Development and validation of the psychometric properties of the perceived barriers of mammography scale

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ABSTRACT
We aimed to develop and test the psychometric properties of the Perceived Barriers of Mammography Scale (PBMS-23). Based on a mixed method design researchers generated item pool through qualitative data and literature review and next, 500 women ages 40 to 69 years completed the questionnaire. Based on exploratory and confirmatory Factor Analysis, 23 items, researchers revealed eight domains of fate and destiny, breast conflict, defense avoidance, inconveniences/difficulties of mammography screening, contrasting/competing priorities, fear, distrust of mammography, and lack of knowledge with appropriate fitness for the data. PBMS-23 is valid and reliable instrument for assessing perceived barriers of mammography.

Abbreviations: Perceived Barriers of Mammography Scale; PBMS-23: Health Belief Model; HBM: Content Validity Ratio; CVR: Content Validity Index; CVI: Exploratory Factor Analysis; EFA: Confirmatory Factor Analysis; CFA: Kaiser–Mayer–Olkin; KMO: Root Mean Square Error of Examination; RMSEA: Goodness-of-Fit Index; GFI: Adjusted Goodness-of-Fit Index; AGFI:

Early detection of breast cancer is recommended by the World Health Organization (WHO) and the Center for Disease Control and Prevention (CDC, 2019; WHO, 2016) which are known as a fact and scientific based cornerstone of providing real information, which improve the survival rate of women with breast cancer (CDC, 2019; WHO, 2016). On the other hand, according to the statistics, breast cancer with the Age standardized rate of 47.8 and 43.7 per 100000 at the worldwide, and Iran, respectively, is the most common cancer among women (WHO, 2020). While there are numerous evidences that indicated many of women do not adhere to
mammography and early detection of breast cancer, this non-adherence to mammography might lead to investigate breast cancer when it has metastases to the other tissues (Babu et al., 2011; Mousavi et al., 2008). In other words, the consequences of delayed in early detection of breast cancer leads to detecting cancer in the advanced stages resulting in higher cost of care, preventable deaths, and disability from cancer (WHO, 2019).

Compliance with mammography is influenced by multiple cognitive, behavioral, and environmental factors (Kamaraju et al., 2016). In fact, inadequate knowledge on breast cancer and early detection, and benefits of mammogram, and environmental factors such as unavailability of screening units and the higher costs of screening, might affect women's perception, which consequently might be the cause of low participation rate among women for mammography referrals to the mammography centers (Allahverdipour et al., 2011). Additionally, low rate of participation of women at the early detection of breast cancer at the worldwide might be because of cultural beliefs such as “women should hidden their problems about their sexual organs” or “women are commonly ashamed to express their breasts problem” (Harandy et al., 2010; Khodayarian et al., 2016). For example, in a study, Asian-American women believed that their bodies as well as their breasts should not be seen or exposed (Moy et al., 2006). In a focus group study, Hispanic women also expressed a similar discomfort with the exposure of their breasts even for health care providers (L. Watson-Johnson et al., 2011). Additionally, among a sample of African-American, the women who had not history of mammography, they had lower levels of perceived social support in the both domains of functional and emotional support (Farmer et al., 2007). Researchers targeting early detection of breast cancer, had mainly utilized theories that do not emphasize the disparities, which are rooted in the social and cultural contexts of communities (Pasick et al., 2009). In fact, developing cultural- specific scales might be a precise measurement tool especially for cultural factors. In this regard, the majority of researchers that have examined the perceived barriers of mammography, has used the Champion’s Health Belief Model (HBM) Scale that is designed in the United States, where cultural and traditional views are quite different from a traditional community in other countries such as Iran and the view of Iranian women on the issue. Although the validation of this scale is previously translated into Persian (Taymoori & Berry, 2009), there are still some particular context-based considerations like cultural and religious beliefs that should be taken into account (Tanner-Smith & Brown, 2010). Additionally, the HBM accounts for a wide range of important psychosocial predictors of behavior, however, critics of the application of this model claim that there is a lack of consistent predictive power mainly because of its focus on a limited number of factors (Glanz et al., 2008).
In mammography adherence research, the applied tools for measuring perceived barriers of mammography have failure in addressing the contextual factors like availability, affordability and convenience of the service, women's insurance status as well as the emphasis of the model on individual responsibility for behavior (Sarma, 2015). Conversely, perceived barriers within individuals, cultures, and communities may play influential roles in women's decisions how to adhere or not adhere mammography. Hence, before implementing of interventions to encourage women to adhere to mammography (Lee et al., 2009; Peterson et al., 2016; Shirzadi et al., 2020), relevant barriers should be identified. As a result, to better understand the reasons that underpin barriers of mammography screening, there is a need for valid and reliable instruments. Based on the abovementioned background, we aimed to develop and examine the psychometric properties of the developed scale for measuring perceived barriers of mammography among Persian speaking women as first or second language.

**Methods**

**Participants and procedures**

This cross-sectional study was the part of a large-scale study (Shirzadi et al., 2017; 2019; 2020) to better understand of barriers of mammography in urban area in Iran which we used the results of qualitative phase of study for extracting the item pool (Shirzadi et al., 2020). Our aim in this part was to develop and test the psychometric properties of the mammography screening barriers scale for Persian speaking women. The target population was from two cities of Tabriz and Hamadan, in Iran in autumn of 2017. Participants were 500 women ages 40 to 69 years and inclusion criteria were being at least 40 years of age and older, with no physical or mental disability and with no history of breast cancer. We intended to recruit the maximum number of participants based on the remaining items of the scale; with 23 items (after assessing content and face validity) of PBMS, this meant recruiting at least 230 women. To obtain an adequate final sample size, 500 women participated in the study. In the first stage of sampling, the research team allocated the two cities of Tabriz and Hamadan as convenience clusters and next, we selected four regions from Tabriz and two regions from Hamadan city. In the final stage, 357 women from Tabriz health regions and 143 women from Hamadan health regions participated in the study based on their health code in the relevant health centers in each region. In each health center, we divided the population of the under coverage population to the estimated sample size in that region to obtain the interval of the number of codes of each family to reach
participants. Finally, participants completed the written questionnaire in a self-report manner.

**Scale development procedure**

**Item generation**
The initial item pool for the PBMS-23 extracted from the qualitative results of (Shirzadi et al., 2020), then comprehensive review of existing instruments, literature review, and content review by experts were conducted. The initial PBMS-23 for Iranian women was a 28-item instrument designed to investigate perceived barriers of mammography among Persian speaking women.

**Content and face validity**
To establish content and face validity, we sent instrument to the panel of ten health professional experts including qualitative researchers, specialists in the field of nursing, health education and health promotion, public health, epidemiology, women's health, and midwifery. The content validity of the questionnaire was carried out using qualitative and quantitative approaches. In the quantitative method, we used Content Validity Ratio (CVR) and Content Validity Index (CVI). In order to calculate the CVR, ten experts were asked to assess each item on a three-point Likert scale (where 1 = essential, 2 = useful but not essential, and 3 = not essential). In order to calculate the CVI, these experts were asked to determine the relevance, clarity, and simplicity of each item using a four-point Likert scale (Liamputtong, 2019; Polit et al., 2007).

The research team determined face validity of the scale in two stages. In the qualitative stage, these ten experts reviewed each item to determine the ambiguity, relevance and difficulty of each item. Additionally, experts provided written feedback on the clarity of the instructions and on the relevance of the content of the scale.

During the quantitative stage, the impact score of each item was calculated (impact score = frequency (%) × importance). For this purpose, experts scored the importance of each item on a 5-point Likert scale. In case of believing that new items are necessary, the panel members also had been encouraged to suggest additional items. Consensus on the removing or keeping items was achieved based on research team discussion rather than the calculation of a content and face validity. According to the Lawshe table, CVR was considered favorable if it was ≥0.62. In addition, If CVI quantity was ≥0.79, the item was acceptable. The items with impact scores of 1.5 or above were considered to be satisfactory (Cottrell & McKenzie, 2010; Liamputtong, 2019; Polit et al., 2007).
**Construct validity**

To investigate the construct validity, we used Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). The items were extracted into eight dimensions of breast conflict (two items), believe destiny (two items), defensive avoidance (three items), fear (three items), lack of knowledge (four items), contrasting/competing priorities (two items), distrust of mammography screening (two items), and inconveniences/difficulties of mammography screening (five items).

The EFA was carried out by the principal component method with direct oblimin rotation, and the Kaiser–Mayer–Olkin (KMO) and Bartlett’s test was used to assess the sampling adequacy of the EFA. We calculated the sample size based on the requirement to conduct an EFA. There is no agreed-upon consensus as to the appropriate ratio between the number of items in a scale and the number of respondents. Tabachnick and Fidell recommend about 300 participants for a factor analysis (Tabachnick et al., 2007), and Burns and Grove recommend five to ten participants per item (Kwok et al., 2010). A correlation of 0.30 or higher between each item and its scale was considered as evidence of convergent validity. A higher correlation of each item with its scale than with the other scales was considered a successful demonstration of convergent validity. Stewart and Ware recommend that items scoring less than 0.30 should be removed from the analysis (Kwok et al., 2010). Before application of EFA, we did KMO test to investigate the compatibility of the sample size for factoring. The KMO value was found greater than 0.60 and the Bartlett test of sphericity test was significant ($p < 0.001$) (Kwok et al., 2010). For defining the construct validity, the research team performed the EFA and CFA on 23 items as PBMS-23. It is recommended that oblique rotation should be used if the oblique factor correlation matrix displays correlations of 0.31 or higher. Values of all factor loading in each of the subscale were higher than 0.30. The correlations of each item with its subscale exceeded the 0.30, criterion for convergent validity in all items that were accepted.

The CFA model fitness was determined using the Chi-squared/df < 5, the Root Mean Square Error of Examination (RMSEA) <0.08, the Comparative Fit Index (CFI) >0.9, the Goodness-of-Fit Index (GFI)>0.9 and the Adjusted Goodness-of-Fit Index (AGFI) >0.9. Additionally, to assess how well the EFA extracted model fits to observe data, we conducted CFA. The method of estimation was robust maximum likelihood. Asymptomatic covariance matrix was considered as a weighted matrix. Input matrix was covariance matrix of data. Fit indices and reasonable values of these indices for CFA were considered as $X^2$/df < 5, RMSEA < 0.08 and also, CFI, GFI, AGFI > 0.90 (Tinsley & Brown, 2000). For data analysis research team performed statistical analysis using IBM SPSS.
Statistics 21.0 (IBM SPSS Statistics, ARMONK, USA) and AMOS 24. P-values less than 0.05 were considered as significant.

**Reliability**

The research team assessed internal consistency reliability of the whole scale and each domain by using Cronbach’s alpha. We used test retest to examine the instrument’s stability. Thirty women completed the scale twice in a two-week interval, and the Intra-class Correlation Coefficient (ICC) was calculated.

**Demographic characteristics**

Participants also completed a questionnaire with eight demographic characteristics including age, marital status, education status, employment, family monthly income, health insurance, family history of breast cancer, and having problems related to breast.

**Statistical analysis**

We expressed data by mean Standard Deviation (SD) and frequency (percent) for numeric and categorical variables, respectively. We computed the total score of scale by summing items of scale and used it in the analysis. A Cronbach’s (alpha) coefficient of 0.70 or above indicates that the instrument has acceptable reliability (Cronbach, 1951). Additionally we computed ICC to evaluate the stability over time. ICC of 0.40 was considered poor to fair, 0.41–0.60 moderate, 0.61–0.80 good and > 0.80 excellent (Bartko, 1966).

**Result**

**Participants**

Mean age of the participants (n=500) was 51.12 (SD = 9.18), ranging from 40 to 69 years. The majority of the participants were younger than 50 (83.30%), married (85.71%) and unemployed (86.70%) and about 43.21% of the participants had elementary and secondary level of education. Table.1 provides detailed information on the demographic characteristics of the sample.

**Content and face validity**

Based on the results of CVR, the estimated CVR for ten items were lower than 0.62, which CVR of two of them were 0.60. Next, according to
opinion of the research team, two items with CVR = 0.60 were kept in
the final scale. For the other eight items, according to opinion of the
research team, we omitted five items and retained three other items in
the scale. It is noteworthy that we revised all items based on the quanti-
tative results and qualitative recommendations of the experts and finally,
five items were dropped from further analysis. In the assessment of face
validity using the impact score method, no score was lower than 1.5 per
item and consequently all items were included in the scale (Table 2).

**Construct validity**

The KMO measure produced a coefficient of >0.61, indicative of moderate
sampling adequacy which was confirmed by Bartlett's test of Sphericity
\((p < 0.001)\). Additionally, the total variance explained was estimated at
about 59.20% which this amount of value is known as an acceptable value
(Kline, 2014). Model adequacy and factor loadings of the scales are shown
in Table 3.

As it shown in Table 4, we conducted CFA to assess how well the EFA
extracted model fits to observed data. The results of confirmatory factor
analysis confirmed the factor structure of the scale. The CFA on the 23

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**Table 1. Demographic and underlying characteristics of the women \((N = 500)\).**

| Variables                          | n (%) |
|-----------------------------------|-------|
| **Age**                           |       |
| \(< = 50\)                        | 235 (47.1) |
| 51–60                             | 187 (37.5) |
| 61+                               | 77 (15.4)  |
| **Literacy level**                |       |
| Illiterate                        | 29 (28.2)  |
| Elementary and secondary school   | 198 (43.2) |
| Diploma                           | 87 (19)    |
| University                        | 44 (9.6)    |
| **Marital Status**                |       |
| Married                           | 415 (83.3) |
| Single/divorced/widowed           | 83 (16.7)  |
| **Employment**                    |       |
| Does not work outside the home    | 430 (86.7) |
| Employed outside home             | 66 (13.3)  |
| **Family Monthly Income**         |       |
| Good                              | 26 (5.3)  |
| Moderate                          | 242 (49.3) |
| Weak                              | 223 (45.4) |
| **Health Insurance**              |       |
| Insured                           | 67 (13.5)  |
| Uninsured                         | 431 (86.5) |
| **Family history of breast cancer** |     |
| Yes                               | 455 (93.4) |
| No                                | 32 (6.6)   |
| **Having problems related to breast** |     |
| Yes                               | 116 (23.5) |
| No                                | 378 (76.5) |
| Item | Item content | CVI  | CVr  | IS  | Result                                                                 |
|------|--------------|------|------|-----|------------------------------------------------------------------------|
| 1    | I am afraid to be diagnosed with cancerous tumor in my breasts by mammography. | 0.97 | 0.88 | 4   | corelate with qualitative recommendations of expert panel and confirm the research team |
| 2    | Procedure of doing mammogram is painful. | 0.90 | 0.81 | 4.2 | Accept without change                                                  |
| 3    | To be exposed by mammography's radiation will hurt my body. | 1    | 1    | 4.1 | Accept without change                                                  |
| 4    | I do not want to think about breast cancer | 0.93 | 0.80 | 3.7 | corelate with qualitative recommendations of expert panel and confirm the research team |
| 5    | Breast cancer happen only in older ages, I'm still young enough to do regular mammography. | 0.90 | 0.80 | 4   | Accept without change                                                  |
| 6    | For being more relaxed, I prefer to be unaware about my probable breast cancer. | 1    | 1    | 4.3 | corelate with qualitative recommendations of expert panel and confirm the research team |
| 7    | I am healthy and don't have disease or problem in my breasts | 0.90 | 1    | 4.3 | Accept without change                                                  |
| 8    | I think breast self-examination is enough to diagnose breast cancer. | 0.97 | 0.81 | 3.9 | corelate with qualitative recommendations of expert panel and confirm the research team |
| 9    | Mammography is not necessary unless my physician recommend it. | 0.97 | 0.6  | 4   | Accept without change                                                  |
| 10   | I don't know what to do for getting a mammogram. | 0.93 | 0.81 | 4.1 | corelate with qualitative recommendations of expert panel and confirm the research team |
| 11   | I believe in divine destiny and mammography does not change my destiny. | 0.97 | 0.60 | 4.2 | corelate with qualitative recommendations of expert panel and confirm the research team |
| 12   | Mammography will not save my life. | 0.80 | 0.40 | 4   | Accept without change                                                  |
| 13   | My spouse/family doesn't assist me to do mammography. | 0.80 | 0.4  | 4.10| corelate with qualitative recommendations of expert panel and confirm the research team |
| 14   | I'm ashamed to do mammography. | 0.90 | 1    | 4.10| Accept without change                                                  |
| 15   | Accessing the mammography imaging centers is difficult for me. | 0.97 | 1    | 4.20| Accept without change                                                  |
| 16   | The mammography screening process (from making the appointment to receiving test results) is time consuming. | 0.97 | 1    | 4.20| Accept without change                                                  |
| 17   | Mammography imaging staffs do not behave respectfully with clients. | 0.97 | 1    | 3.60| Accept without change                                                  |
| 18   | In case of being diagnosed by breast cancer, my family will be involved with my problems. | 0.97 | 0.80 | 3.70| Accept without change                                                  |
| 19   | Cost of mammogram is high. | 0.93 | 1    | 4.40| Accept without change                                                  |
| 20   | In case of mastectomy because of breast cancer I will lose my women's charms. | 0.70 | 0.40 | 3.90| corelate with qualitative recommendations of expert panel and confirm the research team |
| 21   | In case of being diagnosed by breast cancer, others will look at me as a flawed woman. | 0.90 | 0.80 | 4   | Accept without change                                                  |
| 22   | Mammography is not a reliable method to early diagnose of breast cancer. | 0.90 | 1    | 4.20| corelate with qualitative recommendations of expert panel and confirm the research team |
| 23   | Breast cancer cannot be cured even if it is diagnosed earlier. | 1    | 0.80 | 4   | corelate with qualitative recommendations of expert panel and confirm the research team |
Table 3. Model adequacy and factor loading of the PBMS-23 scale.

| Dimension of scale | Believe in fate and destiny | Breast conflict | Defense avoidance | Inconveniences/difficulties of mammography screening | Contrasting/competing of priorities | Fear | Distrust of mammography screening | Lack of knowledge |
|-------------------|----------------------------|----------------|-----------------|-------------------------------------------------|-----------------------------------|------|-------------------------------|-------------------|
| KMO               |                            |                |                 | 0.66                                            |                                    |      |                               |                   |
| P-Value           | <0.001                     | <0.001         | <0.001          | <0.001                                          | <0.001                            | <0.001| <0.001                        | <0.001            |
| Total Variance Explained |                |                |                 | 0.784                                           |                                    |      |                               |                   |
| 1                 | Q1                         |                |                 | 0.830                                           |                                    |      |                               |                   |
| 2                 | Q2                         |                |                 | 0.830                                           |                                    |      |                               |                   |
| 3                 | Q3                         |                |                 |                                                |                                    |      |                               |                   |
| 4                 | Q4                         |                |                 |                                                |                                    |      |                               |                   |
| 5                 | Q5                         |                |                 |                                                |                                    |      |                               |                   |
| 6                 | Q6                         |                |                 |                                                |                                    |      |                               |                   |
| 7                 | Q7                         |                |                 |                                                |                                    |      |                               |                   |
| 8                 | Q8                         |                |                 |                                                |                                    |      |                               |                   |
| 9                 | Q9                         |                |                 |                                                |                                    |      |                               |                   |
| 10                | Q10                        |                |                 |                                                |                                    |      |                               |                   |
| 11                | Q11                        |                |                 |                                                |                                    |      |                               |                   |
| 12                | Q12                        |                |                 |                                                |                                    |      |                               |                   |
| 13                | Q13                        |                |                 |                                                |                                    |      |                               |                   |
| 14                | Q14                        |                |                 |                                                |                                    |      |                               |                   |
| 15                | Q15                        |                |                 |                                                |                                    |      |                               |                   |
| 16                | Q16                        |                |                 |                                                |                                    |      |                               |                   |
| 17                | Q17                        |                |                 |                                                |                                    |      |                               |                   |
| 18                | Q18                        |                |                 |                                                |                                    |      |                               |                   |
| 19                | Q19                        |                |                 |                                                |                                    |      |                               |                   |
| 20                | Q20                        |                |                 |                                                |                                    |      |                               |                   |
| 21                | Q21                        |                |                 |                                                |                                    |      |                               |                   |
| 22                | Q22                        |                |                 |                                                |                                    |      |                               |                   |
| 23                | Q23                        |                |                 |                                                |                                    |      |                               |                   |
items yielded the following results: \( \chi^2/df = 4.40 \), RMSEA (90% CI) = 0.064 (90% CI), GFI = 0.97 and CFI = 0.98, KMR = 0.049 and AGFI = 0.91) that indicate an acceptable fit of the proposed model. In addition, all item-scale relationship and the correlation among the scales were all significant \( p < 0.05 \).

**Reliability**

Alpha coefficients and ICC for dimensions of PBMS-23 were as follow: believe in fate and destiny \[0.718, 0.898 (0.591–0.975)]], breast conflict \[−0.219, 0.873 (0.488–0.968)]], defense avoidance \[0.487, 0.983 (0.730–0.983)]], inconveniences/difficulties of mammography screening \[0.344, 0.905 (0.619–0.977)]], contrasting/competing priorities \[0.563, 0.811 (0.238–0.953)]], fear \[0.616, 0.897]
Table 5. The Perceived Barriers of Mammography Scale (PBMS-23).

| Dimension                          | Item | Item content I will not do mammogram because | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|------------------------------------|------|-----------------------------------------------|-------------------|----------|---------|-------|----------------|
| Fear                               | 1    | I am afraid to be diagnosed with cancerous tumor in my breasts by mammography. |                   |          |         |       |                |
|                                    | 2    | Procedure of doing of mammogram is painful. |                   |          |         |       |                |
|                                    | 3    | To be exposed by mammography's radiation will hurt my body. |                   |          |         |       |                |
| Defense avoidance                  | 4    | I do not want to think about breast cancer |                   |          |         |       |                |
|                                    | 5    | Breast cancer happen only in older ages, I'm still young enough to do regular mammography. |                   |          |         |       |                |
|                                    | 6    | For being more relaxed, I prefer to be unaware about my probable breast cancer. |                   |          |         |       |                |
| Lack of knowledge                  | 7    | I am healthy and don't have disease or problem in my breasts |                   |          |         |       |                |
|                                    | 8    | I think breast self-examination is enough to diagnose breast cancer. |                   |          |         |       |                |
|                                    | 9    | Mammography is not necessary unless my physician recommend it. |                   |          |         |       |                |
|                                    | 10   | I don't know what to do for getting a mammogram. |                   |          |         |       |                |
| Believe in fate and destiny        | 11   | I believe in divine destiny and Mammography will not save my life. |                   |          |         |       |                |
|                                    | 12   | Mammography will not save my life. |                   |          |         |       |                |
| Inconveniences/difficulties of mammography screening | 13   | My spouse/family doesn't assist me to do mammography. |                   |          |         |       |                |
|                                    | 14   | I'm shy to do mammography. |                   |          |         |       |                |
|                                    | 15   | Accessing to mammography imaging centers is difficult for me. |                   |          |         |       |                |
|                                    | 16   | The mammography screening process (from making the appointment to receiving test results) is time consuming. |                   |          |         |       |                |
|                                    | 17   | Mammography imaging staffs do not behave respectfully with clients. |                   |          |         |       |                |
| Contrasting/competing priorities   | 18   | In case of being diagnosed by breast cancer, my family will be involved with my problems. |                   |          |         |       |                |
|                                    | 19   | Cost of mammogram is high. |                   |          |         |       |                |
| Breast conflict                    | 20   | In case of mastectomy because of breast cancer I will lose my femininity. |                   |          |         |       |                |
|                                    | 21   | In case of being diagnosed by breast cancer, others will look at me as a flawed woman. |                   |          |         |       |                |
| Distrust of mammography screening  | 22   | Mammography is not a reliable method for early diagnosis of breast cancer. |                   |          |         |       |                |
|                                    | 23   | Breast cancer cannot be cured even if it is diagnosed earlier. |                   |          |         |       |                |
(0.584–0.974)], distrust of mammography screening [−0.096, 0.879 (0.515–
0.970)], lack of knowledge [0.594, 0.507 (−0.985–0.878)]. Additionally, alpha
coefficients for the total scale PBMS-23 was 0.7; this provided further support
for the internal consistency reliability of the scale, indicating that the scale has
adequate internal consistency reliability. ICC = 0.92 (0.688–0.981) also indicated
that scale had satisfactory stability.

**Discussion**

In this study, we described the development and psychometric properties
of a new instrument, called the mammography screening barriers scale or
PBMS-23 for Persian language women. To our knowledge, PBMS-23 is
the first scale designed to measure barriers of mammography screening.

Generally, the findings showed satisfactory psychometric properties for
the PBMS-23. Finally, the scale contained twenty-three items and eight
dimensions (Table 5). Based on our findings, the content validity was
reasonable and content validity assessment is required, since inferences
are made based on the final scale items. The item content must be deemed
valid to instill confidence in all consequent inferences (Morgado et al., 2017).

In addition, the results of construct validity showed a good structure
for our PBMS-23. Construct validity is most directly related to the ques-
tion of what the instrument is in fact measuring—what construct, trait,
or concept underlies an individual’s performance or score on a measure.
This refers to the degree to which inferences can be legitimately made
from the observed scores to the theoretical constructs about which these
observations are supposed to contain information (Morgado et al., 2017).

**Believe in fate and destiny dimension**

Items included in the “believe in fate and destiny dimension,” reflect this
belief that all events that comprise the life of an individual are predeter-
mined. These beliefs including that women are unable to do anything to
prevent breast cancer, belief in fatalism and the inability to change fate
might be barriers for screening health behavior (Jun & Oh, 2013).

These items do not exist in Rakowski scale that was developed based
on decisional balance construct of the Trans-theoretical Model (Rakowski
et al., 1993) and also in the Champion’s scale (Champion, 1999) and in
the “Hyman-Baker mammography questionnaire” (Hyman et al., 1994),
which they had been developed based on the HBM, but in the scale that
was developed for Chinese women (Kwok et al., 2010) has been mentioned.
Moreover in relation to our scale, the cancer fatalism scale developed by
Powe, the degree of negativity and hopelessness of individuals associated
with the cancer diagnosis was measured (Powe, 1995).
In the Islamic countries, this type of beliefs as a barrier may be because of Islamic teaching and ideology that emphasizes “the will of God,” which means that birth, life, and death of all creatures are in God’s hands. Additionally, believe in fate and destiny dimension can be express by women who are believe to the other religions. Influences of spirituality and religiosity may lead to sense of belief that the outcome of their health is controlling by fate or by God. There are numerous statements in the main Islamic texts such as Quran, which states in the surah al-Imran “no one will die except by God’s permission”. On the other hand, the Islam holds individuals completely responsible for their personal wellness, health, and physical wellbeing.

Therefore, these types of beliefs can act as both barrier and motivated factors for mammography screening. When it comes to health care seeking behaviors, this means patients should effectively look for medical care and only then pray that God makes these medications and treatments effective. Yet, at the same time, it is reported that people have been actively engaged with their medical treatment and they showed that they are far from being passive or believe in fate (Harandy et al., 2010).

**Distrust of mammography screening dimension**

“Distrust of mammography screening dimension” includes items reflect distrust in medical system, lack of expert/skill of health care providers/technicians doing mammography screening, distrust to mammography machines and misconceptions due to late detection of breast cancer and its adverse outcomes such as ineffectiveness of treatment and death. Distrust of the medical system as barrier of mammography screening was also reported previously (Sarma, 2015).

Death due to late detection of cancer may make a belief that cancer will inevitably lead to death thus resulting in distrust of mammogram. In addition, distrust in medical diagnostics can create insecure feelings among women. Therefore, informing and educating women would be useful to create trust among women to engage voluntarily in mammography.

**Breast conflict dimension**

“Breast conflict dimension” represent a woman’s unpleasant feelings and dissatisfaction toward her breasts, which may adversely affect her decision to undertake the procedures for an early detection of breast cancer. Mammography is negatively related to breast conflict (Shirzadi et al., 2019). Self-esteem and self-efficacy development interventions and consultations might be effective to eliminate the breast conflict related beliefs. Breast
conflict can act as a barrier to refer for mammography by enhancing the negative beliefs about body image (Shirzadi et al., 2020; Thomas, 2006; Thomas & Usher, 2009). Although there are less evidence to show the relationship between breast conflict and mammography (Thomas, 2011; Thomas & Usher, 2009), additional studies are needed to explain whether breast conflicts effect on women's decision to persuade to do early breast cancer screening. Furthermore, body image is one of the most frequently reported reasons for not intending to engage in the cancer screening behaviors (Ridolfi & Crowther, 2013).

**Defense avoidance and fear dimensions**

One of the domains of PBMS-23 was “defense avoidance,” which reflect women's high fear about breast cancer and high level of fear becomes the cause of avoiding to think about cancer, which consequently might lead to not engaging in mammography screening. Additionally, “fear dimension” includes items reflecting women's fear and negative expectations about the screening such as pain, being informed about breast cancer, and X-ray.

According to PBMS-23, in other scales, fear of being diagnosed with breast cancer, the imagining and thinking about getting cancer and its consequences, harmfulness of mammography, and mammogram procedure are mentioned as a reasons for not getting mammograms (Champion, 1999; Hyman et al., 1994; Kwok et al., 2010; Rakowski et al., 1993). Based on a Breast Cancer Fear Scale (Champion et al., 2004) thinking about breast cancer creates feelings such as fear, nervousness, upset, depressed, anxiety, uneasiness, tachycardia that might be considered as barriers for women's participation in mammography screening programs.

**Lack of knowledge dimension**

Additionally, items of “lack of knowledge dimension” reflect low awareness about health services, screening and early detection of breast cancer as well as breast cancer. Evidences were found that breast cancer awareness interventions increase the likelihood of breast cancer screening attendance (Anastasi & Lusher, 2019).

Based on health belief model, as a psychological model which was designed to predict health behaviors through focusing on attitudes and beliefs of individuals, if individuals perceive themselves as susceptible to a condition, would have potentially believed that anticipated benefits of taking an action for reducing either their susceptibility to or severity outweighs the barriers to action, they are likely to engage in healthy behavior (Glanz et al., 2008). In addition, based on extended parallel process model and theories of stress and coping, people exposed to
threading conditions doing appraisal that way if they feel capable of taking action and control threading conditions, they will control the risk accordingly. However, when they doubt their ability to minimize the threat, they focus instead on controlling their fear. They will also go into a state of denial, or defensive avoidance. In sum, perceived threat motivates action. Perceived efficacy (i.e., recommended response efficacy and self-efficacy) determines whether individuals control the danger and make behavioral changes or control their fear through psychological defense mechanisms (Sharma, 2016; WHO, 2012). It seems that fear of chemotherapy and body changes that take place after examinations and treatment, fear of pain, and fear of death is common among women. Thus, they prefer not to know because they believe that cancer means end of life and death. Additionally, harmfulness of mammography may be considered as another barrier on getting mammograms because women may be worry about potential side effects of the mammogram procedure (Kissal & Beşer, 2011; L. C. Watson-Johnson et al., 2011) and squeezing of the breast during mammography may lead to breast cancer (Kissal & Beşer, 2011). Therefore, fear may motivate the individual who believes the threat of breast cancer can be reduced by taking action (i.e., engaging in screening). However, if fear is too high, the behavioral response to control the fear will result in avoidance rather than participation in screening. If fear is too low, etc., the motivation for change will not be present. As a result, health promotion and public health practitioners should design comprehensive messages and interventions about mammography and benefits of early detection of breast cancer, so that it can influence the fear and informed decision about the adoption of mammography.

**Contrasting/competing priorities dimension**

“Contrasting/competing priorities dimension” points out to the perceived issues that are more important than mammography. Women may have other health problems, or may have personal concerns, or their health has less priority in comparison to other interests or obligations that they may have such as job, family, and childcare (Sarma, 2015; Shirzadi et al., 2020). Additionally, having numerous routine responsibilities and facing certain daily challenges may be considered as important barriers to mammography adoption. This barrier is defined as conflicting priorities or competing priorities (Shirzadi et al., 2020).

**Inconveniences/difficulties of mammography screening dimension**

“Inconveniences/difficulties of mammography screening dimension” items reflect issues such as lack of access to screening services, time consuming
screening process, modesty and privacy concerning one's breasts and uncomfortable feeling to discuss about breast issues, lack of family support, and perceived lack of good communication skills of health care providers.

In Middle East culture, people consider and value family institution and the family cohesion is very important. In addition, emotional relationship between family members is strong and they are interdependent (Nikpey & Pouya, 2012). Additionally, lack of spouse/family support, both personally and financially, played a role in mammography adherence. Furthermore, issues such as upsetting the family, especially their children, and worrying about family/children's fate causes women to avoid pursuing their health problems or disclosing the existence of a problem (Shirzadi et al., 2020). What was mentioned above, it could be explained by theory of planned behavior that whether important referent individuals approve or disapprove of performing the behavior, weighted by his or her motivation to comply with those referents. In addition, we should account for factors that are outside of control of women that may affect their screening behaviors (Glanz et al., 2008). In the cultural belief scale for mammography screening which developed by Russell, et al, they explained five subscales that is consistent with our scale (Russell et al., 2003).

Support from family members, peers, health care workers, decision-makers and insurance systems can facilitate mammography adoption, in other word, instrumental, informational and emotional support to perform preventive behaviors is essential.

Measurement is a fundamental activity of science, since it enables researchers to acquire knowledge about people, objects, events, and processes. Measurement scales are useful tools to attribute scores in some numerical dimension to phenomena that cannot be measured directly (Morgado et al., 2017). As such, we believe that this newly developed instrument may be especially helpful for health care teams to recognize and to plan preventive health strategies that are functional and targeted to specific conditions. The inclusion of eight domains in this scale further allows health experts to understand how to improve these in need domains. The scales also are useful in that they may be quickly administered and they allow for immediate assessments and interventions based upon the results.

**Limitation**

Our study also has some limitations. First, we emerged the primary data from three cities and professionals may intend to use this developed scale in the other areas. Second, because of limited sample we cannot generalize findings to other populations. Additionally, because of the lack of the
other similar standard instruments in the literature, we could not critically examine the criterion validity. Additionally, due to non-experimental nature of the study, no causal inferences were drawn.

**Conclusion**

Generally, based on these findings, we suggest that the mammography screening barriers scale for Iranian women is a valid and reliable instrument to assess barriers affecting women's mammography screening which researchers in the Middle East area can apply it to investigate the relevant barriers. This research with a focus on barriers of mammography screening has offered a conceptual framework, to better understanding of women's behavior about breast cancer screening programs and how mitigate this problem. Based on the findings obtained in this study, to increase mammography screening rate attention must be paid to all barriers in different levels of individual, family, community, health system and legislation. Furthermore, professionals should implement appropriate for each level. Collaborations between health care providers and policymaker is essential to minimize the barriers faced by women. One of the aspects of this instrument is using comprehensive approach in developing it including the qualitative study findings, review of existing instruments, literature review, and content review by experts. Furthermore and based on our analysis mentioned in this research, PBMS-23 can be used by women in other countries in the Middle East area. Finally, we recommend further studies in different populations to establish stronger psychometric properties for the instrument.

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**Author’s contributions**

SS, MAJ, HA designed the study. SS collected survey data. SS, MAJ, HA analyzed and present statistical results. SS, MAJ, HA were major contributors in writing the manuscript. MMH edited the manuscript. All authors read and approved the final manuscript.

**Disclosure statement**

The authors claim no conflict of interests with other people or organizations
Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical approval

Ethics Committee in Tabriz University of Medical Sciences provided ethical approval for the study (Ethics Code: IR.TBZMED.REC. A/149-451). All the participants signed informed consent before the study.

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