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PSYCHOMETRIC PROPERTIES OF PERSIAN VERSION OF PATIENT HEALTH QUESTIONNAIRE (PHQ-9) IN AN IRANIAN HIV-INFECTED PATIENTS

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ABSTRACT

Depression is one of the most common mental disorders in People Who Live with HIV (PWLH). The current study aimed to investigate the psychometric properties of the Persian version of the Patient Health Questionnaire (PHQ-9) among Iranian infected with HIV. In total, 150 PWLH were selected using the convenient sampling method among patients who visited Shemiranat, Dokmehchi, and Bouali health centers during the October 22 to December 16, 2020. Beck Depression Inventory (BDI-II) and Anxiety and Depression Scale (HADS) were used to collect data. Reliability, validity and Rock curve were assessed.

The exploratory analysis revealed one factor. The CFA results confirmed the one-factor model of the PHQ. The results (Cronbach's Alpha = 0.879, CR = 0.901, AVE = 0.504, rho_A = 0.899) indicated a high stability. The convergence validity of all questions (β = 000) was significant. For all questions β> 0.5 and PHQ-9, the AVE index was more than 0.5, but for HADS and BDI-II the AVE was less than 0.5. For PHQ-9, HADS had a CR higher than 0.7. PHQ-9 of divergence validity for all three questionnaires was AVE> MSV and AVE> ASV. The Cross Loadings, Farnell-Larcker and HTMT was confirmed. Therefore, convergence validity was acceptable. Finally, it can be reported that constructive validity was also acceptable. Cut off score was higher than 9, and sensitivity and specificity were equal to 957 and 937. According to the results, the validity and reliability of the PHQ-9 in assessing depression among PWLH are high.

Keywords: *Patient health questionnaire, Depression, HIV, Psychometrics, Sensitivity and specificity.*

INTRODUCTION

AIDS is one of the most serious public health challenges all around the world (Eshleman *et al.*, 2019). According to US AIDS statistics, globally, 37.9 million people were living with HIV at the end of 2018 (HIV, 2018). Nearly two-thirds of new HIV cases in 2017 were from Egypt, the Islamic Republic of Iran, and Sudan. Meanwhile, Iran accounted for 35% of all new HIV cases in the Middle East region. Special efforts are needed to expand and improve HIV testing and treatment programs in Iran, which in 2017 accounts for more than 60% of all AIDS-related deaths in the Middle East region. 60,000 patients infected with HIV are living in Iran, and its

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annual incidence is 4,700, and 3,500 die each year (UNAIDS, 2017). Among patients who are hospitalized at least once, HIV/AIDS is the third most commonly diagnosed disease (0.021), followed by gastrointestinal disorders (0.095), and mental illnesses (0.09) (Betz *et al.*, 2005). Depression is a common cause of illness and disability among adolescents and adults (LeMasters *et al.*, 2020). Besides, depression is common among PWLH (Olley *et al.*, 2006). which affects the progression of the disease (Ghebremichael *et al.*, 2009). Its prevalence is twice among PWLH, compared to non-HIV patients (Ciesla & Roberts, 2001) and is more prevalent in low-income families (Andersen *et al.*, 2020). Depression can increase mortality (Cook *et al.*, 2004). suicide (Obadeji *et al.*, 2014). drug abuse, and sleep disorders, and decrease the social functioning and CD-4 counts (Moayedi *et al.*, 2015).

Several tools are developed for identifying depression, including quantitative tools, structured and semi-structured interviews, and self-report tools (Fiest *et al.*, 2016). All of these complex and time-consuming tools are developed for well-trained specialists, including structured clinical interviews, and diagnostic and statistical Manual of Mental Disorders (DSM-5) (Osório *et al.*, 2019). However, self-report tools are very effective in assessing depressive symptoms because they are short, free, standard, and low cost (Fiest *et al.*, 2016). The following tools commonly used for assessing depression among PWLH: Center for Epidemiologic Studies Depression (CES-D) (Mueses-Marín *et al.*, 2019). Patient Health Questionnaire-9 (Cholera *et al.*, 2014). The hospital anxiety and depression scale (HADS) (Reda, 2011). Patient Health Questionnaire-2 (Monahan *et al.*, 2009). Beck Depression Inventory (Patterson *et al.*, 2006). Hopkins Symptom Checklist (HSC) (Psaros *et al.*, 2015). The following tools are common in Iran: Beck's Depression Inventory-II (Moradi *et al.*, 2013). Depression, Anxiety, and Stress Scales questionnaire (DASS21) (Saadat *et al.*, 2015), Center for Epidemiologic Studies Depression (CES-D) (Bagheri *et al.*, 2019). Hamilton Depression Rating Scale (HDRS) (Emadi-Kouchak *et al.*, 2016). The patients' Health Questionnaire 9 (PHQ-9) is normalized for patients with stroke (Dajpratham *et al.*, 2020), infertility (Maroufizadeh *et al.*, 2019), epilepsy (Xia *et al.*, 2019), and type 2 diabetes (Zhang *et al.*, 2015). Few tools are normalized for HIV patients in Iran. Due to limited access to standardized tools for HIV patients, particularly for depressive disorders, as well as a low number of questions and affordability of the implementation time, it was decided to normalize this tool for Iranian specialists interested in research on HIV patients. Therefore, the current study aimed to investigate the psychometric properties of the Persian version of the Patient Health Questionnaire (PHQ-9) in Iranian HIV-infected patients.

MATERIALS AND METHODS

Initially, the goals and methodology of the study were described for patients, and if they were agreeing, a written consent form was taken.

This is a descriptive and cross-sectional study. The study population was all HIV-positive patients referring to Shemiranat, Dokmehchi, and Bouali health centers from October 1 to December 16, 2020. Participants were selected using the convenient sampling method, after applying inclusion and exclusion criteria. To determine the sample size previous studies were reviewed, which their sample size was varying from 2 to 20 subjects per each variable (Anthoine *et al.*, 2014). In the current study, 16 participants were selected per each variable, which resulted in a total sample size of 144, but eventually, 150 questionnaires were filled. Inclusion criteria were: willingness

to participate in the study, being aged 18-65 years, HIV diagnosis, and no addiction. Exclusion criteria were unwillingness to participate and tiredness. To translate the questionnaire into Persian, three psychologists with good English language skills, first translated the questionnaire independently. The translations were matched and revised in a committee. Then, the final translated text was given to a translator who was familiar with psychological texts with an IELTS score of 7 to translate the Persian translation into English, the translator was not aware of the translation process. The English translation was matched with the original questionnaire; this process was repeated twice until the Persian questions were translated exactly according to the English questions.

At the second step, the translated questionnaire was reviewed by five experts, and necessary revisions were made, concerning spelling, editing, font, pagination. Content validity index (CVI) was investigated by eight experts, the scores of all questions were 0.87 and higher, which indicates a good CVI.

The content validity ratio (CVR) index was assessed by eight experts, and for all questions, results were above 0.78, according to the Lashae table. Therefore, content validity results were confirmed. To assess simultaneous validity, the Beck Depression questionnaire (second edition), hospital anxiety, and depression questionnaire were used. Then, the goals and methodology of the study were described for patients, and if they were agreeing, a written consent form was taken. The questionnaire was given to 150 participants, and the results were entered into the software and exploratory and confirmatory analyzes were performed. SPSS software version 24, Amos software version 24, and PLS software version 3 was used to analyze the data.

Tools

The patients' Health Questionnaire 9 (PHQ-9)

The PHQ-9, developed by Kronke and colleagues, is a new 9-item tool designed based on DSM criteria, and each item has multiple options: not at all (0), several days (1), more than half the days (2), and nearly every day (3). This tool intends for both the diagnosis and severity of depressive symptoms. To be diagnosed as depressed, the person should have 5 out of 9 symptoms of depression during the last two weeks and should at least have one of the symptoms of depressed mode or lack of pleasure. It ranks the severity of the depression in a range between zero to 27, which categorizes them into the following categories 0-4, 5-9, 10-14, 15-19, and 20-27. The cutting point is 10 and above, the sensitivity and specificity of this tool are reported as 0.88 (Hatzenbuehler *et al.*, 2011). Cronbach's alpha of the questionnaire was reported as 0.78 (Monahan *et al.*, 2009).

Beck's Depression Inventory-II

This questionnaire has 21 questions; it takes about 10 minutes to complete. Zero and three scores indicate the lowest and the highest levels of intensity of depression symptoms, respectively. The interpretation of the results is as follows: 5-9 indicates "normal ups and downs", 10-18 "mild to moderate depression", 19-29 "moderate to severe depression", and 30-63 "major depression" (Effendy *et al.*, 2019).

Hospital Anxiety and Depression Scale

It's developed by Zigmond and Snaith (Zigmond & Snaith, 1983). This scale is a self-report questionnaire comprising of two micro scales (i.e. depression and anxiety) for patients with physical problems, in which each subscale contains seven questions (that we investigated the sub-scale related to the depression). Symptoms during the last week measure on a Likert scale, from 0 (not at all) to 3 (nearly every day) (Hartung *et al.*, 2017). The total Cronbach's alpha was 0.99, for the anxiety subscale was 0.78, and for the depression, the subscale was 0.86 (Montazeri *et al.*, 2003).

RESULTS AND DISCUSSION

Demographic the patients with HIV showed male and female overall were 150, the percent (%) male and female ordinare were 60 and 40, Average age (years) (range) 32.22 (20-48) and 34.48 (20-61), Education; Under Diploma (%)68.9 and 51.7, Diploma (%)25.6 and 35, Bachelor (%)5.6 and 13.3, Marital status; Married (%)46.7 and 36.7, Divorced (%)6.7 and 5, Occupational status; Employed (%)56.7 and 38.3, Unemployed (%)43.3 and 61.7, The average diagnosis of HIV(years) (range) 3.97 (1-9) and 3.78 (1-8), Sexual orientation; Heterosexuality (%)93.3 and 88.3, Homosexuality (%)3.3 and 3.3, Bisexuality (%)3.3 and 8.3.

Exploratory Factor Analysis

The exploratory factor analysis showed a KMO higher than 0.7 (KMO=90) and Bartlett's Test of Sphericity sig was equal to zero. Therefore, it can be concluded that the results of PHQ-9 can be interpreted.

The Figure Scree Plot showed that the questions of the PHQ-9 measure only one factor. The share of this factor was 51.58. The share of these questions in measurement of factor 1 was: PHQ.1 = 68, PHQ.2 = 74, PHQ.3 = 61, PHQ.4 = 71, PHQ.5 = 69, PHQ.6 = 66, PHQ.7 = 73, PHQ.8 = 80, and PHQ.9 = 78.

Table 1, showed Cronbach alpha higher than 0.8 and Cronbach's Alpha if Item Deleted was not higher than 0.879 **(Table 1)**.

Table 1. Item analysis of PHQ-9

Number	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PHQ.1	13.6133	12.024	.589	.869
PHQ.2	13.5600	12.074	.658	.864
PHQ.3	13.6067	12.187	.521	.875
PHQ.4	13.6600	11.837	.622	.866
PHQ.5	13.6400	11.547	.608	.868
PHQ.6	13.6000	11.852	.571	.871
PHQ.7	13.6000	11.396	.648	.864
PHQ.8	13.6200	11.405	.725	.857
PHQ.9	13.5533	11.967	.696	.861

The results indicated a Cronbach alpha higher than 0.8.

Confirmatory Factor Analysis

Fitness indicators were appropriate (i.e. Chi-Square= 2.098, CMIN/df= 1.78, RMSEA= 0.73, PNFI= 0.685, GFI= 0.930, AGFI= 0.883, NFI=0.914, TLI= 0.946, CFI= 960, RFI= 0.885, IFI= 960). Therefore, the results are generalizable.

Table 2. Reliability and constructive validity

variables	Cronbach's Alpha	CR	AVE	rho_A	MSV	ASV
BDI-II	0.790	0.330	0.096	0.405	0.011	0.008
PHQ-9	0.879	0.901	0.504	0.899	0.096	0.054
HADS	0.805	0.843	0.291	0.829	0.096	0.068

Reliability

The reliability scores of Cronbach's Alpha, CR, AVE, and rho_A indicated that the reliability of PHQ-9 and HADS are acceptable, but BDI-II, only Cronbach's Alpha is acceptable. But, because AVE, rho_A, and CR tests were below 0.5, they didn't confirm the reliability of BDI-II **(Table 2)**.

Convergence Validity

For all questions the β = 000 was significant. For all questions β> 0.5, for PHQ-9 the AVE index was 0.5, but for HADS and BDI-II the AVE was below 0.5. For the PHQ-9, HADS, and BDI-II, AVE was lower than CR and for HADS the CR was higher than 0.7 **(Table 2)**.

Divergence Validity

For all three questionnaires, AVE was higher than MSV, and AVE was higher than ASV.

Table 3. Cross Loadings

	BDI	HANDS	PHQ
PHQ1	0.134	0.225	0.705
PHQ2	0.212	0.228	0.763
PHQ3	0.149	0.090	0.581
PHQ4	0.134	0.173	0.717
PHQ5	0.099	0.081	0.642
PHQ6	0.302	0.220	0.709
PHQ7	0.040	0.179	0.687
PHQ8	0.239	0.260	0.764
PHQ9	0.165	0.236	0.796
BDI-II10	0.473	0.099	0.189
BDI-II11	0.611	0.185	0.113
BDI-II12	0.506	0.140	0.026
BDI-II13	0.343	0.104	-0.105
BDI-II14	0.167	-0.011	-0.064
BDI-II15	0.197	0.064	-0.040
BDI-II16	0.101	0.021	-0.016
BDI-II17	0.003	0.086	-0.011
BDI-II18	0.001	0.084	-0.091

BDI-II19	-0.276	-0.026	-0.143
BDI-II20	-0.339	-0.116	-0.256
BDI-II21	-0.320	-0.062	-0.038
BDI-II22	-0.057	0.041	-0.078
BDI-II23	-0.105	-0.027	-0.022
BDI-II24	-0.097	-0.022	-0.055
BDI-II25	0.149	0.113	-0.078
BDI-II26	0.300	0.199	-0.045
BDI-II27	0.254	0.056	0.064
BDI-II28	0.255	-0.001	0.012
BDI-II29	0.366	0.085	-0.054
BDI-II30	0.527	0.225	0.093
HADS31	0.192	0.452	0.084
HADS32	0.232	0.600	0.165
HADS33	0.172	0.597	0.156
HADS34	0.227	0.658	0.201
HADS35	-0.033	0.129	0.049
HADS36	0.076	0.565	0.206
HADS37	0.047	0.484	0.113
HADS38	0.189	0.406	-0.025
HADS39	0.241	0.631	0.248
HADS40	0.220	0.600	0.177
HADS41	0.277	0.651	0.120
HADS42	0.224	0.608	0.218
HADS43	0.128	0.543	0.075
HADS44	-0.009	0.365	0.217

All questions were divergent and it was found that only measure their corresponding variable. Meanwhile, in the next test that is provided by Farnell Larker, the weakness of this test is addressed. Its weakness is only investigating the divergence of questions, while the divergence of variables should also be investigated. It comprises of only two tables: (1) Correlation between variables; (2) AVE table, that if the AVE square root is placed on the main diameter of the correlation matrix, instead of the number one, the Furnell and Larker table will appear **(Table 3)**.

Table 4. Fornell-Larcker Criterion

Variables	BDI-II	PHQ-9	HANDS
BDI-II	0.310		
PHQ-9	0.256	0.710	
HADS	0.336	0.284	0.539

After developing the Farnell Larker table, then their law should be reviewed. Farnell Larcker claimed that if the AVE square root of each variable is greater than the correlation of that variable

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with the other variables, the Farnell and Larker test will be valid. Fortunately, in the current study, all AVE square roots of variables were higher than other variables, hence the Farnell and Larker confirm the divergence of variables **(Table 4)**.

Table 5. Heterotrait-Monotrait Ratio of Correlations (HTMT)

variables	BDI-II	PHQ-9	HANDS
BDI-II			
PHQ-9	0.272		
HADS	0.369	0.338	

All coefficients were less than one, and even less than 0.8, so regarding the previous two tests, it can be said that the divergence validity is confirmed. Besides, also by establishing the convergent validity, it can be claimed that the evaluated model is derived from data obtained by the constructive validity questionnaire. That is, the researcher measured what was supposed to be measured **(Table 5)**.

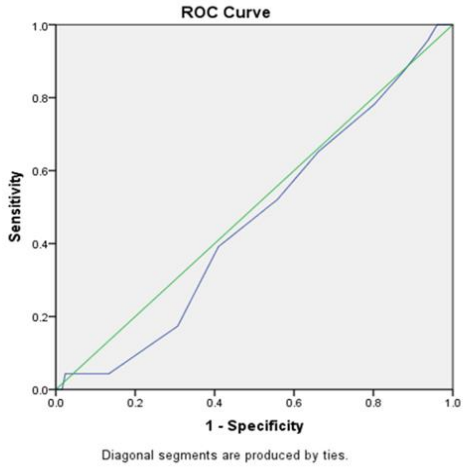

Figure 1. Receiver operating characteristic curve of the C-PHQ-9

The Rock curve indicated that the sensitivity and specificity of question number 9 were 957 and 937, respectively. Therefore, the Cutoff score was ≥ 9 **(Figure 1)**.

The main purpose of the study was to investigate the psychometric properties of the Persian version of the Patient Health Questionnaire (PHQ-9) in Iranian HIV-infected patients. We used HADS and BDI-II, which are standard tools in psychological research, and we're aware that this the first normalizing study on the PHQ-9 questionnaire as a screening tool for depressive symptoms among HIV-infected patients in Iran. According to the findings, the PHQ-9 scale is both valid and reliable, with a Cutoff score ≥ 9. Exploratory factor analysis confirms one factor, and The CFA results confirmed the one-factor model of the PHQ-9 (Chi-Square= 2.098, CMIN/df= 1.78, RMSEA= 0.73, PNFI= 0.685, GFI= 0.930, AGFI= 0.883, NFI=0.914, TLI= 0.946, CFI= 960, RFI= 0.885, IFI= 960).

The high internal consistency of the PHQ-9 questionnaire along with Cronbach's Alpha = 0.879, CR = 0.901, AVE = 0.504, and rho_A = 0.899 indicated the high reliability of this tool in

screening depression among HIV-positive patients in Iran. Besides, item analysis of PHQ-9 revealed a Cronbach's alpha higher than 8 for all questions of the questionnaire, which confirms the strong reliability of the questionnaire compared to other studies conducted on normalizing (Monahan *et al.*, 2009; Woldetensay *et al.*, 2018).

The convergence validity of all questions of PHQ-9 (all β = 000) was significant (for all questions β> 0.5). For PHQ-9, AVE was higher than 0.5, but for HADS and BDI-II, the AVE was less than 0.5. PHQ-9, HADS and BDI-II are AVE <CR, PHQ-9, HADS have (CR> 0.7).

This indicates the appropriate convergence of this questionnaire, relative to other questionnaires designed for assessing the depression.

For divergence validity of all three questionnaires AVE was higher than MSV and ASV. Fortunately, the Cross Loading test revealed that all questions are divergent and only measure their corresponding variable. The main weakness of this test is only investigating the divergence of questions, while variables should also be divergent. An issue that is addressed by the Farnell Larker. Fortunately, in the current study, all square roots of AVE variables were higher than other variables, therefore Hence, Fornell and Larker test also confirmed the divergence of variables. Also, in the HTMT test, all coefficients are less than 1 and even less than 0.8.

Therefore, regarding the previous two tests, it can be said that the divergence validity is confirmed. Also, if a questionnaire has convergent validity, it can be claimed that it's structurally valid. That is, the researcher measured what was supposed to be measured.

The Cutoff score ≥ 9 which was determined for screening major depression among Iranians infected with HIV showed that it is consistent with other studies on depression in patients with epilepsy (Fiest *et al.*, 2014). and bariatric surgery volunteers (Cassin *et al.*, 2013). Also, the best balance was found between sensitivity = 957 and specificity = 937, which is consistent with other studies conducted on patients with MS (Patrick & Connick, 2019). and women in primary care. This short version of PHQ-9, which is self-administration, widely uses in different clinical conditions (Montazeri *et al.*, 2003). PHQ-9 had good specificity and sensitivity in previous studies, and according to the results of the current study, its specificity and sensitivity were good in the context of Iran culture and language.

The current study also had limitations. Firstly, all participants were from Shemiranat, Dokmehchi, and Bouali health centers, so care should be taken before generalizing the results. Secondly, participants were selected using convenience sampling, therefore generalizability of the results is low. Third, although self-report screening questionnaires are useful tools for identifying major depressive symptoms, they cannot replace the psychological assessment.

The strengths of the current study are the willingness of participants to advance the research, using new statistical analysis to identify reliability and divergence and convergence validity, and normalizing the PHQ-9 questionnaire for the first time in Iran, which resulted in invaluable information for future studies.

CONCLUSION

Finally, according to the results, the PHQ-9 is a good tool for screening depression in Iranians infected with HIV. Besides, its validity and reliability are good, and its validity and reliability were acceptable, and the cutoff score of ≥ 9 was obtained.

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