# Psychometric Properties of the Persian Versions of Patient Health Questionnaire-9 and Patient Health Questionnaire-2 in Patients with Coronary Heart Disease

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**ABSTRACT**

**Background:** Patient Health Questionnaire-9 (PHQ-9) and Patient Health Questionnaire-2 (PHQ-2) have been characterized as appropriate screening tools for coronary heart patients. However, their psychometric properties have not been assessed in Iranian coronary heart patients.
**Objectives:** This study aimed to determine the psychometric properties of the Persian versions of PHQ-9 and PHQ-2 in patients with Coronary Heart Disease (CHD).
**Methods:** This cross-sectional study was conducted to investigate the psychometric properties of the Persian versions of PHQ-9 and PHQ-2 in patients with CHD. Totally, 284 patients with CHD referred to Imam Ali Hospital in Kermanshah were selected through purposive sampling. They were first given a structured clinical interview (SCID-I) and were then asked to complete PHQ-9, PHQ-2, and Beck Depression Inventory-version 2 (BDI-II). The data were analyzed by descriptive statistics, Cronbach's α, Spearman's correlation coefficient, exploratory factor analysis, and Receiver Operating Characteristic (ROC) curve.
**Results:** Cronbach's alpha was 0.86 for PHQ-9 and 0.77 for PHQ-2. The correlation between PHQ-9, and BDI-II and PHQ-2 was 0.74 and 0.80, respectively ($P < 0.001$). Additionally, the correlation between PHQ-2 and BDI-II was 0.64 ($P < 0.001$). Using exploratory factor analysis, a one-factor structure was extracted. The optimal cutoff point for PHQ-9 was $\geq 8$ with the sensitivity of 0.80, specificity of 0.81, and Area Under the Curve (AUC) of 0.87 (95% confidence interval: 0.83 - 0.91). Additionally, the optimal cutoff point for PHQ-2 was $\geq 3$ with the sensitivity of 0.68, specificity of 0.83, and AUC of 0.81 (95% confidence interval: 0.75 - 0.86).
**Conclusion:** The Persian versions of PHQ-9 and PHQ-2 possessed acceptable psychometric properties and could, consequently, be used to screen depression in CHD patients.

## 1. Background

Coronary Heart Disease (CHD) emerging from atherosclerotic lesions and platelet aggregation in coronary arteries makes the arteries tight and hard, thereby causing difficulty in blood supply to the heart tissue followed by pain in the chest, heart attack, or other heart problems (1). Psychological components (such as depression and anxiety) play key roles in suffering from heart problems (2). Studies have indicated that the prevalence of depression was higher in patients with Coronary Artery Disease (CAD) in comparison to the general population. (3) The prevalence of major depression has been reported to be 17 - 27% in patients with CAD (4). Depression has been reported to be associated with sudden cardiac death, all-cause mortality, poor lifestyle, poor adherence to treatment, and poor treatment outcomes in patients with CAD (5, 6). Thus, it is essential to diagnose depression in patients with CHD to provide the best possible cares (5).

Considering the need for a simple screening instrument to identify depression among cardiovascular patients, the

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American Heart Association (AHA) Science Advisory suggested the use of the Patient Health Questionnaire-2 (PHQ-2), which includes the first two items of the Patient Health Questionnaire-9 (PHQ-9) in 2008 (7). If patients give negative answers to the two questions of the PHQ-2, the diagnosis of depression is rejected. Consequently, there is no need for further evaluations. However, in case patients answer positively to these two items, other evaluations including completing the full form of the questionnaire or an structured interview will be required (8, 9). PHQ-9 is a self-report tool based on nine Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) criteria for major depression (10). Being short and readily available are among the characteristics of this tool (11). The efficacy of this tool has been investigated in patients with CHD in different countries (12-14).

As mentioned above, a suitable tool is needed to be used for depression screening amongst CHD patients. However, different cut-off points have been obtained for PHQ-9 in different countries. Indeed, no studies have evaluated the psychometric properties of this tool among coronary artery patients in Iran. Therefore, the present study aims to determine the psychometric properties of the Persian version of this questionnaire in order to suggest the optimal cut-off point for coronary artery patients in Iran.

## 2. Objectives

This study aims to determine the validity, reliability, optimal cut-off point, sensitivity, specificity, and accuracy of the Persian versions of PHQ-9 and PHQ-2 used as screening tools for depression in patients with CHD.

## 3. Patients and Methods

### 3.1. Participants and Procedures

The study participants included 284 patients with CHD diagnosis, such as patients with unstable angina, those with a heart attack, patients seeking admissions to undergo cardiac surgery, and those with coronary artery bypass graft surgery or percutaneous coronary angioplasty, referring to Imam Ali Hospital, Kermanshah, Iran. The exclusion criteria of the study were suffering from cognitive disorders such as dementia or Alzheimer, stroke, severe psychological disorders such as psychotic symptoms, and physical problems displaying symptoms similar to those of depression such as thyroid disorders. After receiving explanations about the purpose of the study, the patients were required to complete informed consent forms. Then, they were given a semi-structured clinical interview and were asked to complete the study questionnaires.

### 3.2. Measurements

#### 3.2.1. Structured Clinical Interview for DSM-IV

In order for clinical assessment, the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) was used as the medical gold standard to diagnose major depression. The psychometric properties of SCID have been reviewed and approved in Iran (15).

#### 3.2.2. PHQ-9 and PHQ-2

PHQ-9 is a new clinical instrument with nine items

designed for making diagnoses of depressive disorders based on DSM-IV criteria. The sensitivity and specificity of this scale were reported to be 0.88 and 0.88, respectively with a cutoff point ≥ 10 (10). Dadfar et al. reported a Cronbach's α of 0.88 and one-week test-retest reliability of 0.79 for PHQ-9 in a sample of Iranian psychiatric outpatients. In that study, the correlation between PHQ-9 and PHQ-15, World Health Organization-Five Wellbeing Index (WHO-5), and Beck Depression Inventory-13 (BDI-13) were 0.64, -0.35, and 0.70, respectively (16). PHQ-2 consists of the first two items of PHQ-9. The sensitivity and specificity of this instrument were reported to be 0.83 and 0.92, respectively with a cutoff point ≥ 3 (8). Zhang et al. found a Cronbach's α of 0.72 and test-retest reliability of 0.82 for PHQ-2 among college students in China (12).

#### 3.2.3. Beck Depression Inventory-II

Beck Depression Inventory-II (BDI-II) is a 21-item self-report rating inventory that evaluates the severity of depression in adolescents and adults. The BDI-II correlated (r = +0.71) with the Hamilton Rating Scale for Depression (HRSD) and had a one-week test-retest reliability of 0.93 (17). The psychometric properties of BDI have been reviewed and approved in several studies in Iran (18).

### 3.3. Data Analysis

The research data were analyzed using the SPSS statistical software, version 21. The data were analyzed by descriptive statistics, Cronbach's α, Spearman's correlation coefficient, and exploratory factor analysis (principal component analysis). In order to determine the optimal cutoff point, sensitivity, specificity, and accuracy, the Receiver Operating Characteristic (ROC) curve was calculated. To interpret the ROC curve and obtain the best cut-off point, two principles suggested by Lowe et al. were used, the maximal Youden Index (sensitivity + specificity - 1) and a two-stage screening (maximal sensitivity and specificity ≥ 75%) (19).

### 3.4. Ethical Considerations

This research project was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (code: IR. SBMU.MSPREC.1396.286).

## 4. Result

A total of 284 patients with CHD diagnosis referring to Imam Ali Hospital in Kermanshah completed the questionnaires. The mean age of the patients was 59.78 ± 10.19 years and 155 patients (54.6%) were male. Additionally, 46 participants (16.2%) were employees, 108 (38%) were self-employed, and 130 (45.8%) were unemployed. Considering education level, 38% of the participants had under diploma degrees, 42% held diplomas and associate degrees, and 20% held bachelor's or higher degrees.

### 4.1. Reliability and Item Analysis

The internal consistency of PHQ-9 was found to be 0.86 assessed using Cronbach's alpha. Indeed, the correlations between the total score and each item ranged from 0.40 to 0.79. As for the PHQ-2, Cronbach's alpha coefficient was 0.77 and the correlations between the total score and

each item ranged from 0.88 to 0.91 (P < 0.001). The results of Cronbach's alpha coefficient analysis indicated that all items, if deleted, would reduce the value of alpha. However, item 9, if deleted, would increase the value of alpha as much as 0.001 (Table 1).

### 4.2. Validity

The correlation between PHQ-9, and BDI-II and PHQ-2 was 0.74 and 0.80, respectively. Additionally, PHQ-2 and BDI-II had a correlation coefficient of 0.64 (P < 0.001).

### 4.3. Construct Validity (Factor Analysis)

The Kaiser-Meyer-Oklin value was 0.88. Bartlett's test of sphericity was also significant (P < 0.001), which indicated the suitability of the data for factor analysis. The results of exploratory factor analysis revealed a one-factor structure with eigenvalue of 4.24, which explained 47.10% of the variance. Besides, factor loadings ranged from 0.51 to 0.78. The factor's eigenvalue and its difference from the subsequent factors have been depicted in the following scree plot (Figure 1).

### 4.4. Criterion Validity

Based on the highest Younden index, the cutoff point of PHQ-9 was ≥ 8 with the sensitivity of 0.80 and specificity of 0.81 (Table 3). In addition, the area under the ROC curve (AUC) was 0.87 (standard error of 0.02 and 95% confidence

interval: 0.83-0.91) (Table 2 and Figure 2). For a two stage screening with the sensitivity of 0.83 and specificity of 0.77, the recommended cutoff point was ≥ 7, which was considered to be more suitable for clinical purposes (Table 3).

According to the highest Younden index, the cutoff point of PHQ-2 was ≥ 3 with the sensitivity of 0.68 and specificity of 0.83 (Table 3). Additionally, the AUC equaled 0.81 (standard error of 0.02 and 95% confidence interval: 0.75 - 0.86) (Table 2 and Figure 2).

## 5. Discussion

The present study aimed at determining the validity, reliability, and optimal cutoff point of the Persian versions of PHQ-9 and PHQ-2 in a sample of coronary heart patients. The results revealed that both PHQ-9 and PHQ-2 were valid and reliable tools for depression screening in the CHD population. Using Cronbach's alpha coefficient, the reliability of PHQ-9 and PHQ-2 was 0.86 and 0.77, respectively. This was consistent with the findings of the studies conducted by Gholizadeh et al. (12) and Zhang et al. (20). As mentioned above, deletion of all items would reduce the alpha value, indicating the items fitness. Nonetheless, deletion of item 9 would increase the alpha value slightly. Therefore, it would be better to exclude this item from all item groups. Gholizadeh et al. also suggested the exclusion of item 9 as its removal would not alter the alpha value (12).

**Table 1.** Item Analysis of PHQ-9

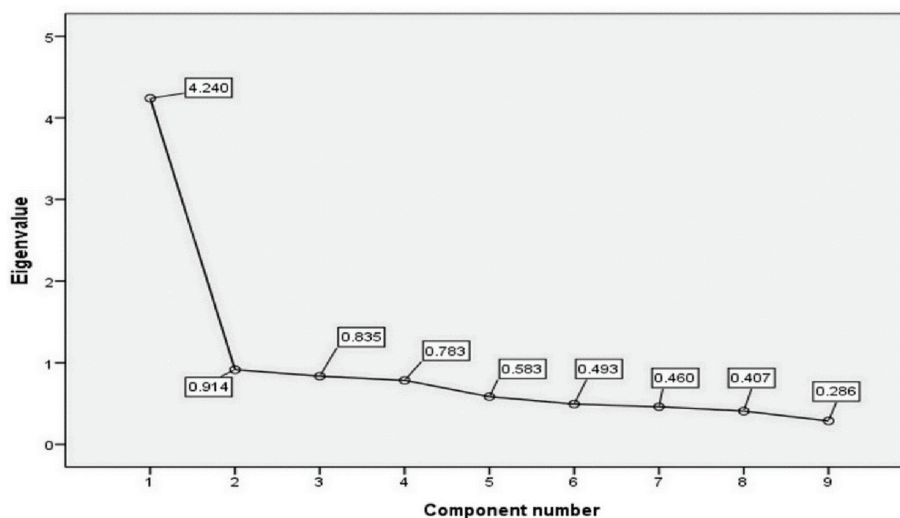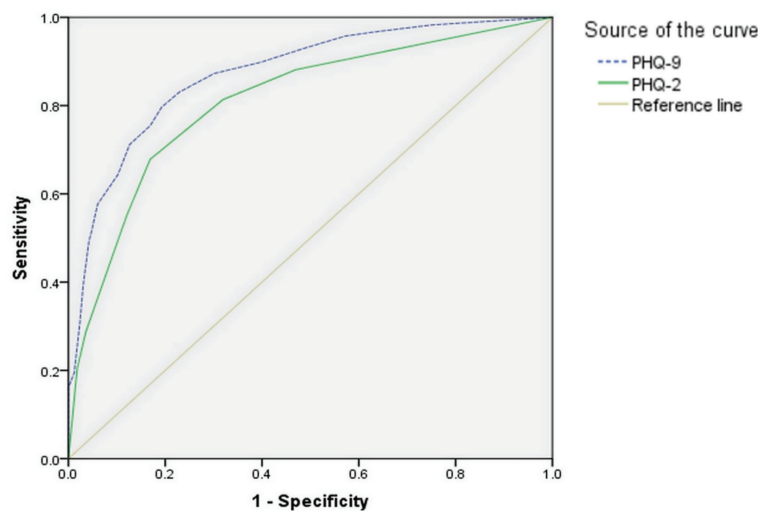| Item | | Corrected Item - Total Correlation | Cronbach's Alpha if the Item Is Deleted |
|------|--|--|--|
| P1 | Little interest or pleasure in doing things | 0.60 | 0.84 |
| P2 | Feeling down, depressed, or hopeless | 0.69 | 0.83 |
| P3 | Trouble falling or staying asleep, or sleeping too much | 0.59 | 0.84 |
| P4 | Feeling tired or having little energy | 0.67 | 0.83 |
| P5 | Poor appetite or overeating | 0.45 | 0.85 |
| P6 | Feeling bad about yourself or that you are a failure | 0.65 | 0.84 |
| P7 | Trouble concentrating on things | 0.59 | 0.84 |
| P8 | Moving or speaking so slowly that other people could have noticed | 0.59 | 0.84 |
| P9 | Thoughts that you would be better off dead or of hurting yourself | 0.41 | 0.86 |



**Figure 1.** Scree Plot for PHQ-9

**Table 2.** Area under the Curve for PHQ-9 and PHQ-2

| Test Result Variable(s) | Area | Std. Error | P value | Asymptotic 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower bound | Upper bound |
| **PHQ-9** | 0.87 | 0.02 | < 0.001 | 0.83 | 0.91 |
| **PHQ-2** | 0.81 | 0.02 | < 0.001 | 0.75 | 0.86 |



**Figure 2.** ROC Curve for PHQ-9 and PHQ-2

**Table 3.** Sensitivity, Specificity, Predictive Values, and Likelihood Ratios at Various Cutoff Scores of PHQ-9 and PHQ-2

| Test Result Variable(s) | Cutoff Score | Sensitivity | Specificity | Positive Predictive Value | Negative Predictive Value | Positive Likelihood Ratio | Negative Likelihood Ratio |
|---|---|---|---|---|---|---|---|
| **PHQ-9** | ≥ 7 [a] | 0.83 | 0.77 | 0.72 | 0.86 | 3.62 | 0.21 |
| | ≥ 8 [b] | 0.80 | 0.81 | 0.74 | 0.84 | 4.13 | 0.25 |
| | ≥ 9 | 0.75 | 0.83 | 0.76 | 0.82 | 4.46 | 0.29 |
| | ≥ 10 [c] | 0.71 | 0.87 | 0.80 | 0.81 | 5.60 | 0.33 |
| **PHQ-2** | ≥ 3 [b] | 0.68 | 0.83 | 0.74 | 0.78 | 4.01 | 0.38 |

[a] Recommended cutoff scores for a two-stage screening (maximal sensitivity and ≥ 75% specificity)

[b] Optimal cutoff scores according to maximal Youden index (sensitivity + specificity - 1).

[c] Generally recommended cutoff score

However, Razykov et al. reported that PHQ-8 was better to be used instead of PHQ-9 in patients with CHD (21). With regard to the validity of PHQ-9 and PHQ-2, another study established a good correlation with BDI-II, which was in line with the results of the previous investigations (20).

Using exploratory factor analysis, the construct validity presented a one-factor structure. These findings were consistent with those of the previous studies performed in Iran (16).

The results of the ROC curve demonstrated that the AUCs of PHQ-9 and PHQ-2 were 0.87 and 0.81, respectively, which were acceptable according to the conventional classification system (21). Based on the obtained AUCs, the Persian versions of PHQ-9 and PHQ-2 had the discriminatory ability to correctly classify those with and without CHD. Thus, these instruments could be used as diagnostic tests to trace depression amongst these patients. The optimal cutoff point of PHQ-9 (≥ 8) was used for depression diagnosis calculated by computing the sensitivity of 0.80 and specificity of 0.81 according to the Youden index. In a previous study carried out on patients with CHD in the UK, researchers found the cutoff point of 8 with the sensitivity of 94% and specificity of 84% (14). Similarly, Van der Zwaan

conducted a research on patients with CAD or diabetes and introduced the optimal cutoff point of 8 with the sensitivity of 0.71 and specificity of 0.71 for mild depression and the optimal cutoff point of 10 with the sensitivity of 0.84 and specificity of 0.82 for severe depression (22). Moreover, the cutoff point of ≥ 7 was suggested for clinical purposes under a two-stage approach. Stanford et al. proposed a cutoff point of ≥ 5 with the sensitivity of 91.4% and specificity of 75.3% based on a two stage approach and a cutoff point of ≥ 6 with the sensitivity of 82.9% and specificity of 78.8% based on Younden index. Both of these values were lower than those obtained in the present study (14).

Considering PHQ-2 for depression diagnosis, the optimal cutoff point was found to be ≥ 3 with the sensitivity of 0.68 and specificity of 0.83 according to Youden index. The cutoff point obtained in this research was in line with the score measured in the study done by MacManus et al. They presented the cutoff point of ≥ 3 with the sensitivity of 0.39 and specificity of 92 (9).

The present study had some limitations that should be taken into consideration. The first limitation was that PHQ-9 and PHQ-2 were investigated among patients with CHD selected via purposeful sampling. Hence, the findings

cannot be generalized to other samples. In addition, the participants were required to complete three measures of depression in one questionnaire pack and SCID for depression. Therefore, the effects of repetition should be taken into account. Due to the above-mentioned limitations, these questionnaires are recommended to be assessed in a different group of patients. Despite these limitations, the results showed that both PHQ-9 and PHQ-2 had acceptable properties for screening depression in patients with CHD.

### Financial Disclosure

The authors have no financial interests related to the material in the manuscript.

### References

1. Andreoli TE, Fitz JG, Benjamin I, Griggs RC, Wing EJ. *Andreoli and Carpenter's Cecil Essentials of Medicine E-Book*. Elsevier Health Sciences; 2010.
2. Kollia N, Panagiotakos D, Georgousopoulou E, Chrysohoou C, Yannakoulia M, Stefanadis C*, et al*. Exploring the path between depression, anxiety and 10-year cardiovascular disease incidence, among apparently healthy Greek middle-aged adults: The ATTICA study. *Maturitas*. 2017;**106**:73-9.
3. DiSante JL, Bires AM, Cline TW, Waterstram-Rich K. An Analysis of the Prevalence of Depression Post-Myocardial Infarction. *Critical care nursing quarterly*. 2017;**40**(2):124-36.
4. Rudisch B, Nemeroff CB. Epidemiology of comorbid coronary artery disease and depression. *Biological psychiatry*. 2003;**54**(3):227-40.
5. Colquhoun DM, Bunker SJ, Clarke DM, Glozier N, Hare DL, Hickie IB*, et al*. Screening, referral and treatment for depression in patients with coronary heart disease. *The Medical journal of Australia*. 2013;**198**(9):483-4.
6. Khawaja IS, Westermeyer JJ, Gajwani P, Feinstein RE. Depression and coronary artery disease: the association, mechanisms, and therapeutic implications. *Psychiatry*. 2009;**6**(1):38-51.
7. Lichtman JH, Bigger JT, Jr., Blumenthal JA, Frasure-Smith N, Kaufmann PG, Lesperance F*, et al*. Depression and coronary heart disease: recommendations for screening, referral, and treatment: a science advisory from the American Heart Association Prevention Committee of the Council on Cardiovascular Nursing, Council on Clinical Cardiology, Council on Epidemiology and Prevention, and Interdisciplinary Council on Quality of Care and Outcomes Research: endorsed by the American Psychiatric Association. *Circulation*. 2008;**118**(17):1768-75.
8. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: validity of a two-item depression screener. *Medical care*. 2003;**41**(11):1284-92.
9. McManus D, Pipkin SS, Whooley MA. Screening for depression in patients with coronary heart disease (data from the Heart and Soul Study). *The American journal of cardiology*. 2005;**96**(8):1076-81.
10. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *Journal of general internal medicine*. 2001;**16**(9):606-13.
11. Kroenke K, Spitzer RL, Williams JB, Lowe B. The Patient Health Questionnaire Somatic, Anxiety, and Depressive Symptom Scales: a systematic review. *General hospital psychiatry*. 2010;**32**(4):345-59.
12. Gholizadeh L, Ali Khan S, Vahedi F, Davidson PM. Sensitivity and specificity of Urdu version of the PHQ-9 to screen depression in patients with coronary artery disease. *Contemporary nurse*. 2017;**53**(1):75-81.
13. Haddad M, Walters P, Phillips R, Tsakok J, Williams P, Mann A*, et al*. Detecting depression in patients with coronary heart disease: a diagnostic evaluation of the PHQ-9 and HADS-D in primary care, findings from the UPBEAT-UK study. *PloS one*. 2013;**8**(10):e78493.
14. Stafford L, Berk M, Jackson HJ. Validity of the Hospital Anxiety and Depression Scale and Patient Health Questionnaire-9 to screen for depression in patients with coronary artery disease. *General hospital psychiatry*. 2007;**29**(5):417-24.
15. Sharifi V, Assadi SM, Mohammadi MR, Amini H, Kaviani H, Semnani Y*, et al*. A Persian translation of the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition: psychometric properties. *Comprehensive psychiatry*. 2009;**50**(1):86-91.
16. Dadfar M, Kalibatseva Z, Lester D. Reliability and validity of the Farsi version of the Patient Health Questionnaire-9 (PHQ-9) with Iranian psychiatric outpatients. *Trends in psychiatry and psychotherapy*. 2018;**40**(2):144-51.
17. Beck AT, Steer RA, Brown GK. Beck depression inventory-II. *San Antonio*. 1996;**78**(2):490-8.
18. Ghassemzadeh H, Mojtabai R, Karamghadiri N, Ebrahimkhani N. Psychometric properties of a Persian-language version of the Beck Depression Inventory--Second edition: BDI-II-PERSIAN. *Depression and anxiety*. 2005;**21**(4):185-92.
19. Lowe B, Spitzer RL, Grafe K, Kroenke K, Quenter A, Zipfel S*, et al*. Comparative validity of three screening questionnaires for DSM-IV depressive disorders and physicians' diagnoses. *Journal of affective disorders*. 2004;**78**(2):131-40.
20. Zhang YL, Liang W, Chen ZM, Zhang HM, Zhang JH, Weng XQ*, et al*. Validity and reliability of Patient Health Questionnaire-9 and Patient Health Questionnaire-2 to screen for depression among college students in China. *Asia-Pacific psychiatry : official journal of the Pacific Rim College of Psychiatrists*. 2013;**5**(4):268-75.
21. Safari S, Baratloo A, Elfil M, Negida A. Evidence based emergency medicine; part 5 receiver operating curve and area under the curve. *Emergency*. 2016;**4**(2):111.
22. van der Zwaan GL, van Dijk SEM, Adriaanse MC, van Marwijk HWJ, van Tulder MW, Pols AD*, et al*. Diagnostic accuracy of the Patient Health Questionnaire-9 for assessment of depression in type II diabetes mellitus and/or coronary heart disease in primary care. *Journal of affective disorders*. 2016;**190**:68-74.