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Research paper

# Fertility awareness scale development study in Turkish women

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ABSTRACT

*Introduction:* There is a lack of information about fertility in the world, so in order to increase fertility awareness, it is necessary to provide effective counseling services. Therefore, there is a need for reliable measurement tools to be used to determine fertility awareness levels in women.

*Methods:* This study of 500 women between the ages of 18 and 49 focussed on developing a valid fertility awareness instrument. Scale development was carried out in 4 stages; creating an item pool, expert opinion, pilot testing, and validity-reliability analysis. Kaiser-Meyer-Olkin Test, Explanatory Factor Analysis and Confirmatory Factor Analysis were carried out to ensure construct validity, and the Cronbach's α internal consistency coefficient. Item total correlation and test-retest analysis were used to test the scale's reliability.

*Results:* As a result of the explanatory factor analysis (EFA) conducted for the validity of the 39-item scale used in the study, 20 items with a factor load below 0.30 were removed from the scale, and a scale consisting of 19 items and two dimensions was obtained. The confirmatory factor analysis (CFA) that was carried out supported the 2-factor construct (bodily awareness and cognitive awareness) of the Fertility Awareness Scale, and the fit indices of the scale were determined to be sufficient. The Cronbach's alpha internal consistency coefficient was found to be 0.887, 0.623 and 0.659 in the overall FAS and its dimensions. Furthermore, the item-total correlation analysis and test-retest analysis of the scale revealed high correlations.

*Conclusion:* Consequently, a valid and reliable measurement tool that can measure the fertility awareness levels of women was obtained.

## 1. Introduction

Desiring to have children is a personal decision [1]. Today, individuals are observed to postpone having children [2,3]. Various studies have shown that the decision to have children is multifactorial and determined by several factors such as individual, social and economic factors [4,5]. Moreover, quite a few couples have a dilemma between their desire to have children and their reasons for delaying their decision of having children [6]. Considering that the fertility rate of an individual decreases at later ages [4], the necessity of preserving the fertility of couples who postpone having children becomes increasingly important [3]. Women need to be informed about this issue, and their obstetric care should be adjusted accordingly [2]. In the literature, it is stated that being familiar with the menstrual cycle and having a high level of fertility awareness is of vital importance for an effective contraception method and planning gestation [1]. At this point, the concept of "fertility awareness" comes to the fore [7,8]. In order for individuals to have fertility awareness, they should know the relationship between the reproductive system, female and male reproductive anatomy and physiology, the importance of fertility, fertility options, fecundity possibility, and have knowledge about lifestyle behaviors that negatively affect fertility and avoid these behaviors [9,10]. Various studies have shown that the fertility awareness levels of women in the reproductive age group are low [5,11]. Women do not exactly know what the behaviors and attitudes that harm their fertility are [3,12]. For example, a study conducted in Switzerland found that most women knew that smoking harms fertility, but they did not know about the importance of keeping body weight within normal limits [13].

It is estimated that the fertility of approximately 12% of sexually active women is impaired [14]. The Centers For Disease Control and Prevention [7] states that environmental, chemical, occupational exposures in utero life can affect gynecological, urological or gestational health and permanently change fertility and biological capacity [7]. Most adverse situations affecting fertility are among preventable risk factors [3]. Age, poor body weight management, insufficient exercise, stress, smoking, consuming caffeinated beverages, environmental

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factors, missing regular health checks, risky sexual behaviors, use of contraceptives and use of vaginal lubricants are listed among these factors [9,15]. The fact that most negative health behaviors are changeable, advising women on making healthy changes in their lives and expanding their awareness may encourage the preservation of their fertility [16]. Fertility counseling is of great importance not only for those who want to conceive a baby, but also for those who do not want to become pregnant [17]. The World Health Organization (WHO) recommends providing planned training to women on these issues to increase their fertility awareness. Furthermore, WHO emphasizes that the educational level of women should not be important, and every woman should be able to understand the content of such training [18]. Every woman who receives effective counseling can learn what changes in her body mean and can have control over her fertility [4,5,15]. For example, a web-based training program that was given to infertile women was found very beneficial, and the women were satisfied with this training [19].

For this reason, providing effective counseling in ensuring fertility awareness and evaluating the fertility awareness levels of women with reliable measurement tools is important. The literature review in this study revealed few measurement tools evaluating fertility awareness. The Cardiff Fertility Knowledge Scale (CFKS) is a 13-item scale developed to assess knowledge about fertility facts, risks and myths. A validity and reliability analysis of this scale was performed in Turkey, and it was determined that it is not suitable for Turkish society ($\alpha = 0.41$) [10]. The Fertility Condition Awareness Tool (FertiSTAT) was developed by the same research team to raise awareness about fertility. This tool consists of 22 items and guides women between the ages of 18 and 44 to make informed decisions about their fertility based on their lifestyle and fertility profile [20]. The tool named the Fertility Health Knowledge Tool is a valid and reliable short screening tool that can be used for women and men to evaluate their fertility knowledge and to have open discussions about the preservation of fertility [21]. There is no Turkish adaptation study of these few measurement tools. Based on this information, it is aimed to develop a measurement tool to determine the fertility awareness levels of women in the reproductive age group. This tool will guide healthcare professionals by determining women's fertility awareness levels.

## 2. Materials and methods

This methodological study was planned to develop the "Fertility Awareness Scale". The population of the study consisted of women registered at all Family Health Centers (FHCs) (Mücelli FHC, Sıtmapınarı FHC, Özalper FHC, Fırat FHC, Göztepe FHC, Adafı FHC) in a city center located in eastern Turkey, with a total population over 20,000. The recommended sample size for applying factor analysis in a scale's validity-reliability studies is categorized as 100 "poor", 200 "medium", 300 "good", 500 "very good" and 1000 "excellent" [22]. Based on this classification, the sample size of the first stage of this study was targeted to be 500. The participants included in the sample were determined using the stratified sampling method. Separating the population into homogeneous subgroups in terms of one or more characteristics is called stratification, and the method of determining the population according to these subgroups is called Stratified Sampling [23]. For stratification, first of all, the number of women over the age of 18 in the FHCs was determined. The numbers of women in FHCs over the age of 18 registered at the specified FHCs were 1157 for the Mücelli FHC, 11,261 for the Sıtmapınarı FHC, 8261 for the Özalper FHC, 8517 for the Fırat FHC, 9026 for the Göztepe FHC, and 11,882 for the Adafı FHC. The FHCs were proportioned to their weight in the population, and 13 women from the Mücelli FHC, 112 from the Sıtmapınarı FHC, 82 from the Özalper FHC, 85 from the Fırat FHC, 90 from the Göztepe FHC and 119 from the Adafı FHC were included in the sample. Married/sexually active women over the age of 18 matching the determined number of study criteria at the specified FHCs were included in the sample.

### 2.1. Data collection tools

In data collection, a "Personal Information Form" that was used to collect information about the sociodemographic characteristics of the women and the "Fertility Awareness Scale" were used.

### 2.2. Personal information form

The form, which was created by the researcher in line with the literature, consisted of 15 questions about information on the sociodemographic characteristics (age, educational level, marital status, employment status, income level) and obstetric characteristics (number of pregnancies, number of births, number of living children) of the women.

### 2.3. Fertility Awareness Scale (FAS)

The Fertility Awareness Scale (FAS) is a Likert-type scale consisting of 19 items and two dimensions. While the Bodily Awareness Dimension consists of 10 items (items 7, 9, 10, 11, 12, 13, 15, 17, 18, 19), the Cognitive Awareness Dimension consists of 9 items (items 1, 2, 3, 4, 5, 6, 8, 14, 16). The items in the scale are scored from 1 to 5 (1-Never, 2-Rarely, 3-Sometimes, 4-Often and 5-Always). There is no inversely scored item in the scale. The lowest and highest total scores that can be obtained in FAS are 19 and 95. The score range is 10–50 in the Bodily Awareness dimension and 9–45 in the Cognitive Awareness dimension. Higher total scores in FAS indicate higher levels of fertility awareness. In the evaluation of the total score of FAS, scores of 19–43 show low awareness, 44–69 show medium-level awareness, and 70–95 show high awareness. These values were determined according to the score ranges average method [22]. The Cronbach's alpha internal consistency coefficient was determined to be 0.887 for the overall FAS, 0.623 for the Bodily Awareness Dimension and 0.659 for the Cognitive Awareness Dimension [24].

### 2.4. Data collection

The data were collected by the researcher between July 2019 and October 2019. To reach the intended sample size, the data were obtained by using the face-to-face interview method between 08.00 and 12.00 on the weekdays until the numbers determined by the stratified sampling method were obtained. Completing the forms took an average of 15 min for each participant. Because the scale included questions about private life, each woman was interviewed alone in a separate room while filling out the forms.

### 2.5. Data analysis

The data were analyzed using the SPSS 25.0 and AMOS 23.0 statistical package programs. In the analysis, descriptive statistics such as frequency, percentage, mean and standard deviation were used to evaluate the descriptive characteristics of the women. Moreover, Explanatory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), the Cronbach's α internal consistency coefficient and test-retest analysis were used. The level of statistical significance was accepted as 0.05.

### 2.6. Multivariate normal distribution

For variables to show multivariate normal distribution, when 'a' is the number of observed variables, the value obtained from the formula "a * ($a + 2$)" must be greater than the Mardia Coefficient (Multivariate value in the AMOS program) [25]. When the skewness and kurtosis values of the data were examined, it was seen that the variables provided the limit of $\pm 2$, and the data were considered to be normally distributed. The extreme values in their linear compositions were examined with the Mahalanobis $D^2$ test, and 20 of the participants were eliminated because

the data obtained in relation to the Mahalanobis Distance result remained below the value of $p < 0.01$. As a result, the analysis was carried out with 480 forms.

### 2.7. Ethical issues

To conduct the study, approval was received from the Inonu University Health Sciences Non-Invasive Clinical Research Ethics Committee (Decision No: 2019/8-19). Moreover, written permission was obtained from the Provincial Directorate of Health in the province where the study was carried out. Before the study started, the condition of "informed consent" from the participants was ensured as an ethical principle.

## 3. Results

### 3.1. Participants

The mean age of the women and their spouses who participated in the study was 32.75 ± 6.21 (min– max 18–48) and 36.46 ± 6.97 respectively.

It was determined that 29.6% of the women were high school or middle school graduates, 63.3% were not employed, 71.0% had medium-level income, 68.1% lived in city centers, and 89.4% had nuclear families. While the spouses of 35% of the women were high school graduates, the spouses of 90.2% were employed. The women's mean number of births was 2.02 ± 1.21 years, the mean number of their living children was 1.95 ± 1.16, the mean number of their pregnancies was 2.69 ± 1.75, and the mean number of their abortions was 0.71 ± 1.20.

### 3.2. Scale development and stages

The scale development procedure was carried out at 4 stages, the creation of an item pool, expert opinion, pilot test and validity-reliability analysis.

### 3.3. Literature review and item pool

At this stage, the aim was to develop a scale to measure fertility awareness and conduct a validity and reliability study. Accordingly, a comprehensive literature review was carried out on the topic, the basic principles about fertility awareness were determined, and a theoretical framework was created in accordance with WHO and CDC. An item pool consisting of 50 items was prepared to test each item's suitability for inclusion in the Fertility Awareness Scale. These items included questions about women's reproductive system, the relationship between female and male reproductive anatomy and physiology, the importance of fertility, fertility options, the possibility of fecundity, and lifestyle behaviors that negatively affect fertility [18].

### 3.4. Expert opinion

At this stage, the item pool consisting of 50 questions and prepared for evaluation was presented to the opinions of 11 academic staff experienced in the fields of gynecology nursing and midwifery. The experts were asked to rate each item on a scale of 1–4 (1 = item is not suitable, 2 = item needs to be remodeled, 3 = suitable but needs minor change, 4 = quite suitable) and evaluate the scale for the expediency and understandability of its items. It was recommended in previous studies that after examining the mean scores given by the experts for each item of the scale, the items that are below the minimum compliance limit or the least compatible items should be completely removed from the scale or rearranged [26]. As a result of the expert evaluations, the content validity index (CVI) for each item was calculated, and the item pool was reduced to 39 items. It was stated that attention should be paid to the number of experts in the calculation of CVI values [27]. The expert opinions were evaluated using the Davis technique, and the items that the experts stated as quite suitable or wanted minor correction were revised once again and corrected. The items found unsuitable by the experts were removed from the scale. It was observed that the scores obtained from the experts were not significantly different, and there was agreement among the experts. In this study, the CVI scores had a range of 0.545–1.00, and the CVI score for the entire scale was calculated as 0.805. After the items in the pool were presented to the opinions of Turkish language experts, necessary corrections were made in line with the recommendations of these experts.

### 3.5. Pilot testing

After the content validity analysis, the scale form was applied to 20 participants who were not included in the final sample. In the pilot implementation group, the expressions in the scale were found comprehensible.

### 3.6. Validity and reliability analysis

#### 3.6.1. Validity

In the study, the KMO coefficient was found to be 0.890, and the value of χ2 as a result of the Bartlett's Test of Sphericity was found to be 3282.690. The test results were statistically significant ($p = 0.001 < 0.05$). According to the KMO results, the sample size was sufficient and suitable for factor analysis.

As a result of the EFA conducted to test the validity of the 39-item scale used in the study, the factor load values were found between 0.581 and 0.804 in the bodily awareness dimension and between 0.477 and 0.712 in the cognitive awareness dimension. Moreover, while 25.926% of the total variance was explained by the first dimension, 17.515% of it was explained by the second dimension. The two factors collectively explained 43.440% of the total variance (Table 2). In multifactor scales, the explanation rate of the total variance is recommended to be 40% or higher [27]. In light of this recommendation, the rate of 43.440% was an acceptable value. Items 1, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 15, 23, 26, 27, 29, 30, 37, 38 and 39 were excluded from the scale due to their low factor loads (<0.30). As an indicator that the items measure the related concept or construct correctly, the load values of the items evaluated in factor analysis should not be lower than 0.30 [29]. Thus, a two-dimensional "Fertility Awareness Scale" with 19 items was obtained.

CFA was carried out to determine whether the factor structure of the Fertility Awareness Scale that contained 19 items after removing 20 items according to the EFA results was confirmed or not. The accuracy of the factors was checked this way. The goodness-of-fit index values of the Fertility Awareness Scale were found to be $\chi^2$ 655.606, df 151 ($p < 0.05$), $\chi^2$/df 4.342, RMSEA 0.084, GFI 0.871, CFI 0.840, and IFI 0.841 (Table 3). In the evaluation, the desired result could not be obtained in terms of these indices found for the first model.

A second CFA model was obtained by correlating the error covariances regarding the items in question. After the change, the index values were found to be $\chi^2$ 428.373, df 139 ($p < 0.005$), $\chi^2$/df 3.082, RMSEA 0.067, GFI 0.917, CFI 0.908, and IFI 0.909 (Table 1). These results showed that all fit indices of the Fertility Awareness Scale were sufficient. Thus, it was seen that the determined 2-factor construct of the scale was generally compatible with the collected data. The diagram of the Fertility Awareness Scale after testing the second CFA model is shown in Fig. 1.

Since the χ2 value calculated according to Table 3 was significant ($p < 0.05$), the model was statistically significant because the $\chi^2$/df value was below 3. According to the obtained NFI, CFI and GFI values, the model satisfied the required conditions (NFI > 0.90, CFI > 0.90, GFI > 0.90). So, the sample was large enough. The sample size was also determined to be sufficient according to the RMSEA value that was obtained (<0.05).

**Table 1**
The distribution of sociodemographic characteristics of women ($n = 480$).

| Descriptive properties<br>Employment status | n | % |
|---|---|---|
| Not working | 304 | 63.3 |
| Working | 176 | 36.7 |
| **Educational level** | | |
| Not Literate | 14 | 2.9 |
| Literate | 93 | 19.4 |
| Primary school | 62 | 12.9 |
| Middle School | 142 | 29.6 |
| High school | 142 | 29.6 |
| University | 27 | 5.6 |
| **Co-employment status** | | |
| Not working | 47 | 9.8 |
| Working | 433 | 90.2 |
| **Spouse training status** | | |
| Not Literate | 10 | 2.1 |
| Literate | 10 | 2.1 |
| Primary school | 74 | 15.4 |
| Middle School | 56 | 11.7 |
| High school | 168 | 35.0 |
| University | 162 | 33.8 |
| **Residential area** | | |
| Province | 327 | 68.1 |
| District | 133 | 27.7 |
| Village | 20 | 4.2 |
| **Family structure** | | |
| Core | 429 | 89.4 |
| Traditional | 51 | 10.6 |
| **Economical situation** | | |
| Low | 99 | 20.6 |
| Middle | 341 | 71.0 |
| High | 39 | 8.3 |
| **Total** | **480** | **100** |
| | **Mean±SD** | |
| **Age (years)** | 32.75 ± 6.24 | |
| **Spouse's age (years)** | 36.46 ± 6.97 | |
| **Number of Births** | 2.02 ± 1.21 | |
| **Living Child** | 1.95 ± 1.16 | |
| **Total Pregnancy** | 2.69 ± 1.75 | |
| **Total abortion** | 0.71 ± 1.20 | |
| **Size** | 164.87 ± 68.34 | |
| **Weight** | 68.21 ± 30.48 | |

**Table 2**
FAS exploratory factor analysis results.

| Questions | Bodily Awareness | Cognitive Awareness | Mean ±SD | Corrected Item-total Correlations |
|---|---|---|---|---|
| FAS41 | 0.804 | | 3.83 ± 1.18 | 0.632 |
| FAS26 | 0.732 | | 3.66 ± 1.29 | 0.639 |
| FAS42 | 0.724 | | 3.62 ± 1.33 | 0.648 |
| FAS29 | 0.711 | | 3.61 ± 1.23 | 0.665 |
| FAS40 | 0.694 | | 3.66 ± 1.69 | 0.571 |
| FAS24 | 0.657 | | 3.67 ± 1.30 | 0.546 |
| FAS38 | 0.626 | | 3.41 ± 1.38 | 0.622 |
| FAS25 | 0.622 | | 3.29 ± 1.40 | 0.535 |
| FAS34 | 0.606 | | 3.60 ± 1.24 | 0.509 |
| FAS28 | 0.581 | | 3.83 ± 1.17 | 0.504 |
| FAS6 | | 0.712 | 2.91 ± 1.26 | 0.561 |
| FAS12 | | 0.599 | 3.07 ± 1.16 | 0.563 |
| FAS4 | | 0.599 | 2.94 ± 1.29 | 0.511 |
| FAS22 | | 0.577 | 3.38 ± 1.12 | 0.511 |
| FAS48 | | 0.562 | 2.76 ± 1.07 | 0.594 |
| FAS39 | | 0.535 | 2.77 ± 1.38 | 0.588 |
| FAS37 | | 0.525 | 2.97 ± 1.17 | 0.509 |
| FAS21 | | 0.491 | 3.24 ± 1.07 | 0.532 |
| FAS18 | | 0.477 | 3.25 ± 1.22 | 0.545 |
| **%Variance Explained** | 25.926 | 17.515 | **Total** = 43.440 | |

FAS: Fertility Awareness Scale.

### 3.6.2. *Reliability*

The Cronbach's alpha internal consistency coefficient, item-total correlation coefficient and test-retest reliability coefficient were calculated to test the reliability of FAS and its dimensions.

As shown in Table 4, the overall FAS Cronbach's alpha internal consistency coefficient was found to be 0.887, while the coefficients were 0.623 for the "Bodily Awareness" dimension and 0.659 for the "Cognitive Awareness" dimension (Table 4). FAS was observed as quite reliable in terms of its entirety and its two dimensions.

### 3.6.3. *Item-total correlation coefficient*

Test-retest analysis was carried out to determine the time-invariance of the scale. Fifteen days after the first application [29], 31 women were reached again, and the scale was administered for the second time. As shown in Table 4, the correlation values for the relationship between the results of the two implementations were $r = 0.997$ for the overall FAS, $r = 0.994$ for the Bodily Awareness Dimension and $r = 0.997$ for the Cognitive Awareness Dimension, and these values were statistically significant ($p < 0.005$).

As shown in Table 5, the mean score of the participants for the Bodily Awareness Dimension was 36.2 ± 8.9, and the score range was 11–50. These values for the Cognitive Awareness Dimension were 27.3 ± 6.4 and 12–45, respectively. Moreover, the mean total FAS score of the participants was 63.6 ± 13.6, and the score range was determined as 28–95.

The classification of the participants based on their FAS scores is given in Table 6. In the evaluation of the total score received from FAS, scores between 19 and 43 are considered low, those in the range of 44–69 are considered medium-level, and those in the range of 70–95 are considered high awareness [28]. As the mean total FAS score in this study was 63.6 ± 13.6, the fertility awareness levels of the women were considered medium.

## 4. Discussion

This study was conducted to develop a scale that measures women's fertility awareness levels. Validity and reliability are the two most important features that a scale should have. As a result of the psychometric analysis of the Fertility Awareness Scale (FAS), the scale was accepted to be valid and reliable.

### 4.1. *Validity*

EFA was applied to test the construct validity of FAS, and then, CFA was performed to confirm the validity of the obtained construct. Items 1, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 15, 23, 26, 27, 29, 30, 37, 38 and 39 with factor loads below 0.30 found as a result of the EFA were excluded from the analysis. It was determined that the items belonging to the scale were collected under 2 factors, and 43.440% of the total variance was explained by these factors. Since a cutoff value of ≥30% was taken into consideration for the ratio of the total variance explained in scale studies, it was seen that the scale had sufficient construct validity [28]. In scale development studies, load values in the factor in which items are

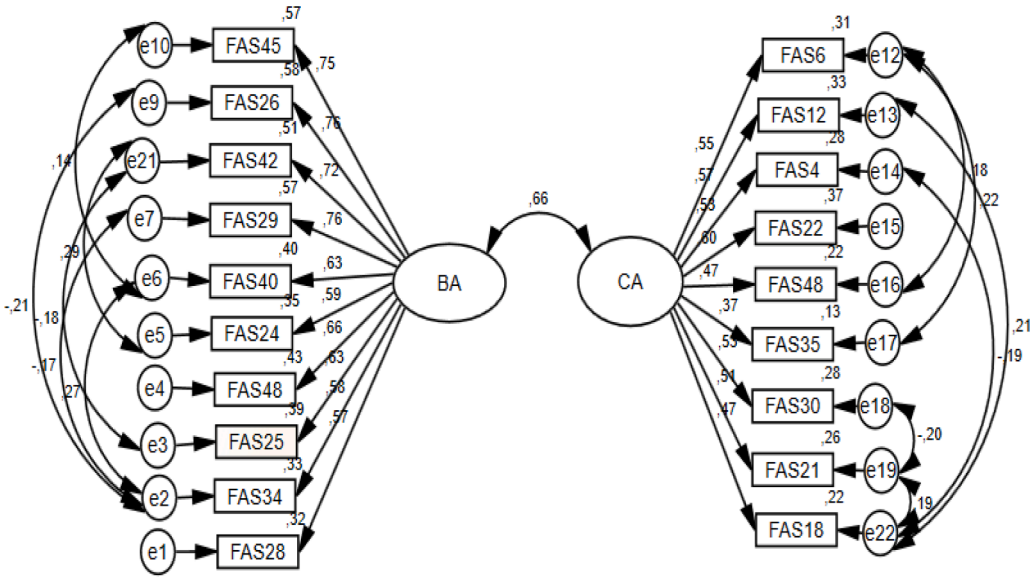


**Fig. 1.** Diagram of the Fertility Awareness Scale.

**Table 3**
Goodness of Fit Index values for confirmatory factor analysis.

| Fit Index | First Model | Model 2 | Good Fit | Acceptable Compliance |
|---|---|---|---|---|
| **CMIN** | 655.606 | 428.373 | The model with the smallest value is more compatible. | |
| **Sd** | 151 | 139 | – | |
| **P** | 0.001 | 0.001 | $p < 0.005$ | |
| **$\chi^2$ / sd** | 4.342 | 3.082 | ≤ 3 | 3–5 |
| **GFI** | 0.871* | 0.917 | ≥ 0.95 | 0.90 – 0.95 |
| **IFI** | 0.841* | 0.909 | ≥ 0.95 | 0.90 – 0.95 |
| **CFI** | 0.840* | 0.908 | ≥ 0.97 | 0.95 – 0.97 |
| **RMSEA** | 0.084* | 0.066 | ≤ 0.005 | 0.05 – 0.08 |

* Values are not in the desired range.

**Table 4**
Test-retest values and Cronbach's alpha of FAS total and sub-dimensions.

| Scale and Sub-dimensions | r; p | Cronbach's alpha |
|---|---|---|
| FAS Total | 0.997; 0.001 | 0.887 |
| Bodily awareness | 0.994; 0.001 | 0.623 |
| Cognitive awareness | 0.997; 0.001 | 0.659 |

FAS: Fertility Awareness Scale, $p < 0.05$.

**Table 5**
The Min Max points that can be taken and received from the FAS and its sub-dimensions and the Scale Total Score Average ($n = 480$).

| **Scale** | **Min-Max Values That Can Be Taken** | **Min-Max Values That Can Be Taken** | **Min-Max Values That Can Be Taken** |
|---|---|---|---|
| **FAS Total** | 19–95 | 28 – 95 | 63.6 ± 13.6 |
| Bodily awareness | 10–50 | 11 - 50 | 36.2 ± 8.9 |
| Cognitive awareness | 9–45 | 12 – 45 | 27.3 ± 6.4 |

FAS: Fertility Awareness Scale.

included are expected to be high. If there is a cluster of items that have a high level of association with a factor, this finding means that these items can measure a concept-structure-factor together [30]. For example, when evaluating the variance rate described in CFKS developed by Bunting et al., items with load values of ≥0.30 were used [12].

**Table 6**
Classification of FAS.

| **Groups** | **Score range** |
|---|---|
| Low | 19–43 |
| Middle | 44–69 |
| High | 70–95 |

FAS: Fertility Awareness Scale.

By applying CFA to the 2-factor scale consisting of 19 items obtained by the EFA, the accuracy of the dimensions was tested. Goodness-of-fit indices were taken into account to evaluate whether the model established with the CFA was suitable for the data. The fit index values calculated in the first model of the scale were $\chi^2$ 655.606, df 151 (Table 3; $p < 0.05$), χ2/df 4.342, RMSEA 0.084, GFI 0.871, CFI 0.840 and IFI 0.841, and a good fit could not be achieved. When the modification indices of the model were examined, the e19-e22, e18-e19, e14-e22, e13-e22, e12-e22, e12-e17, e12-e16, e5-e21, e2-e9, e2-e6, e2-e7, e13-e22, e6-e10 and e3-e21 residual terms were found to have the highest values, and by drawing covariances between these binary residual terms, a new model was created, and calculations were made. The fit index values for the second model were calculated as $\chi^2$ 428.373, df 139 ($p < 0.05$), $\chi^2$/df 3.082, RMSEA 0.067, GFI 0.917, CFI 0.908 and IFI 0.909. A good fit was found in terms of the scale's $\chi^2$/df and RMSEA values. It was determined that the model had an acceptable fit (Table 3). It was observed that the CFA supported the 2-factor scale construct resulting from the EFA.

### 4.2. *Reliability*

The reliability of FAS was evaluated with the Cronbach's α internal consistency coefficient, item-total correlation coefficient and test-retest reliability coefficient. The Cronbach's α internal consistency coefficient was found as 0.623 for the "Bodily Awareness" dimension and 0.659 for the "Cognitive Awareness" dimension. The internal consistency coefficient of the overall FAS was calculated as 0.887 (Table 4). Considering that a Cronbach's α internal consistency coefficient that can be considered sufficient in a measurement tool should be as close to 1 as possible, the internal consistency coefficients obtained for the entirety and two dimensions of FAS indicated reliability ($p < 0.05$). It was stated that the Cronbach's α internal consistency coefficient was 0.79 in the original version of the measurement tool called CFKS, which focuses on cognitive

awareness towards fertility, whereas it was 0.74 in the Japanese version [20,31].

In the study, the item-total correlation coefficients were found to be above the acceptable value in terms of item selection that is ≥0.20, and these coefficients varied between 0.504 and 0.665 for the "Bodily Awareness" dimension and between 0.308 and 0.463 for the "Cognitive Awareness" dimension. If the correlation coefficient obtained for each item is high, the item is effective and sufficient in measuring the intended variable [30]. In this study, the correlations between the scores of all items and the total score of the scale were on an acceptable level and statistically significant ($p < 0.05$). The correlations between the mean scores of the first implementation of the scale and its second implementation performed on 31 women 15 days after the first one ranged from 0.994 to 0.997, and they were statistically significant (Table 4). In this study, it was determined that FAS was a consistent scale, in other words, it was invariable over time, since there was enough time between the two measurements, and the fit did not change during this period.

## 5. Conclusion

The analyses that were conducted in this study showed that the "Fertility Awareness Scale" that was developed to measure the fertility awareness levels of women is a valid and reliable measurement tool. It is believed that the use of this scale by healthcare professionals to determine the fertility awareness levels of women at the ages of 18 to 49 will contribute to the health of women.

## Author contributions

**Zeliha Özşahin:** Conceptualization, Methodology, Software, Writing – original draft, Visualization, Supervision. **Yeşim Aksoy Derya:** Conceptualization, Methodology, Software, Investigation, Writing – review & editing.

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## Declaration of Competing Interest

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### *Data availability*

Any additional information can be obtained from the author on request.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.eujim.2022.102101.

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