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Primary Development and Psychometric Properties of PRECEDE Model-based Scales for Brucellosis Prevention among an Iranian Rural Population

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Abstract

Background: According to WHO, brucellosis is one of the 7 neglected zoonotic diseases and a major challenging issue for public health.
Objectives: The aim of this study was to investigate the psychometric properties of the PRECEDE model-based scales for brucellosis prevention (PRECEDE-MSBP).
Methods: In this cross-sectional study conducted in 2015, stratified random sampling was employed to recruit 420 rural residents in Ahar county, Iran. A comprehensive literature review was conducted to develop the initial draft of PRECEDE-MSBP. Face, content, and construct validity and reliability were determined.
Results: Applying Exploratory Factor Analysis, the optimal solution including 37 items and 7 factors for Educational and Ecological diagnosis, 5 items and 2 factors for Environmental diagnosis, and 9 items and 3 factors for Behavioral diagnosis were emerged, which accounted for 60.43%, 56.51%, and 53.75% of the total variances, respectively. Appropriate validity, reliability, functionality, and simplicity were demonstrated for PRECEDE-MSBP.
Conclusions: Researchers and health care providers interested in brucellosis prevention may apply the PRECEDE-MSBP inventory as a suitable instrument to provide the best information while conducting brucellosis prevention need assessments for their interventional efforts. However, further studies applying this instrument are needed in order to compare the different aspects of PRECEDE-MSBP in different communities.

Keywords: Brucellosis, Prevention, PRECEDE-PROCEED Model, Instrumentation, Rural Population

1. Background

According to the world health organization (WHO), brucellosis, as one of the 7 neglected zoonotic diseases, is a major challenging issue for public health due to the physical suffering and reduced work ability of those infected, along with the decreased productivity of the livestock with the disease (1). Despite the great progress in the control and eradication of brucellosis in many countries, there are still regions with high prevalence rates where the infection persists among domestic animals and, consequently, frequent transmissions occur among the human populations (2).

Iran is an endemic region for brucellosis (3) with a range of 0.5% to 10.9% for the prevalence rate in different areas (2). In this country, the region with the highest risk for brucellosis was reported to be East Azarbayjan province, where Ahar county is a hot spot (4).

Brucellosis is often transmitted by inhalation, animal contact, and consumption of unpasteurized dairy as well as undercooked meat products (5). Social and cultural factors and socioeconomic status have also been highlighted as risk factors for brucellosis (6, 7). Review on the literature shows that brucellosis control requires integrated action from both human and animal health sectors alongside political and financial supports especially on a regional scale

(8). Moreover, tackling the problem of "neglect" in relation to a disease like brucellosis requires high-level advocacy (9). Involving the government and community members may also affect the prevalence of brucellosis. A study in Greece showed vaccination of animals against brucellosis combined with health education and preventive measures among rural populations as promising measures in great reduction of brucellosis incidence rate (10).

In Iran, health behavior change frameworks have been widely used to address different health issues (11-14). However, limited studies have applied the planning frameworks to evaluate health care interventions on infectious diseases (15) such as brucellosis. Accordingly, there is a lack in the development of standard instruments measuring the components of such frameworks in order to design comprehensive brucellosis prevention programs. In order to answer the question that why the prevalence of brucellosis in East Azarbayjan, Iran, is the highest in the region and also, what strategies may be suggested to decrease this prevalence, we set a comprehensive study with a field trial design applying the PRECEDE-PROCEED Model (3). As Green and Kreuter noted, in order to modify a behavior, the individual alone should not be targeted; rather, the entire surrounding environment and the factors affecting his/her behavior should be considered (3, 16, 17).

To start the study, we needed a valid and reliable instrument to assess the components of the model, which is a prerequisite to study a subject (18). Several previous studies have investigated the factors associated with brucellosis prevention (9, 16, 17, 19). Nevertheless, most studies have focused on some aspects of the related factors, like brucellosis knowledge, attitude, and practice. In 2016, Hajari et al. (20) applied the PRECEDE-PROCEED model to conduct an educational need assessment aiming to prevent brucellosis in Isfahan, Iran. Their focus was only on the educational factors. Therefore, our review on the literature showed lack of a valid comprehensive and framework-based instrument to assess the determinants of brucellosis preventive behaviors. In the present study, we reported the development process and psychometric properties of PRECEDE Model-based Scales for Brucellosis Prevention (PRECEDE-MSBP). These instruments may help investigators precisely assess the behavioral, environmental, ecological, and educational factors related to brucellosis prevention, aiming to address the issue in the communities with a high rate of the disease.

2. Methods

2.1. Participants and Data Collection

In 2015, applying a cross-sectional study, stratified random sampling was employed to recruit 420 respondents from 4 rural regions of Ahar county, East Azerbaijan province, as a county with the most prevalence rate of brucellosis. Based on the Iranian health system, the governmental primary health care services are provided for the rural areas of this county through rural health centers. In order to provide the remote settings with PHC services, health houses (HHs) are established in some villages. These HHs are delivering PHC services to the rural populations under the supervision of the rural health centers. In the present study, the county was stratified into 4 regions: north, south, west, and east. Considering the nature of sampling method, two health centers (HCs) were selected from each region and then, one health house (HH) was randomly selected from each HC (in total eight HHs). Finally, in proportion to the population coverage of the HHs, 42 to 62 subjects aged 15 - 70 were recruited from the household health records of each rural HH.

As it was a validation study, the ratio of at least 5 subjects per item (19) was considered to estimate the sample size (n = 310). Since the initial instrument developed in the present study constituted 67 items, the sample size was considered 335 respondents. Considering the possibility of losing some of the subjects, the sample size increased to 420. Respondents with at least 15 years of age and living in the villages for at least 6 months were included in the study. People who were too old and unable to answer the questions and those who were unwilling to provide consent for data collection, and employees in the health centers or veterinary office were excluded from the study.

The literate respondents completed the questionnaires independently and the illiterate or poorly educated subjects were interviewed in a private room in the HHs. The time needed to complete the questionnaires was about 10 - 15 minutes. In order to conduct test–retest reliability, 30 randomly selected respondents were asked to complete the questionnaires, on a second occasion, 7 - 10 days later.

2.2. Design AND Item Generation

This study aimed to undertake rigorous psychometric testing of the PRECEDE-MSBP inventory. In order to develop the instrument, a comprehensive review of the literature was conducted to create an item pool (7, 15, 21, 22). The four most popular search engines PubMed/MEDLINE, ScienceDirect, Scopus, and Google Scholar were searched with the special keywords of brucellosis, prevention, PRECEDE-PROCEED Model, Instrumentation, brucellosis preventive behaviors, and health education. The derived data were crosschecked by a researcher linked to the study and in total, 67 items were generated and divided into three subscales including educational and ecological factors (predisposing (knowledge, attitudes, and self-efficacy), reinforcing and enabling factors) (52 items), Behavioral (9

items), and environmental factors (6 items) for brucellosis prevention.

The Knowledge subscale measured individuals' awareness and understanding about the disease and how to prevent it. This subscale included 16 items with 3-point responses (yes, no, I don't know). The items were related to patients' knowledge about the causes of brucellosis, the ways of its transmission, and the protective behaviors. The participants were asked to put a check in the box that corresponded to each item. The higher the responders' total score, the higher their knowledge about brucellosis prevention.

The Attitudes subscale measured positive and negative tendencies toward the disease. The attitudes subscale consisted 17 items with a 5-point Likert-type scale (strongly agree to strongly disagree). Each of the five responses was given a numerical value. The higher the total score, the more positive attitude toward brucellosis prevention.

The Self-efficacy subscale included 7 items with a 5-point Likert-type scale (completely uncertain to completely certain). The scale assessed the beliefs of the respondents on their ability to perform the brucellosis preventive behaviors. Each of the five responses was given a numerical value. The higher the total score, the more self-efficacy toward brucellosis preventive behaviors.

The Enabling factors subscale consisted 5 items with 5 possible answers (always, very often, sometimes, rarely, never) about availability and accessibility of the materials and resources to facilitate brucellosis preventive behaviors. The higher the total score, the higher the respondents' enabling factors to conduct brucellosis preventive behaviors.

The Reinforcing factors subscale contained 8 items with 5 possible answers (always, usually, sometimes, rarely, never) in which the respondents' perception of receiving social and familial support to prevent brucellosis was raised. The higher the total score, the higher the level of support perceived by the respondents to perform brucellosis preventive behaviors.

The Environmental factors scale included 6 items with 5 possible answers (always, usually, sometimes, rarely, never) designed to assess the characteristics of the environment that facilitates the required actions, skills, or resources to prevent brucellosis. The higher the total score, the better the level of perception on environmental factors among the respondents regarding brucellosis prevention.

The Behavioral factors scale, included 9 items with 5 possible answers (always, usually, sometimes, rarely, never) designed to assess the brucellosis preventive behaviors among the rural population. The higher the total score, the better the level of brucellosis preventive behaviors among the respondents.

Moreover, all the participants were asked to answer the following demographic questions: gender, age, marital status, educational status, job, the history of having disease, and the family history of being diagnosed with the disease.

The Persian version (23) of the general health questionnaire-12 (GHQ-12) (24) was also used to assess the degree to which the measures of this scale and the PRECEDE-MSBP constructs are related. The GHQ-12, as a self-report instrument, has two dimensions: positive mental health (6 items) and symptoms of mental disorder (6 items). The response format is based on a 4-point Likert-type scale ("not at all", "same as usual", "rather more than usual", and "much more than usual") with the scores ranging from 0 to 36. Higher scores represent higher levels of distress.

2.3. Content Validity

To determine content validity, both qualitative and quantitative methods were used. A panel of 5 experts including three health education specialists, a specialist physician in infectious diseases, and a psychologist evaluated the grammar and wording of the items as well as item allocation and scaling of the instruments (19). All the items were checked by the expert panel and decided whether a series of items adequately cover the target construct. Therefore, the revision was made into the questionnaire and 5 items were deleted based on the expert panel recommendations. Content validity ratio (CVR) and content validity index (CVI) were used for quantitative content validity of the constructs (19).

CVRs were assessed based on a 3-point rating scale: essential, useful but not essential, and unessential (19). CVIs were conducted by 12 experts who were not included in the primary expert panel. These 12 experts were asked to comment independently on the necessity, relevance, clarity, and simplicity of the items. The relevance of the items was also assessed, using a four-point rating scale: a) not relevant; b) slightly relevant; c) relevant; and d) completely relevant. CVI value of 0.79 or more was considered satisfactory for each statement (20).

2.4. Face Validity

Face validity of the instruments was assessed with both qualitative and quantitative methods (25). The qualitative assessment of each item for ambiguity, relevancy, and difficulty was conducted by the same expert panel. Quantitative face validity of the items was conducted and the importance of each item was scored based on a 5-point rating scale. Then, the impact score of each item was assessed. The impact of each item was calculated by multiplying the frequency of an item by its mean importance [impact score

= frequency (%) × importance]. The impact score of 1.5 or higher was desired, as recommended previously (24).

2.5. Convergent Validity

In order to compare the convergent validity, the relationships between the PRECEDE-MSBP constructs and the dimensions of GHQ-12 were tested applying Pearson's correlation coefficients.

2.6. Statistical Analysis

The statistical package for social sciences (SPSS) v. 18 for Windows (SPSS Inc., Chicago, IL) was used to conduct all statistical analyses. The measures of central tendency and variability were used to summarize and organize the data. Linear interpolation was conducted to fill in the irregular missing values throughout the data. The normality of data distribution was approved by conducting One-Sample Kolmogorov-Smirnov test. EFA was performed in order to assess the construct validity of the questionnaire (19). The principal component analysis with varimax rotation was performed to extract factors. Factor loadings equal or greater than 0.3 were considered appropriate and the eigenvalues above 1 were used to assign the number of factors. In order to obtain the appropriateness of the sample, the Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were used (23). Internal consistency of the instrument was evaluated by the Cronbach's alpha coefficient for each factor. The test–retest reliability coefficient was also calculated. Intra-class correlation coefficients (ICC) with 95% confidence intervals (CI) were calculated; an ICC $\geq$ 0.70 was also considered acceptable. Pearson's correlation coefficient was used to assess convergent validity. The Cronbach's alpha coefficient of 0.7 or above was thought to be satisfactory (11). The level of significance was considered 0.05, a priori.

2.7. Ethical Considerations

The ethics committee of the vice chancellor for research in Tabriz University of Medical Sciences approved the study (number 5/4/7647, 7.11.2015). Informed consent was obtained from the respondents by signing a consent form. They were also explained about the purpose of the study and were assured on the confidentiality of their information.

3. Results

3.1. Participants

In total, 420 rural residents participated in the study. The data of 20 participants were excluded due to incomplete information. The mean age of the participants was 36.6 (SD = 11.3). Demographic characteristics of the respondents and the associations between their demographic characteristics and the mean score of the factors are shown in Table 1.

Based on the recommendations of the expert panel, 5 items were removed from the initial 67 items of the instrument and therefore, the PRECEDE-MSBP with 62 items was included in the CVI and CVR process. In terms of face validity and content validity, the Impact Score and the CVR value for all PRECEDE-MSBP items were more than 1.5 and 0.62 (25), respectively, and therefore no item was deleted; however, in qualitative content validity, some modifications were made in the wording and phrasing of some items. According to quantitative content validation, 11 items were deleted due to their low CVR value (less than 0.62). In CVI assessment, no item was deleted. The mean items' relevancy, clarity, simplicity, and their total mean score were 89.4 ± 0.3, 91.2 ± 0.3, 88.2 ± 0.5, and 91.6 ± 0.2, respectively. Eventually, 51 items remained.

3.2. Exploratory Factor Analysis

The initial comprehensive principal component analysis was conducted to assess the factor loadings at the level of whole questionnaire but the results were not satisfactory. Therefore, we chose to conduct separate principal component analyses for the constructs (educational and ecological construct and behavioral and environmental constructs). Kaiser-Meyer-Olkin measure of sampling adequacy as well as the Bartlett's test of sphericity for the Educational-Ecological construct and for the Environmental and Behavioral constructs were 0.805 (Approx. Chi-Square = 4.794E3, df = 666, P < 0.001), 0.516 (Approx. Chi-Square = 135.682, df = 10, P < 0.001), and 0.634 (Approx. Chi-Square = 419.110, df = 36, P < 0.001), respectively. The number of items, mean and standard deviations, range, skewness and kurtosis as well as ceiling and floor effects of the factors are presented in Table 2.

3.3. EFA for Educational and Ecological constructs

Nine factors were extracted with eigenvalues more than 1 by which, in total 60.43% of all variance between the items was explained. Cattell's scree test indicated that 4 to 9 factors might be extracted. Therefore, multiple runs of factor analysis, varying the number of factors, were conducted and finally, a seven-factor solution was distinguished as the clearest pattern of loading. This solution explained 50.25% of all variance. Table 3 shows the rotated factor pattern coefficient for this solution as well as some related information.

As is shown in Table 3, some of the factors had Cronbach's alpha less than 0.65, which argues omitting of these

Table 1. Relationship Between the Respondents' Characteristics and the Mean Score of the Factors

Variables	N (%)	Educational and Ecological[a]							Environmental[b]		Factors[c]		
		F1	F2	F3	F4	F5	F6	F7	F1E	F2E	F1B	F2B	F3B
		P Value	P Value	P Value	P Value	P Value	P Value	P Value	P Value	P Value	P Value	P Value	P Value
Age, y		0.059	0.000	0.270	0.193	0.189	0.009	0.330	0.248	0.594	0.248	0.180	0.146
15 - 29	129 (32.2)												
30 - 39	107 (26.8)												
40 - 59	151 (37.8)												
60 ≥	13 (3.2)												
Gender		0.191	0.912	0.064	0.049	0.74	0.308	0.007	0.112	0.899	0.093	0.000	0.225
Male	201 (50.25)												
Female	199 (49.75)												
Occupation		0.222	0.000	0.016	0.070	0.225	0.012	0.045	0.160	0.794	0.009	0.000	0.046
Farmer/Rancher	118 (29.5)												
Self-employed	69 (17.2)												
Housewife	192 (48)												
Student	21 (5.2)												
Education		0.003	0.000	0.017	0.450	0.297	0.001	0.643	0.415	0.099	0.012	0.160	0.011
Illiterate	35 (8.8)												
Elementary/Guidance	226 (56.5)												
High school/Diploma	111 (27.8)												
Higher Education	28 (7)												
Family Size		0.006	0.023	0.003	0.321	0.029	0.001	0.145	0.035	0.337	0.027	0.013	0.000
1 - 2	31 (7.8)												
3	60 (15)												
4	129 (32.2)												
5	96 (24)												
6	46 (11.5)												
7 and more	38 (9.6)												
History of being with Brucellosis		0.001	0.644	0.037	0.809	0.392	0.092	0.726	0.860	0.048	0.957	0.120	0.984
Yes	34 (8.5)												
No	366 (91.5)												
Family history of being with Brucellosis		0.001	0.483	0.296	0.643	0.651	0.046	0.714	0.204	477	0.511	0.523	0.807
Yes	60 (15)												
No	340 (85)												

[a] F1, knowledge; F2, self-efficacy; F3, attitude toward brucellosis; F4, enabling factors; F5= internal rewards/family norm; F6, attitude toward Preventive behaviors; F7, external rewards.
[b] F1E, house/barn condition, F2E, supportive environment.
[c] F1B, preventive behaviors in barn; F2B, fresh cheese usage/Livestock's timely vaccination; F3B, preventive eating behaviors.

factors. Visual inspection and the hyperplane count (26) were considered to determine the simple structure and the best solution, respectively. Finally, the authors decided not to eliminate the factors number 6 and 7. Instead, in order to promote the Cronbach's α of the factors, those items that in visual inspection found to be loaded incorrectly (based on the theoretical basis) on a factor and also, to be loaded more than 0.3 on another factor (which was supported by the theoretical basis) were removed from the original factor and added to the new factor with the loading more than 0.3. The relocation of the items was as follows: K13 and K7 from F3 and F4, respectively, were relocated to F1, and instead, A1, A9, and A10 from F1 were relocated to F3, F6, and F6, respectively; SE1 and SE4 from F3 and F6, respectively, were relocated to F2 and instead, RF1 from F2 was relocated to F7; RF5 and RF3 from F4 and F6, respectively, were relocated to F7. Then, the Cronbach's α of the new factors was calculated (Table 3) and a slight increase was found in the reliability of the factors. Therefore, this factor pattern was considered as the optimal solution.

3.4. EFA for Behavioral and Environmental Constructs

For Behavioral and Environmental constructs, three and two factors, respectively, with eigenvalues more than 1, were extracted. These solutions explained 53.75% and 56.51% of all variances between the items in Behavioral and

Table 2. Summary of PRECEDE-MSBP Inventory Psychometric Properties

Scale	Number of Items	Range	Mean (SD)	Kurtosis	Skewness	Floor Effect, %	Ceiling Effect, %
F1 = knowledge	11	11 - 33	19.96 (2.4)	-1.33	-0.07	0	0.5
F2 = Self-efficacy	7	7 - 35	26.03 (4.92)	-0.59	0.02	0.2	2.5
F3 = Attitude toward brucellosis	4	4 - 20	15.67 (3.02)	0.49	-0.71	0.2	8.5
F4 = Enabling factors	2	2 - 10	5.29 (2.2)	-0.76	0.14	0	0.4
F5 = Internal Rewards/Family norm	3	3 - 15	13.03 (2.24)	2	-1.32	0	0.7
F6 = Attitude toward Preventive behaviors	5	5 - 25	18.83 (3.46)	-0.40	-0.46	2	2.4
F7 = External Rewards	5	5 - 25	12.85 (3.84)	0.21	0.44	0.5	0.5
F1E = House/Barn Condition	2	2 - 10	4.78 (1.23)	0.49	0.19	3	0.2
F2E = Supportive Environment	3	3-15	5.87 (1.47)	1	0.53	5	0.5
F1B = Preventive Behaviors in Barn	4	4 - 20	10.64 (3.55)	0.07	0.51	2.8	2.5
F2B = Fresh Cheese Usage/Livestock's Timely Vaccination	2	2 - 10	7.08 (1.5)	-0.09	-0.15	1	6.8
F3B = Preventive Eating Behaviors	3	3 - 15	11.12 (1.51)	1.19	-0.10	0.5	3.2

Environmental constructs, respectively. The Cattell's scree test for both the constructs indicated that 3 and 2 factor solutions were the clearest patterns of loading. Table 4 shows the rotated factor pattern coefficient for the solutions of the variables as well as some related information.

The factor pattern coefficient values were used to interpret the factors. As recommended by Nunnally (27), the cut-off of 0.30 was considered to include one item in the interpretation of a factor (Tables 3 and 4). Educational and Ecological Factors included 7 factors. This solution accounted for 50.25% of the total variance. Environmental and Behavioral Factors included 5 factors. These solutions, also, accounted for 56.51% and 53.75% of the total variances in Environmental and Behavioral factors, respectively.

Bivariate correlations for all the factors are indicated in Table 5. Statistically significant correlations were found between most of the factors. The highest and the lowest correlations were observed between factors 1 and 6 (r = 0.551) and between factors 1 and 7 (r = 0.000), respectively.

By applying Pearson's correlation analysis, it was found that most of the PRECEDE-MSBP factors scores had statistically significant correlations with the both components of the GHQ-12 (weak to moderate correlations). Positive correlations were found between all the factors and Positive Mental Health component of GHQ-12. In addition, negative associations were found between all the factors and Symptoms of Mental Disorders component of GHQ-12. The results are summarized in Table 6.

4. Discussion

The current study reported the development and psychometric properties of the PRECEDE-MSBP inventory. During construct validity investigation for educational and ecological constructs, it was found that a seven-factor solution yielded a clearer pattern of factor loadings, which accounted for 50.25% of all variance between the items. The first three factors, namely "Knowledge", "Self-efficacy", and "Attitude toward brucellosis prevention", explained about 35% of the total variance. This finding strongly approves the conceptual framework of PRECEDE model within which, predisposing factors were considered to have a significant role in performing a healthy behavior (3, 28-30).

In addition, construct validity for environmental and behavioral constructs showed that two- and three-factor solutions yielded clearer patterns of factor loadings for these components. These solutions accounted for 56.51% and 53.75% of the total variances in Environmental and Behavioral factors, respectively. As is clear, all the other factors are consistent with the components of educational and ecological factors as well as the behavioral and environmental factors in the PRECEDE model.

Diverse associations with a range from no association to moderate and strong associations were found between the factors. This diversity in the relationships may be attributed to the nature of the factors, as they cover a wide range of cognitive, socially supportive, environmental, and behavioral variables. The weakest and the strongest relationships were found between factor 1 (Knowledge) and factor 6 (Attitude toward preventive behaviors) and be-

Table 4. Rotated Factor Pattern Coefficients for Variable Solutions (14 Items) of Behavioral and Environmental Factors[a]

Behavioral Factors	F1	F2	F3
I clean the barn by disinfectant after disposal of an aborted fetus.	0.754		
I wash the udder of my cattle, properly, before milking.	0.741		
I wear gloves and a mask while disposing an aborted fetus in the barn.	0.694		
I wear gloves and a mask while cleaning the barn.	0.643	0.352	
My family and I eat fresh cheese.		0.832	
I vaccinate my cattle on time.		-0.643	0.491
My family and I used to boil milk, for at least 5 minutes, before drinking.			0.677
My family and I used to consume pasteurized milk.			-0.560
My family and I used to eat raw or partially cooked meat			0.515
Initial Eigenvalues	2.22	1.40	1.20
Rotation sums of squares	2.16	1.34	1.33
Percentage of variance explained	24.67	15.64	13.42
Cronbach's α	0.69	0.67	0.10
ICC (95% CI)	0.690 (0.637- 0.736)	0.674 (0.375- 1.03)	0.64 (0.576 - 0.706)
Environmental Factors	F1	F2	-
The barn in our house is eroded and needs reconstruction.	0.843		-
Our home is situated close to the barn in a way that we smell the odor of the barn from inside home	0.809		-
The rural district council provides us with a trunk for carrying out the animal wastes to the outside of the village		0.779	-
The local veterinary office conducts periodical measures to identify and slaughter the livestock with brucellosis		0.718	-
The site of disposing the livestock waste is far enough from the village circumstances		-0.524	-
Initial Eigenvalues	1.53	1.29	-
Rotation sums of squares	1.42	1.40	-
Percentage of variance explained	30.59	25.91	-
Cronbach's α	0.57	0.44	-
ICC (95% CI)	0.57 (0.445 - 0.611)	0.448 (0.328 - 0.546)	-

[a] F1, house/barn condition; F2, supportive environment; ***F1, preventive behaviors in barn; F2, fresh cheese usage/Livestock's timely vaccination; F3, preventive eating behaviors.

tween factor 1 (Knowledge) and factor 7 (External Rewards), respectively.

Convergent validity was assessed using GHQ-12 in the present study. The results showed that some factors derived from PRECEDE-MSBP had weak to moderate associations with the two components of GHQ-12. Despite the statistically non-significant relationships observed between some of the PRECEDE-MSBP factors and the two components of GHQ-12, it was found that the associations between all the factors with Positive Mental Health component were positive. In addition, inverse associations were found between all the factors and Symptoms of Mental Disorder component of GHQ-12. These findings may be supporting for the concepts of convergent construct validity.

Most of the factors derived from PRECEDE-MSBP showed a partly satisfactory internal consistency. Based on the previously accepted reference tables (31, 32), the Cronbach's alpha for the PRECEDE-MSBP factors ranged from low (0.44) to very high (0.9). There are several psychometric studies (8, 26, 33-36) in which Cronbach's alpha has been used to confirm the internal consistency of the instruments. Moreover, the results of CVI as well as those of the face and content validity in the present study ensured the simplicity, clarity, and relevancy of PRECEDE-MSBP.

To the best of our knowledge, this was the first study trying to develop and validate a comprehensive and framework-based instrument aiming at need assessment of a rural population on brucellosis prevention. The developed PRECEDE-MSBP may be helpful in primary assessments of educational and ecological interventions for brucellosis prevention, with the hope to address the determinants of brucellosis preventive behaviors. As a limitation for our study, the difficulty in comparing PRECEDE-MSBP with other similar instruments may be noted, which may be due to the lack of comparable instruments in Iran and/or other countries or the instruments specific to the constructs of the PRECEDE model.

4.1. Conclusions

In the present study, the PRECEDE-MSBP inventory showed an appropriate validity, reliability, simplicity, and functionality. Researchers, health care providers, and health practitioners interested in brucellosis prevention may apply this suitable instrument to provide best information while conducting brucellosis prevention need assessments for their interventional efforts. However, further studies applying this instrument are needed to compare the different aspects of PRECEDE-MSBP in different communities.

Table 5. PRECEDE-MSBP Inventory Correlation Matrix

Factors	F1	F2	F3	F4	F5	F6	F7	F1E	F2E	F1B	F2B	F3B
F1 = Knowledge	1											
F2 = Self-efficacy	0.363[a]	1										
F3 = Attitude toward brucellosis	0.515[a]	0.346[a]	1									
F4 = Enabling Factors	0.210[a]	0.181[a]	0.181[a]	1								
F5 = Internal Rewards/Family norm	0.258[a]	0.125[b]	0.336[a]	-0.051	1							
F6 = Attitude toward Preventive behaviors	0.551[a]	0.470[a]	0.456[a]	0.226[a]	0.261[a]	1						
F7 = External Rewards	0.000	-0.025	0.093	0.262[a]	0.005	0.060	1					
F1E = House/Barn Condition	-0.151[a]	-0.116[b]	-0.028	-0.140[a]	-0.073	-0.073	-0.008	1				
F2E = Supportive Environment	0.021	0.134[a]	-0.079	0.018	-0.136[a]	0.024	-0.041	0.086	1			
F1B= Preventive Behaviors in Barn	0.212[a]	0.212[a]	0.251[a]	0.446[a]	0.169[a]	0.261[a]	0.395[a]	-0.242[a]	-0.068	1		
F2B = Fresh Cheese Usage/Livestock's Timely Vaccination	0.163[a]	0.309[a]	0.250[a]	0.137[a]	0.149[a]	0.235[a]	0.278[a]	-0.047	0.021	0.295[a]	1	
F3B = Preventive Eating Behaviors	0.124[b]	0.236[a]	0.077	0.121[b]	0.092	0.101[b]	-0.068	-0.177[a]	0.105[b]	0.078	0.116[b]	1

[a] Correlation is significant at the 0.01 level (2-tailed).
[b] Correlation is significant at the 0.05 level (2-tailed).

Table 6. Pearson Correlation Coefficients of the PRECEDE-MSBP Factors and GHQ-12 Components Scores

Factors/Constructs	GHQ-12 Components		GHQ-12 Total
	Positive Mental Health	Symptoms of Mental Disorders	
F1 = Knowledge	0.085	-0.098	0.104[a]
F2 = Self-efficacy	0.180[b]	-0.005	0.081
F3 = Attitude toward brucellosis	0.153[b]	-0.248[b]	0.235[b]
F4 = Enabling Factors	0.080	-0.027	0.055
F5 = Internal Rewards/Family norm	0.145[b]	-0.129[b]	0.153[b]
F6 = Attitude toward Preventive behaviors	0.224[b]	-0.134[b]	0.193[b]
F7 = External Rewards	0.015	-0.044	0.022
F1E = House/Barn Condition	0.096	0.082	0.013
F2E = Supportive Environment	0.081	-0.194[b]	0.165[b]
F1B = Preventive Behaviors in Barn	0.088	-0.080	0.091
F2B = Fresh Cheese Usage/Livestock's timely vaccination	0.115[a]	-0.096	0.117[a]
F3B = Preventive eating behaviors	0.093	-0.107[a]	-0.113[a]
Environmental Construct	0.160[b]	-0.166[b]	-0.113[a]
Behavioral Construct	0.094	-0.156[b]	0.070

[a] Correlation is significant at the 0.05 level (2-tailed).
[b] Correlation is significant at the 0.01 level (2-tailed).

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Footnotes

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Table 3. Rotated Factor Pattern Coefficients for Variable Solutions (37 items) of Educational and Ecological Factors

	Factors[a]	1[a]	2	3	4	5	6	7
K12	Handling the waste of infected animals may transmit the disease to the human body	0.691						
K9	Brucellosis may be transmitted through breathing	0.650						
K6	Brucellosis may be transmitted to the human body from infected goats	0.639						
K10	Sunlight may disinfect the contaminated waste of animals	0.631						
K11	Brucellosis may be transmitted through a wounded skin	0.608						
K8	The brucellosis microbe may be alive in the barn or the waste of animals for a long time	0.550			0.371			
K5	Brucellosis may be transmitted to the human body from an infected cattle	0.538						
A1	There is no way to prevent brucellosis among humans (1)	0.523b		0.421[b]				
EF2	Periodic educational classes on brucellosis prevention are being held for us by regional health care center/veterinary office	0.436						
A10	Vaccination of livestock against brucellosis is a difficult task and needs a lot of money	0.408[b]					0.404[b]	

A9	Digging a hole in the ground to bury a livestock aborted fetus is a difficult task	0.359[b]					0.314[b]		
K16	In order to avoid the spread of brucellosis microbes, the site of aborted fetus in the barn has to be burned or to be washed with disinfectant	0.342			0.339				
SE7	I am sure that I can wear mask while working in the barn		0.704						
SE6	I am sure that I can disinfect the site of aborted fetus in the barn	0.341	0.644						
SE3	I am sure that I can wash the udder of the livestock properly before milking		0.638						
SE2	I am sure that I can wear gloves while working in the barn		0.608						
RF1	Have you ever been praised by the leaders or council in the village for proper disposal of livestock waste		-0.491					0.472	
SE5	I am sure that I can refrain from eating fresh cheese even I have to keep it inside the salty water for a long time		0.451						
A3	As I like the raw and cold milk, I prefer to drink it without boiling			0.691					
A4	The local fresh cheese is so delicious that I eat without paying attention to the chance of being infected with brucellosis			0.652					

SE1	I am sure that I can boil fresh milk for, at least, 5 minutes before drinking		0.596			
A2	I prefer to get brucellosis rather than do lots of cumbersome and time consuming works (like wearing mask or gloves) while working in the barn	0.359	0.497			
K13	Boiling the raw and fresh milk for, at least, 5 minutes before drinking destroys all the germs and microbes	0.401[b]	0.405[b]			
EF3	I have access to the stores of personal protective equipment (e.g. mask and gloves)			0.869		
EF4	I have access to the stores of disinfectants/detergents			0.829		
RF5	My family members provide me the protective equipment (e.g. gloves and masks) before going to the barn.			0.442[b]		0.366[b]
K7	Brucellosis can be transmitted to human body from wildlife, as well	0.382[b]		0.387[b]		
RF7	I am satisfied with performing brucellosis preventive behaviors				0.808	
RF8	I am relieved with the confidence I have while performing brucellosis preventive behaviors				0.786	

RF6	My family is agree with adhering brucellosis preventive behaviors while diary processing and usage					0.784		
A6	Wearing protective cloths (gloves, masks) while working in the barn is necessary to protect me from brucellosis						0.618	
A7	Boiling milk, for at least 5 minutes, before drinking is necessary to protect me from brucellosis						0.579	
RF3	My family members or friends usually help me bury an aborted fetus in the ground.						0.445[b]	0.398[b]
SE4	I am sure that I can vaccinate my livestock despite the high costs		0.420[b]				0.430[b]	
A8	Wearing protective equipment (e. g. masks and gloves) makes my working difficult around the barn	0.308	0.336[b]				0.412[b]	
RF2	I have been praised by the veterinay office/staff for following up the on time vaccination of my livestock							0.743
RF4	Local veterinary office supports regular vaccination of my livestock against brucellosis							0.599
	Initial Eigenvalues	7.02	2.7	2.27	2.15	1.77	1.34	1.31
	Rotation sums of squares	4.52	2.91	2.52	2.4	2.36	2.05	1.78
	Percentage of variance explained	18.98	7.3	6.14	5.83	4.8	3.64	3.55

Cronbach's α	0.81	0.69	0.67	0.806	0.806	0.523	0.443
Cronbach's α after relocations suggested by factor loadings higher than 0.3	0.79	0.70	0.67	0.90	0.806	0.67	0.52
ICC (95% CI)	0.795 (0.763-0.823)	0.708 (0.662-0.750)	0.676 (0.621-0.725)	0.902 (0.880-0.919)	0.806 (0.771-0.837)	0.671 (0.617-0.719)	0.526 (449 - 0.596)

[a] F1, knowledge, F2, self-efficacy, F3, attitude toward brucellosis, F4, enabling factors, F5, internal rewards/Family norm, F6, attitude toward preventive behaviors, F7, external rewards.
[b] The factor loadings presented in bold are the items that were relocated to promote the reliability of the factors.