-Bone CHBPT scale score became non-significant after controlling age, gender, presence of other chronic health conditions, health literacy, marital status, employment status, family monthly income, and educational level (β = 0.357, p-value = 0.305, 95 % CI [–0.328—–1.043]). Marital status was not associated with the Hill-Bone CHBPT scale score (β = 0.411, p-value = 0.5388, 95 % CI [–0.909—–1.733]). Likewise, employment status was not associated with the Hill-Bone CHBPT scale score (β = 0.199, p-value = 0.4826, 95 % CI [–0.3605—–0.759]). Moreover, the family monthly income was not associated with the Hill-Bone CHBPT scale score (β = 0.471, p-value = 0.246, 95 % CI [–0.328 – 1.271]). Additionally, neither educational level (β = –0.07521, p-value = 0.7006, 95 % CI [–0.461 – 0.3107]) nor health literacy (β = 1.489, p-value = 0.161, 95 % CI [–0.600 – 3.578]) were associated with the Hill-Bone CHBPT scale score.

4. Discussion

The 14-item Hill-Bone CHBPT scale has been validated in various clinical settings and cultures and is considered a reliable indirect method for the assessment of medication adherence in patients with HTN. It has been translated into over 25 different languages and is widely utilized due to its ease of use, accessibility, high predictive validity, and high clinical utility for patient-specific treatment management (Commodore-Mensah, Delva et al., 2023). Although two published studies have

administered the Hill-Bone CHBPT scale in Arabic language, the need for a reliable and validated version in the Arabic language still remained (Alsolami, Hou et al., 2013, Al-Daken and Eshah, 2017). Furthermore, the prevalence of HTN in the Middle East and North Africa (MENA), where the majority of Arabic countries are located, has been reported to be between 24.36 and 26.2 % with only 43.1 % having controlled HTN (Balouchi, Rafsanjani et al., 2022, Okati-Aliabad, Ansari-Moghaddam et al., 2022).

Uncontrolled HTN and resistant HTN, in particular, can be ameliorated by patient medication adherence (Hamrahian, 2020). Medication adherence has been associated with not only blood pressure control, but also a reduction in the risk of cardiovascular events and all-cause mortality (Kettani, Dragomir et al., 2009, Mazzaglia, Ambrosioni et al., 2009, Perreault, Dragomir et al., 2009, Perreault, Dragomir et al., 2010, Corrao, Parodi et al., 2011, Chowdhury, Khan et al., 2013, Maciej, Christobelle et al., 2014, Beaussier, Boutouyrie et al., 2015). Furthermore, medication adherence can be enhanced by patient education and both direct and indirect assessment of medication taking behaviors (Burnier, Schneider et al., 2001, Sadik, Yousif et al., 2005, Hernandez-Tejada 2012, Brinker, Pandey et al., 2014). Indirect methods, such as the Hill-Bone CHBPT scale, are essential tools to assist clinicians in the MENA region to assess medication adherence among Arabic-speaking patients (Hamdidouche, Jullien et al., 2017).

The 14-item Arabic translated Hill-Bone CHBPT scale showed good construct validity and reliability which was similar to the original instrument and higher than the majority of the translated versions. The internal consistency of the original version was based upon two independent patient groups with HTN. The Cronbach's alpha was reported to be 0.74 and 0.84, and subsequent validation studies have ranged from 0.62 to 0.88(Kim, Hill et al., 2000, Commodore-Mensah, Delva et al., 2023). In this study, the factor analysis extracted three factors which represented the three subscales: factor 1: medication taking (items 1, 2, and 8–14), factor 2: reducing sodium intake (items 3–5), and factor 3: appointment keeping (items 6 and 7). This was similar to the Polish validated version of the Hill-Bone CHBPT scale (Uchmanowicz, Jankowska-Polańska et al., 2016). The original scale by Kim et al. predicted three factors; however, five factors were extracted from the first study and four were extracted from the second study (Kim, Hill et al., 2000). Cheong et al. reported five factors and subsequently combined similar components into three factors (Cheong, Tong et al., 2015). Karademir et al. found three factors also which were classified into unintentional medication non-adherence, intentional medication non-adherence, and salt intake adherence (Karademir, Koseoglu et al., 2009). They merged the medication-related factors and concluded with two factors. Koschack et al. initially discovered six components; however, after taking into consideration the distribution of the scree plot, three factors were preferred and presented (Koschack, Marx et al., 2010). Interestingly, Song et al. identified one factor based upon eight factors after eliminating one question to tailor the scale to the Korean American population (Song, Han et al., 2011). Although Koschack et al. recommended against the use of the complete 14-item version Hill-Bone CHBPT and other authors have also endorsed either the 9-item Hill-Bone Medication Adherence scale or alternative modified versions based on cultural and/or environmental differences, the scale was determined to be suitable for our population in this study (Dennison, Peer et al., 2007, Karademir, Koseoglu et al., 2009, Koschack, Marx et al., 2010, Song, Han et al., 2011, Alsolami, Hou et al., 2013, Cheong, Tong et al., 2015, Nashilongo, Singu et al., 2017). In addition, the ICC was 0.91 based upon the test–retest which provided additional confirmation of its reliability.

Older individuals, patients with other chronic health conditions, and a higher number of prescription medications were all positively associated with the Hill-Bone CHBPT scale score in the univariate regression analysis, however, this positive relationship became non-significant after controlling for other potential confounders, such as age, gender, and educational level. This was similar to the higher levels of adherence reported by Mutneja in Indian patients; however, two studies in elderly Polish elderly patients by Chudiak et al. did not confirm such an association (Chudiak, Jankowska-Polańska et al., 2017, Chudiak, Uchmanowicz et al., 2018, Mutneja, Yadav et al., 2020). Furthermore, although seemingly counterintuitive, Etebari et al. also found a positive association between the Hill-Bone CHBPT and a higher number of prescription medications (Etebari, Pezeshki et al., 2019). The increase in medication adherence in those advanced in age and those with more prescription medications may be an indication that these patients have become more concerned with their health when considering their complex health conditions.

There are some limitations that should be acknowledged. This was a single center study and conducted among Saudi patients; therefore, the results may not be generalizable. Furthermore, direct measures of medication adherence such as **drug assays of blood or urine** were not used as a method to confirm positive correlations with the Hill-Bone CHBPT scale.

5. Conclusion

The Arabic-translated version of the Hill-Bone CHBPT scale has both good reliability and validity and will hopefully help healthcare providers assess and monitor HTN patients' adherence to their antihypertensive medication regimens. Multicenter studies should be conducted to verify the validity and reliability of the translated scale among different Arabic-speaking HTN patient populations.

CRediT authorship contribution statement

Ibrahim Sales: Conceptualization, Project administration, Writing – original draft, Writing – review & editing. **Yazed AlRuthia:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Alammari, G., Alhazzani, H., AlRajhi, N., et al., 2021. Validation of an Arabic version of the adherence to refills and medications scale (ARMS). Healthcare (Basel) 9. https://doi.org/10.3390/healthcare9111430.

Al-Daken, L.I., Eshah, N.F., 2017. Self-reported adherence to therapeutic regimens among patients with hypertension. Clin. Exp. Hypertens. 39, 264–270. https://doi.org/10.1080/10641963.2016.1247164.

Alenazi, A.M., Alqahtani, B.A., 2023. National and regional prevalence rates of hypertension in Saudi Arabia: A descriptive analysis using the national survey data. Front. Public Health 11, 1092905. https://doi.org/10.3389/fpubh.2023.1092905.

Alhazzani, H., AlAmmari, G., AlRajhi, N., et al., 2021. Validation of an arabic version of the self-efficacy for appropriate medication use scale. Int. J. Environ. Res. Public Health 18. https://doi.org/10.3390/ijerph182211983.

Al-Makki, A., DiPette, D., Whelton, P.K., et al., 2022. Hypertension Pharmacological treatment in adults: A World Health Organization guideline executive summary. Hypertension 79, 293–301. https://doi.org/10.1161/hypertensionaha.121.18192.

Alshammari, S. A., A. S. Alshammari, H. S. Alshammari, et al., 2023. Overview of hypertension in Saudi Arabia. A systematic review and meta-analysis. 44, 951-964. 10.15537/smj.2023.44.10.20230178.

Alsolami, F.J., Hou, X.-Y., Correa-Velez, I., et al., 2013. An Arabic instrument to measure medication adherence in Saudi hypertensive patients. World Family Med. J.: Incorp. Middle East J. Family Med. 99, 1–7.

Anghel, L.A., Farcas, A.M., Oprean, R.N., 2019. An overview of the common methods used to measure treatment adherence. Med. Pharm. Rep. 92, 117–122. https://doi.org/10.15386/mpr-1201.

Anthoine, E., Moret, L., Regnault, A., et al., 2014. Sample size used to validate a scale: a review of publications on newly-developed patient reported outcomes measures. Health Qual. Life Outcomes 12, 176. https://doi.org/10.1186/s12955-014-0176-2.

Ashur, S. T., K. Shamsuddin, S. A. Shah, et al., 2015. 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. 10.26719/2015.21.10.722.

Awwad, O., AlMuhaissen, S., Al-Nashwan, A., et al., 2022. Translation and validation of the Arabic version of the Morisky, Green and Levine (MGL) adherence scale. PLoS One 17, e0275778. https://doi.org/10.1371/journal.pone.0275778.

Cheong, A.T., Tong, S.F., Sazlina, S.G., 2015. Validity and reliability of the Malay version of the Hill-bone compliance to high blood pressure therapy scale for use in primary healthcare settings in Malaysia: A cross-sectional study. Malays. Fam. Physician 10, 36–44.

Chudiak, A., Jankowska-Polańska, B., Uchmanowicz, I., 2017. Effect of frailty syndrome on treatment compliance in older hypertensive patients. Clin. Interv. Aging 12, 805–814. https://doi.org/10.2147/cia.S126526.

Chudiak, A., Uchmanowicz, I., Mazur, G., 2018. Relation between cognitive impairment and treatment adherence in elderly hypertensive patients. Clin. Interv. Aging 13, 1409–1418. https://doi.org/10.2147/cia.S162701.

Commodore-Mensah, Y., Delva, S., Ogungbe, O., et al., 2023. A systematic review of the Hill-bone compliance to blood pressure therapy scale. Patient Prefer. Adherence 17, 2401–2420. https://doi.org/10.2147/ppa.S412198.

Dennison, C.R., Peer, N., Steyn, K., et al., 2007. Determinants of hypertension care and control among peri-urban black south Africans: The HiHi study. Ethn. Dis. 17, 484–491.

Etebari, F., M. Z. Pezeshki and S. Fakour, 2019. Factors related to the non-adherence of medication and nonpharmacological recommendations in high blood pressure patients. J Cardiovasc Thorac Res. 11, 28-34. 10.15171/jcvtr.2019.05.

Fadda, M., Kanj, M., Kabakian-Khasholian, T., et al., 2016. Validation of three Arabic health literacy assessment tools in Lebanon. Health Promot. Int. 33, 261–267. https://doi.org/10.1093/heapro/daw079.

Ferdinand, K.C., Senatore, F.F., Clayton-Jeter, H., et al., 2017. Improving medication adherence in cardiometabolic disease: Practical and regulatory implications. J. Am. Coll. Cardiol. 69, 437–451. https://doi.org/10.1016/j.jacc.2016.11.034.

Goodyear, M.D., Krleza-Jeric, K., Lemmens, T., 2007. The declaration of Helsinki. Bmj 335, 624–625. https://doi.org/10.1136/bmj.39339.610000.BE.

Hamrahian, S.M., 2020. Medication non-adherence: A major cause of resistant hypertension. Curr. Cardiol. Rep. 22, 133. https://doi.org/10.1007/s11886-020-01400-3.

Ibrahim, K.M., Schommer, J.C., Morisky, D.E., et al., 2021. The association between medication experiences and beliefs and low medication adherence in patients with chronic disease from two different societies: The USA and the Sultanate of Oman. Pharmacy (Basel) 9. https://doi.org/10.3390/pharmacy9010031.

Islam, M.A., Nisa, Z.U., Almuzel, A.I., et al., 2021. Concurrent validity of the Arabic version of general medication adherence scale using two validated indirect adherences measures in Saudi patients with non-communicable diseases. Saudi Pharm. J. 29, 874–878. https://doi.org/10.1016/j.jsps.2021.07.002.

Jaeger, B.C., Chen, L., Foti, K., et al., 2023. Hypertension statistics for US adults: An open-source web application for analysis and visualization of National Health and nutrition examination survey data. Hypertension 80, 1311–1320. https://doi.org/10.1161/hypertensionaha.123.20900.

Karademir, M., Koseoglu, I.H., Vatansever, K., et al., 2009. Validity and reliability of the Turkish version of the Hill-bone compliance to high blood pressure therapy scale for use in primary health care settings. Eur. J. Gen. Pract. 15, 207–211. https://doi.org/10.3109/13814780903452150.

Kim, M.T., Hill, M.N., Bone, L.R., et al., 2000. Development and testing of the Hill-bone compliance to high blood pressure therapy scale. Prog. Cardiovasc. Nurs. 15, 90–96. https://doi.org/10.1111/j.1751-7117.2000.tb00211.x.

Koo, T.K., Li, M.Y., 2016. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. J. Chiropr. Med. 15, 155–163. https://doi.org/10.1016/j.jcm.2016.02.012.

Koschack, J., Marx, G., Schnakenberg, J., et al., 2010. Comparison of two self-rating instruments for medication adherence assessment in hypertension revealed insufficient psychometric properties. J. Clin. Epidemiol. 63, 299–306. https://doi.org/10.1016/j.jclinepi.2009.06.011.

Mahmoud, M.A., Islam, M.A., Ahmed, M., et al., 2021. Validation of the Arabic version of general medication adherence scale (GMAS) in Sudanese patients with diabetes mellitus. Risk Manag. Healthc. Policy 14, 4235–4241. https://doi.org/10.2147/rmhp.S325184.

McKown, S., Acquadro, C., Anfray, C., et al., 2020. Good practices for the translation, cultural adaptation, and linguistic validation of clinician-reported outcome, observer-reported outcome, and performance outcome measures. J. Patient Rep. Outcomes 4, 89. https://doi.org/10.1186/s41687-020-00248-z.

Mutneja, E., Yadav, R., Dey, A.B., et al., 2020. Frequency and predictors of compliance among patients taking antihypertensive medicines. Indian Heart J. 72, 136–139. https://doi.org/10.1016/j.ihj.2020.03.008.

Nashilongo, M.M., Singu, B., Kalemeera, F., et al., 2017. Assessing adherence to antihypertensive therapy in primary health care in Namibia: Findings and implications. Cardiovasc. Drugs Ther. 31, 565–578. https://doi.org/10.1007/s10557-017-6756-8.

Neiman, A.B., Ruppar, T., Ho, M., et al., 2018. CDC grand rounds: Improving medication adherence for chronic disease management - innovations and opportunities. Am. J. Transplant. 18, 514–517. https://doi.org/10.1111/ajt.14649.

Nguyen, T.M., La Caze, A., Cottrell, N., 2014. What are validated self-report adherence scales really measuring?: A systematic review. Br. J. Clin. Pharmacol. 77, 427–445. https://doi.org/10.1111/bcp.12194.

Okati-Aliabad, H., Ansari-Moghaddam, A., Kargar, S., et al., 2022. Prevalence of hypertension and pre-hypertension in the Middle East region: a systematic review & meta-analysis. J. Hum. Hypertens. 36, 794–804. https://doi.org/10.1038/s41371-021-00647-9.

Sabate, E., 2016. Adherence to long-term therapies: evidence for action. Geneva: World Health Organization; 2003. NLM classification: W. 85.

Shahin, W., Kennedy, G.A., Cockshaw, W., et al., 2020. The role of medication beliefs on medication adherence in middle eastern refugees and migrants diagnosed with hypertension in Australia. Patient Prefer. Adherence 14, 2163–2173. https://doi.org/10.2147/ppa.S274323.

Shilbayeh, S.A.R., Ibrahim, A.A., 2020. The anti-clot treatment scale (ACTS): Validation of the translated Arabic version among patients undergoing warfarin therapy in Saudi Arabia. Health Qual. Life Outcomes 18, 215. https://doi.org/10.1186/s12955-020-01471-4.

Song, Y., Han, H.R., Song, H.J., et al., 2011. Psychometric evaluation of hill-bone medication adherence subscale. Asian Nurs. Res. (Korean Soc. Nurs. Sci.) 5, 183–188. https://doi.org/10.1016/j.anr.2011.09.007.

Souaiby, L., Kazour, F., Zoghbi, M., et al., 2020. Sexual dysfunction in patients with schizophrenia and schizoaffective disorder and its association with adherence to antipsychotic medication. J. Ment. Health 29, 623–630. https://doi.org/10.1080/09638237.2019.1581333.

Tavakol, M., Dennick, R., 2011. Making sense of Cronbach's alpha. Int. J. Med. Educ. 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd.

Uchmanowicz, I., Jankowska-Polańska, B., Chudiak, A., et al., 2016. Psychometric evaluation of the Polish adaptation of the Hill-bone compliance to high blood pressure therapy scale. BMC Cardiovasc. Disord. 16, 87. https://doi.org/10.1186/s12872-016-0270-y.

Vrijens, B., Vincze, G., Kristanto, P., et al., 2008. Adherence to prescribed antihypertensive drug treatments: Longitudinal study of electronically compiled dosing histories. BMJ. 336, 1114–1117. https://doi.org/10.1136/bmj.39553.670231.25.