Current Psychology (2024) 43:37113–37122
https://doi.org/10.1007/s12144-024-07128-5

Fertility healthy lifestyle assessment scale: development and psychometric study in Turkish women and men

Dilek Bilgiç[1] · Merlinda Aluş Tokat[1] · Sevcan Özöztürk[2] · Figen Yanık[1]

Accepted: 4 December 2024 / Published online: 14 December 2024

Abstract

The study aimed to develop and psychometrically test the Fertility Healthy Lifestyle Assessment Scale among the Turkish female/male population. This methodological study was conducted through an online survey with 526 participants ($n = 340$ women, $n = 186$ men) using the Google Forms tool between July 2020 and December 2021. The scale development process involved 4 steps: item generation, expert review and content validity, pilot study, and a field study with psychometric testing. The scale consisted of 46 items across seven sub-dimensions (emotional well-being, physical activity, sleep, nutrition, clothing/hygiene, use of technology, and spirituality). Confirmatory factor analysis (CFA) supported the 7-factor structure of the Fertility Healthy Lifestyle Assessment Scale (factor loadings 0.33–0.99 according to CFA), and the fit indices of the scale (RMSEA = 0.067, GFI = 0.748, CFI = 0.924, IFI = 0.925, NNFI = 0.918 and NFI = 0.868) were found to be adequate. The seven sub-dimensions accounted for 71.25% of the total variance. The Cronbach's alpha coefficient for the total scale was 0.872, indicating strong internal consistency. As a result of the split into two analyses, Cronbach's alpha value of the first half was 0.722 and the value of the second half was 0.780, with a correlation of 0.898 between the two halves. Our findings indicate that the Fertility Healthy Lifestyle Assessment Scale is a valid and reliable measurement for assessing healthy lifestyle habits with the purpose of enhancing fertility in women and men.

Keywords Infertility · Fertility · Healthy lifestyle · Scale development · Survey

Introduction

Infertility is a critical global health problem with psychosocial implications, affecting individuals, families, and societies (Akalewold et al., 2022; Zhang et al., 2024). Recent studies have shown that lifestyle can cause fertility problems (Savelieva et al., 2023; Zhang et al., 2024). Lifestyle refers to modifiable habits and behaviors that can affect the well-being and overall health of couples, shaped by personal preferences and social environments (Bala et al., 2021; Torkel et al., 2024). While the literature highlights the direct relationship between individuals' lifestyles and fertility (Savelieva et al., 2023; Bala et al., 2021), animal studies have examined how lifestyle affects fertility (Emokpae & Brown, 2021).These studies' findings have demonstrated that different metabolic processes in lifestyles can have long-term impacts on female and male physiology potentially leading to reproductive deficiencies (Emokpae & Brown, 2021). While most of these reproductive disorders can be treated with assisted reproductive techniques (ART), adopting a healthy lifestyle can increase healthy oocyte development in women and sperm quality in men (Akalewold et al., 2022; Boedt et al., 2023). The most important lifestyle factors affecting fertility are diet, psychological health, sleep quality, sedentary life, physical activity, and use of technology.

Globally, changes in diet have been linked to reduced fertility rates (Cristodoro et al., 2024). Studies suggest that a poor diet, regardless of caloric content, can disrupt

✉ Figen Yanık
figen.satkan@gmail.com

Dilek Bilgiç
bilgicdilek@gmail.com

Merlinda Aluş Tokat
merlinda_alus@yahoo.com

Sevcan Özöztürk
sevcan_fata@hotmail.com

[1] Department of Gynecologic and Obstetrics Nursing, Faculty of Nursing, Dokuz Eylul University, İzmir, Turkey

[2] Gynecologic and Obstetrics Nursing, Izmir, Turkey

reproductive physiology, including ovulation and sperm production, significantly increasing the risk of infertility (Yang et al., 2023; Cristodoro et al., 2024). Evidence suggests that a diet high in saturated fat, cholesterol, animal protein, and carbohydrates with a high glycemic index correlates with an increased risk of infertility in both genders (Yang et al., 2023). Contrarily, a diet rich in plant sources, fruits, vegetables, and antioxidants (vitamin C, vitamin E, etc.) has been shown to support fertility(Yang et al., 2023; Gaskins et al., 2019). Psychological health is another important factor that can affect an individual's fertility. Despite the prevalence of infertility, the majority of individuals trying to conceive do not share their story with their social environment, leading to their heightened psychological vulnerability (Souza et al., 2023). The existing literature suggests that the relationship between stress and infertility may not have a definite cause-and-effect direction. Nevertheless, trying to conceive certainly causes considerable distress (Mínguez-Alarcón et al., 2024). An observational prospective study in the literature found that stress in the pre-pregnancy period was negatively associated with live birth in women, and this association persisted in women undergoing in vitro fertilization (Mínguez-Alarcón et al., 2024). Sleep quality, another important yet often overlooked modifiable lifestyle factor, is also known to affect the fertility of individuals (Llaneza et al., 2017; Yanik & Tokat, 2024; Lateef & Akintubosun, 2020). The quality of sleep can influence an individual's mental condition, impairing cognitive function, metabolism, and hormonal balance, which may adversely affect reproductive capabilities and result in infertility (Li et al., 2023a, b). In a meta-analysis exploring the relationship between infertility and sleep quality, Gençtürk et al. (2024) found that infertility significantly reduced women's sleep quality. A sedentary life, one of the lifestyle factors, can negatively affect sperm quality in men and follicular development in women, thus moderate physical activity is very important for maintaining optimal body weight and hormonal balance (Zhang et al., 2024). According to international standards, reducing the risk of reproduction requires at least 150 min a week of moderate physical exercise (Xie et al., 2022; Piercy et al., 2018). A meta-analysis by Xie and colleagues (2022) showed a negative association between increasing physical activity and infertility. Nowadays, the use of technological devices simplifies human life, but electromagnetic waves are one of the other factors that can pose a risk to male and female fertility (Li et al., 2023a, b; Leisegang & Dutta, 2021). A study by Gautam et al. (2021) reported that exposure to mobile phones, laptops, and power lines may reduce or impair fertility.

Many clinical guidelines for male and female fertility emphasize the importance of adopting a healthy lifestyle (American Society for Reproductive Medicine and the Practice Committee, 2022; Romualdi et al., 2023). The rapid changes in modern society are leading to significant shifts in individuals' lifestyles, therefore affecting their fertility capacity. Therefore, a holistic assessment of fertility-related risk factors in both men and women is an essential step in the conception process. This study aimed to develop the Fertility Healthy Lifestyle Assessment Scale (FHLAS) to contribute to the assessment process and serve as a guide for healthcare professionals.

Methods

Design and data collection

The scale development process consisted of 4 steps: item generation, expert review and content validity, pilot study, and field study with psychometric testing.

Step 1: Item generation

This step aimed to develop a scale to measure fertility-related lifestyle factors and to conduct a validity and reliability study. A comprehensive literature review on the topic was conducted, identifying basic lifestyle parameters and creating a theoretical framework compatible with evidence-based/guidelines (American Society for Reproductive Medicine and the Practice Committee, 2022; Bala et al., 2021; Emokpae & Brown, 2021; Li et al., 2023a, b; Leisegang & Dutta, 2021; Meyers & Domar, 2021). An item pool of 123 items including multidimensional lifestyle items was created to test the suitability of each item for inclusion in the Fertility Healthy Lifestyle Assessment Scale.

Step 2: Expert review and content validity

An item pool (123 items), including multifaceted lifestyle, was created by reviewing the literature and assessed for suitability by 10 experts from the clinical and academic fertility fields (Karagoz, 2016; Boateng et al., 2018). They rated each item on a scale from 1 = inappropriate to 4 = very appropriate for assessing fertility-related healthy lifestyles. The experts' opinions were evaluated using the Davis technique, and the items that the experts rated as "quite appropriate" or asked for "minor correction" were reviewed and corrected. It was noted that the expert scores did not significantly differ from one another, prompting an agreement between the experts. Items considered inappropriate by the experts were removed from the scale. After examining the appropriateness of each item as a result of expert evaluations, Item Content Validity Index (I-CVI) > 0.78 and Scale Content Validity Index (S-CVI) > 0.90 were found as recommended in the literature (Polit & Beck, 2006). As a result, the item pool was reduced to 48 items.

Step 3: Pilot study

To verify the comprehensibility of the items, a pilot study was conducted with eight women and men who met the inclusion criteria and were not included in the sample. After evaluating the comprehensibility of the items, two items were removed due to lack of clarity. After removing and modifying some of the items as suggested by the participants, the last FHLAS comprising 46 items was created.

Step 4: Field study and psychometric testing

Participants This methodological study was designed to develop the Fertility Healthy Lifestyle Assessment Scale. The current study was conducted in Turkey between July 2020 and December 2021.

The literature emphasizes that the sample size should be 5–10 times the number of items to be able to conduct factor analysis in scale development studies (Boateng et al., 2018). Furthermore, in the literature, sample sizes for psychometric research are usually classified as follows: unsatisfactory (≤ 100), fair (101–200), good (201–300), very good (301–500), and excellent (> 501) (Alpar, 2014). To ensure that the sample size (46*10 = 460), which is a minimum of 10 times the number of items in the existing scale (46 items), is adequate for factor analysis and that the interrelationships among the factors can be clearly demonstrated the sample consisted of 526 individuals (n = 340 women, n = 186 men) who voluntarily consented to participate in the study. The sample size in our study reached the level of *'excellent'* category (Boateng et al., 2018; Alpar, 2014).

The study sample was determined using the snowball sampling method based on the principles of accessibility and convenience. Inclusion criteria for the sample were as follows: literate, older than 18 years of age, married/single women or men; who did not have children but are planning to have children in the future, and who have voluntarily accepted to participate in the research.

Instruments To collect the data, the Descriptive Information Form was used to collect information on the socio-demographic details of the individuals, and the Fertility Healthy Lifestyle Assessment Scale (FHLAS) development form was used to assess the fertility lifestyle factors.

The Descriptive Information Form, which was designed by the researchers in line with the literature, consisted of seven questions covering the socio-demographic characteristics (gender, age, employment status, type, occupation, marital status, and family structure) of the individuals.

The Fertility Healthy Lifestyle Assessment Scale (FHLAS) is a Likert-type scale comprising 46 items and seven sub-dimensions. While the sub-dimension Emotional Well-being consists of 6 items (1, 2, 3, 4, 5, 6), the sub-dimension Physical Activity consists of 4 items (7, 8, 9, 10), the sub-dimension Sleep consists of 9 items (11, 12, 13, 14, 15, 16, 17, 18, 19), the sub-dimension Nutrition consists of 9 items (20, 21, 22, 23, 24, 25, 26, 27, 28), the sub-dimension Clothing/Hygiene consists of 5 items (29, 30, 31, 32, 33), the sub-dimension Use of Technology consists of 4 items (34, 35, 36, 37) and finally, the sub-dimension Spirituality consists of 9 items (38, 39, 40, 41, 42, 43, 44, 45, 46). The items on the scale are rated from 1 to 5 (1 - strongly disagree, 2 - disagree, 3 - undecided, 4 - agree, and 5 - strongly agree). There are inversely scored items on the scale (1, 6, 7, 12, 13, 14, 21, 23, 24, 28, 32, 35, 36, 37, 41). The lowest and highest overall scores obtained on the FHLAS are 46 and 230. Higher total scores on the FHLAS indicate that individuals have a healthier fertility-related lifestyle.

Data collection process

The online data collection protocol was selected because of the pandemic restrictions and based on the advantages identified by Latkovikj and Popovska (2019): (1) being less expensive, (2) increasing access to study sensitive issues, cultural groups, and 'hidden populations', (3) reaching a larger pool of potential study participants, (4) increasing methodological rigor and control, (5) improving accuracy and efficiency of data entry and analysis, (6) reducing data collection time, and (7) having the ability to track participants (Latkovikj & Popovska, 2019).

Due to the COVID-19 pandemic, data were collected through the online Google Form using the snowball sampling technique. The link was shared through various social media platforms such as WhatsApp, Facebook, Instagram, Twitter, and e-mail groups. After agreeing to participate in the study, volunteers were invited to fill out the survey and forward it to their friends, using the snowball sampling technique. Participants were informed about the study and upon clicking on the link, they were directed to the consent form and information sheet (explaining the aims of the current study, anonymity, voluntary participation in the research, and time to complete the questionnaires). The purpose of the study was explained in detail and participants were assured that no personal/private information would be requested and that all data would be anonymized and used for research purposes only. By ensuring confidentiality, respondents were encouraged to respond honestly and provide more accurate information. Participants were clearly informed that they had the right to withdraw from the study at any time, and the importance of the findings in terms of public health was emphasized. Thus, detailed instructions were provided to reduce inaccuracies to a minimum by explaining the purpose of the questionnaire and the importance of correct responses. The survey link remained active throughout the data collection process and was deactivated at the end of the research.

In order to prevent duplicate submissions of the Google Form questionnaire from any participant, they were asked to log in with their email address after confirming their participation, and the data was filled out once with a single email address. In addition, the data obtained from the Google Forms were transferred to an Excel file and subsequently converted to an SPSS file for descriptive statistical analysis. As participants were required to complete all items on the form, no missing data were identified. The socio-demographic characteristics of the data were checked to ensure that there was no duplication of data.

Ethical considerations

Ethical approval was granted by the Dokuz Eylul University Hospital Non-Interventional Studies Ethics Committee (Decision No: 2020/5691-GOA), and informed consent was obtained from participants using the Google Forms platform. The study was conducted in accordance with the Declaration of Helsinki.

Data analysis

The data analysis was conducted using IBM SPSS (Statistical Package for Social Sciences) version 24.0 (SPSS Inc., Chicago, IL, USA) and AMOS version 24.0. In the statistical analyses, descriptive statistics (frequency values, mean values, standard deviations, minimum and maximum values) were employed for the data related to the socio-demographic characteristics of the individuals. The construct validity of the scale was assessed through both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Reliability was evaluated using Cronbach's alpha, McDonald's omega, Pearson correlation analysis, Spearman-Brown, and split-half analysis methods.

Validity analysis

Both exploratory and confirmatory factor analyses (EFA and CFA) were used to assess the factor structure of the measure. To determine the item-factor relationship, the data were split into two halves and an exploratory factor analysis was performed on the first half. The eigenvalue threshold in the factor analysis was taken as 1. The factor loading coefficient was determined to be 0.30 when deciding the sub-dimension to which the item should be assigned.

Exploratory factor analysis was carried out as part of the determination of construct validity. The Kaiser-Meyer-Olkin (KMO) test was used to measure the sampling adequacy of the EFA, and the normal distribution was determined using Bartlett's test of sphericity. The KMO value ≥ 0.60 indicated that there was sufficient sampling for EFA, and Bartlett's test value ≤ 0.05 indicated that there was sufficient sampling for factor analysis. In addition, principal component and varimax rotation techniques were used to identify sub-dimensions.

CFA was the second part of the construct validity determination, which allowed the researcher to test the hypothesized relationship between the observed variables and the developed subscales. A structural equation model was applied, and the following statistics were calculated: chi-squared degrees of freedom (X2/df), root mean square error of approximation (RMSEA), goodness of fit index (GFI), comparative fit index (CFI), normed fit index (NFI), and non-normed fit index (NNFI). A multicollinearity analysis was performed prior to the confirmatory factor analysis, revealing no multicollinearity among the items. The variance inflation factor (VIF) and tolerance value were used to assess the presence of multicollinearity. A VIF of less than 10 and a tolerance greater than 0.1 signify the absence of multicollinearity. For all items, $\text{VIF} < 10$ and $\text{tolerance} > 0.01$. The correlation matrix was used for exploratory factor analysis and the maximum likelihood method for confirmatory factor analysis. The exploratory factor analysis used principal components as the estimation method and varimax rotation as the rotation technique. The margin of error for data analysis was established at $p = 0.05$.

Reliability analysis

In the reliability analysis of the data, Cronbach's alpha and McDonald's omega were used to determine the internal consistency of the scale and the sub-dimensions, and Pearson correlation analysis and split-half analysis were used to analyze the relationships between the total scores of the items of the scale and the sub-dimensions.

Results

Descriptive

Of the total participants, 64.6% ($n = 340$) were women and 35.4% ($n = 186$) were men. The mean age of the participants was 27.7 ± 6.51 years. In addition, 45.8% of the sample were married, while 54.2% were single.

Validity and reliability analysis

Validity

As a result of the Explanatory Factor Analysis, the Kaiser-Meyer-Olkin (KMO) coefficient of the 46 items was 0.865, the Bartlett test X^2 value was 15265.707, and $p<0.001$ (Fig. 1). The variance of each sub-dimension explains, in order, 18.957%, 16.205%, 14.713%, 7.024%, 5.389%, 4.931%, and 4.037% of the total variance. The total of seven sub-dimensions explains 71.257% of the total variance of the scale. The factor loads of the first sub-dimension of the scale varied between 0.921 and 0.981, the factor loads of the second sub-dimension varied between 0.493 and 0.958, the factor loads of the third sub-dimension varied between 0.606 and 0.938, the factor loads of the fourth sub-dimension varied between 0.586 and 0.791, the factor loads of the fifth sub-dimension varied between 0.590 and 0.819, the factor loads of the sixth sub-dimension varied between 0.523 and 0.780, and the factor loads of the seventh sub-dimension varied between 0.422 and 0.708 (Table 1). The correlations of the scale items with the total scale score varied between 0.195 and 0.578. The correlations of the scale items with the sub-dimension total score varied between 0.212 and 0.987. After the removal, there was no substance that could significantly increase the Cronbach's alpha (Table 1).

The calculated chi-squared value of the seven-factor model was 2058.573, with 952 degrees of freedom and $p=0.000$. The X^2/SD section was 2.162. Among the indices of fit were RMSEA 0.0667, GFI 0.748, CFI 0.924, IFI 0.925, NNFI 0.918 and NFI 0.868. As a result of CFA, the factor loads of the first sub-dimension of the scale varied between 0.86 and 0.99, the factor loads of the second sub-dimension varied between 0.40 and 0.96, the factor loads of the third sub-dimension varied between 0.40 and 0.89, the factor loads of the fourth sub-dimension varied between 0.33 and 0.94, the factor loads of the fifth sub-dimension varied between 0.53 and 0.88, the factor loads of the sixth sub-dimension varied between 0.34 and 0.99, and the factor loads of the seventh sub-dimension varied between 0.34 and 0.71 (Table 2).

Reliability

The overall Cronbach's alpha coefficient of the scale was 0.872. The McDonald's omega coefficient was 0.888. The Cronbach's alpha coefficient for the first sub-dimension of the scale was 0.805, with 0.779 for the second sub-dimension, 0.928 for the third sub-dimension, 0.961 for the fourth sub-dimension, 0.678 for the fifth sub-dimension, 0.601 for the sixth sub-dimension and 0.988 for the seventh sub-dimension. After the split analysis, the Cronbach alpha values were 0.722 for the first part and 0.780 for the second part, with a correlation of 0.898 between the two parts. The Spearman-Brown coefficient was calculated as 0.946 and the Guttman split-half coefficient as 0.944 (Table 3).

The Hotelling's T^2 analysis was conducted to assess the equality of item means among the scale items and to evaluate response bias. The analysis revealed that the item means varied and that there was an absence of response bias. The p-value should be <0.05 to indicate that the measurement tool is valid, authentic, and homogeneous (Ozdamar, 2016). In the current study, Hotelling's T^2 value was found to be 1189.347, $F=24.215$, and $p=0.000$. Some participants may have given up while completing the questionnaires and discontinued the survey midway. However, in the Google form, all items are set to be ticked, so there are no missing/unanswered questions. In addition, to prevent individuals from missing or not responding to the questionnaire, it was regularly shared on social media and reminders were sent out. As a result of the analysis, it was found that there was no response bias in the scale (Table 3). It was found that the scale strongly measured the intended characteristics, demonstrating strong validity, reliability, and homogeneity.

Item-total correlation coefficient

The correlations of the scale items with the total scale score ranged from 0.195 to 0.578. The correlations of the scale items with the overall score of the sub-dimension ranged from 0.212 to 0.987. When the removal of the item, no other item substantially enhanced the Cronbach's alpha value.

Comparing the participants' scale scores by marital status, the mean scores of single participants were 102.24 ± 22.43 and the mean scores of married participants were 109.01 ± 22.54. The mean scale scores of married individuals were statistically much higher than those of single individuals ($t=2.667$; $p=0.008$).

Discussion

Today, an increasing number of studies in the literature show that lifestyle can be an important factor in improving fertility health in both men and women (Nagórska et al., 2022). Therefore, identifying and evaluating lifestyle factors that contribute to an individual's optimal level of fertility and the prevention of fertility problems is extremely important in establishing and maintaining fertility health. The literature has emphasized the need to use scales that have been standardized for validity and reliability. However, it is predicted that the Fertility Healthy Lifestyle Assessment Scale will make a significant contribution to the literature and clinical practice. It is therefore expected to contribute to routine

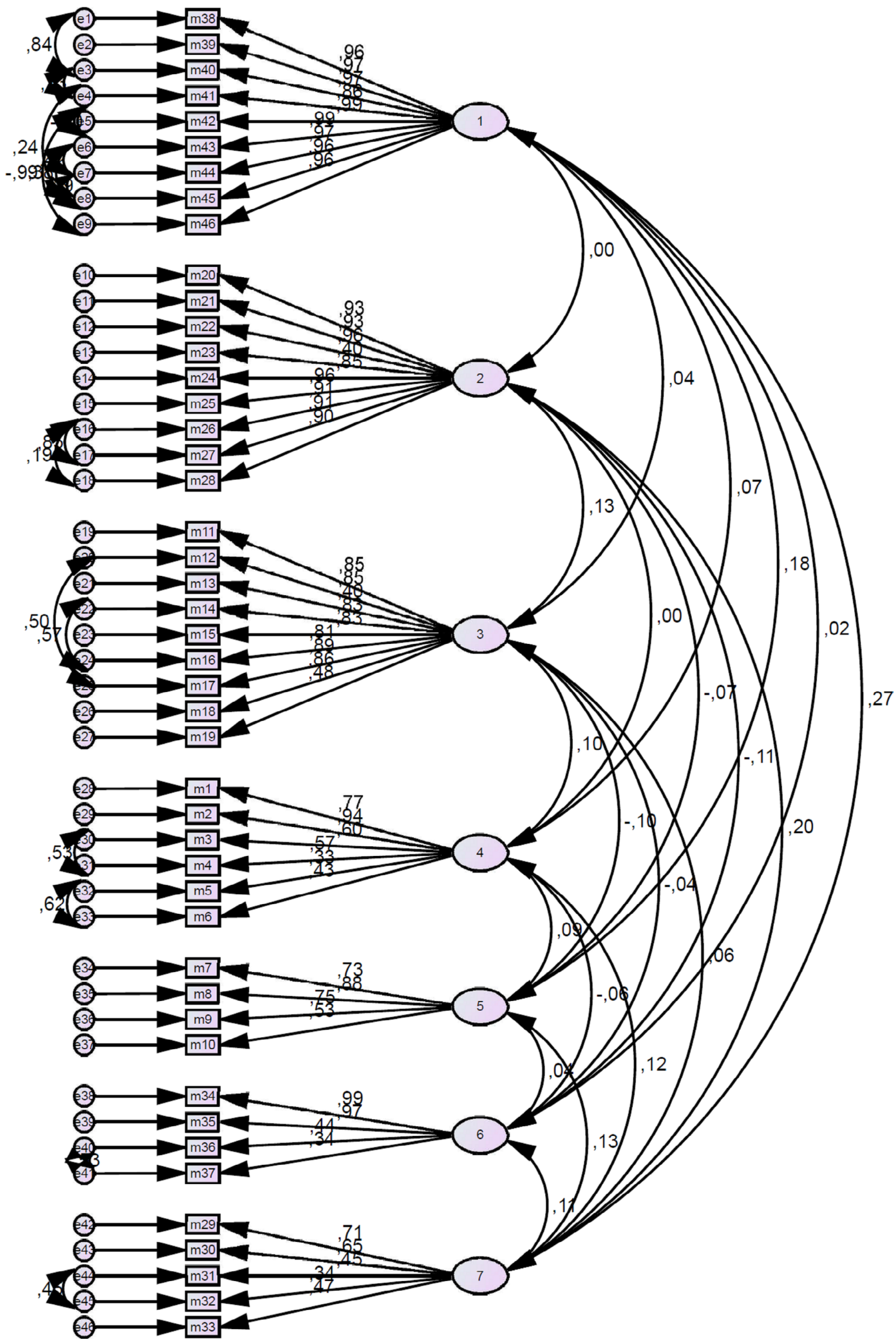

Fig. 1 Confirmatory factor analysis

Table 1 Factor analysis and corrected item-total correlation of the Fertility Healthy Lifestyle Assessment Scale ($n = 263$)

Item No	Factor loading	Corrected item total correlations
Subscale 1: Emotional well-being		
Item 1	0.72	0.28
Item 2	0.79	0.29
Item 3	0.72	0.29
Item 4	0.78	0.29
Item 5	0.58	0.28
Item 6	0.63	0.32
Subscale 2: Physical activity		
Item 7	0.70	0.19
Item 8	0.81	0.21
Item 9	0.74	0.19
Item 10	0.59	0.19
Subscale 3: Sleep		
Item 11	0.87	0.45
Item 12	0.91	0.45
Item 13	0.60	0.32
Item 14	0.84	0.45
Item 15	0.88	0.44
Item 16	0.85	0.42
Item 17	0.93	0.46
Item 18	0.87	0.43
Item 19	0.88	0.32
Subscale 4: Nutrition		
Item 20	0.93	0.54
Item 21	0.93	0.56
Item 22	0.95	0.55
Item 23	0.49	0.29
Item 24	0.90	0.53
Item 25	0.95	0.54
Item 26	0.93	0.56
Item 27	0.93	0.57
Item 28	0.92	0.52
Subscale 5: Clothing/Hygiene		
Item 29	0.54	0.33
Item 30	0.53	0.36
Item 31	0.78	0.33
Item 32	0.67	0.31
Item 33	0.52	0.27
Subscale 6: Use of technology		
Item 34	0.66	0.18
Item 35	0.70	0.19
Item 36	0.51	0.19
Item 37	0.42	0.16
Subscale 7: Spirituality		
Item 38	0.94	0.55
Item 39	0.98	0.55
Item 40	0.95	0.55
Item 41	0.92	0.50
Item 42	0.97	0.55
Item 43	0.97	0.54
Item 44	0.97	0.54
Item 45	0.98	0.54
Item 46	0.97	0.54
Total Variance Explained (%) 71.257		

*$p <$ Significant at 001 level

counseling by identifying fertility-related lifestyle problems in the clinical settings.

Validity

Determining the validity of the scope is a step that should be taken, especially in scale development studies. For scope validity, the measurement tool must measure all the items it contains. The fact that each detail of the measured feature is questioned by the items in the scale is also necessary for content validity (Esin, 2014; Kartal & Bardakçı, 2018). The items of the scale are presented to the experts and evaluated, and the content validity is calculated for the items and the scale (Esin, 2014). The ICV-I in the literature exceeds 78; the S-CVI value is at least 0.90 (Karagoz, 2016). The analysis of the current study revealed that the I-CVI value was higher than 78 and the minimum S-CVI value was 0.90 and above. The results of the scope validity analysis showed that there was a high level of agreement between the expert opinions of the FHLAS and that it adequately represented the desired field (DeVellis & Thorpe, 2021).

The suitability of the sample for factor analysis was assessed using the KMO and Bartlett X^2 tests. According to the literature, the Bartlett X^2 test value should be statistically significant and the KMO value should be greater than 0.60 in order to perform factor analysis (DeVellis & Thorpe, 2021). As a result of the analysis, the Bartlett test was statistically significant ($p < 0.001$) and the KMO value was greater than 0.60. This result showed that factor analysis could be performed (DeVellis & Thorpe, 2021; Kartal & Bardakçı, 2018; Hayran & Hayran, 2011). The scale consisted of seven sub-dimensions and explained 71.257% of the total variance, surpassing the suggested threshold of 40% for multidimensional scales (Kartal & Bardakçı, 2018; Cam & Baysan-Arabaci, 2010).

As a result, the factor loadings of all items in the FHLAS were above 40, as recommended, the factor loadings should be 0.30 and above (DeVellis & Thorpe, 2021; Kartal & Bardakçı, 2018; Hayran & Hayran, 2011). Therefore, no items were excluded from the scale due to low factor load. These results indicate that the scale has a strong factor structure and that the factor load values are medium and high. As a result of the statistical analysis, it is supported that the FHLAS has a high level of construct validity and shows that the scale is a valid measurement tool.

Confirmatory factor analysis generally assesses the validity of the structure identified by explanatory factor analysis and the appropriateness of the regression model identified using the goodness of fit indices, such as RMSEA, SRMR, CFI, NNFI, GFI, and AGF (Kartal & Bardakçı, 2018; Şahin, 2018; Ekka, 2014). In our study, the CFA factor loadings of the seven sub-dimensions of the scale ranged

Table 2 Model fit indexes of the Fertility Healthy Lifestyle Assessment Scale ($n = 263$)

Seven Factor	x^2	SD[a]	X^2/SD	RMSEA[b]	GFI[c]	CFI[d]	IFI[e]	NFI[f]	NNFI[g]
Model	2058.573	952	2.162	0.0667	0.748	0.924	0.925	0.868	0.918

a: Degree of Freedom, b: Root Mean Square Error of Approximation, c: Goodness of Fit Index, d: Comparative Fit Index, e: Incremental Fit Index, f: Normed Fit Index, g: Non-Normed Fit Index

Table 3 Results of the reliability analysis of the scale and its sub-dimensions ($n = 526$)

Split Analysis (Split Half)								
	Cronbach's α	McDonald's Omega	First half Cronbach's α	Second Half Cronbach's α	Spearman-Brown	Guttman Split-half	Correlation between two halves	Mean ± Standard Deviation
Scale Total	0.872	0.888	0.722	0.780	0.946	0.944	0.898	108.37 ± 22.40
First Sub-dimension	0.805	0.813						
Second Sub-dimension	0.779	0.788						
Third Sub-dimension	0.928	0.940						
Fourth Sub-dimension	0.961	0.970						
Fifth Sub-dimension	0.678	0.689						
Sixth Sub-dimension	0.601	0.612						
Seventh Sub-dimension	0.988	0.994						

from 0.33 to 0.99. Most of the fit indices were greater than 0.80 (GFI = 0.748, IFI = 0.925, NFI = 0.868, NNFI = 0.918, CFI = 0.924) and RMSEA (RMSEA = 0.067) was less than 0.80. These results showed that the data were compatible with the model, confirmed the seven-factor structure, that the items and sub-dimensions of the scale were related to the scale, and that the items in each sub-dimension defined their own factor as sufficient. It can be said that the FHLAS has a high level of construct validity. All the analysis results indicate that the scale is a valid measurement tool.

Reliability

Cronbach's alpha coefficient and McDonald's omega coefficient assessed the internal consistency of the scale. Our findings showed that the Cronbach's alpha coefficient of the whole scale was 0.87, the McDonald's omega coefficient was 0.88, and the Cronbach's alpha values of the sub-dimension were 0.60–0.98. According to the literature, Cronbach's alpha coefficients ranging from .60 to .80 are regarded as 'very reliable' while those from .80 to 1.00 are classified as 'extremely reliable' (Johnson & Christensen, 2014). This study shows that the FHLAS is highly reliable. Subscales 2, 5, and 6 were found to be 'quite reliable', and subscales 1, 3, 4, and 7 were found to be 'highly reliable'. These findings show that the scale items are homogenous and measure the same underlying construct. At the same time, Cronbach's alpha and McDonald's omega coefficients are recommended to be higher than 0.70 in the literature (Alpar, 2014; Soysal, 2023). In this study, Cronbach's alpha reliability coefficient of the whole scale was 0.87 and McDonald's omega reliability coefficient was 0.88. These findings meant that the scale had a high level of reliability (Ekka, 2014; Alpar, 2014). Furthermore, the results of the analysis conducted using the two-half split method showed a high correlation between the two halves (0.898), indicating that the whole measurement tool consisted of closely related questions and that the scale exhibited internal consistency (Esin, 2014; Kartal & Bardakçı, 2018). All these results showed that the scale was reliable.

The lower limit for the item-total score correlation value is generally 0.20 (Ekka, 2014). In this study, the item-total score and item-subdimension total score correlation coefficients of the 46-item scale ranged from 0.195 to 0.987. The item-total score and item-subdimension total score correlation coefficients of the FHLAS were 0.20 and above, indicating that the items had a high correlation with the whole scale and its sub-dimensions. As a result of the analysis, the scale was found to be highly reliable.

Conclusions

The FHLAS consists of seven sub-dimensions and 46 items. The results of this study showed that the scale is a valid and reliable measurement tool for assessing healthy lifestyles that contribute to improving fertility in women and men. Fertility-related lifestyle assessment is an important factor for both health professionals and individuals. The FHLAS scale is valid and reliable for measuring fertility-related healthy lifestyle behaviors in individuals undergoing fertility treatment or considering conception in the preconception period. The scale is clinically applicable because it is cost-effective and comprehensive, and it can holistically assess almost all lifestyle-related factors.

Although this study is an important contribution to the literature on the psychometric properties of the Turkish version of the FHLAS, it has some limitations. These limitations include the fact that although the scale was designed for both genders ($n = 340$ women, $n = 186$ men), limitations of the study include the fact that our sample was predominantly female, the data were collected through online surveys and therefore individuals without access to the internet could not be reached, and finally, the surveys were based on self-report in an online environment. However, despite its limitations, this study provided reliable results with a large sample size.

Acknowledgements The authors would like to thank Murat Bektas of Dokuz Eylul University for checking the statistics as an expert statistician before submission and we thank all the participants for their kind participation in this study.

Authors' contributions Conceptualization: DB, MAT, SÖ, FY; Methodology: DB, MAT; Formal analysis and investigation: SÖ, FY; Writing-original draft preparation: DB, MAT, SÖ, FY; Writing-review and editing: DB, MAT; Resources: SÖ, FY; Supervision: DB, MAT.

Funding The authors received no financial support for the research, authorship, and/or publication of this article.

Data availability All data and materials are available from the authors on request.

Declarations

The study was approved by the Non-Interventional Clinical Research Ethics Committee of a university (Decision No: 2020/5691-GOA). The principal researcher explained the purpose of the study and obtained informed consent from all participants.

Conflict of interest There is no conflict of interest among the authors.

References

Akalewold, M., Yohannes, G. W., Abdo, Z. A., Hailu, Y., & Negesse, A. (2022). Magnitude of infertility and associated factors among women attending selected public hospitals in Addis Ababa, Ethiopia: A cross-sectional study. *BMC Women's Health, 22*, 1–11. https://doi.org/10.1186/s12905-022-01601-8

Alpar, R. (2014). *Spor, Sağlık ve Eğitim Bilimlerinden Örneklerle Uygulamalı İstatistik ve Geçerlik- Güvenirlik-SPSS'de Çözümleme Adımları ile Birlikte* (3 Baskı). Detay Yayıncılık.

Bala, R., Singh, V., Rajender, S., & Singh, K. (2021). Environment, lifestyle, and female infertility. *Reproductive Sciences, 28*, 617–638. https://doi.org/10.1007/s43032-020-00279-3

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and Validating Scales for Health, Social, and behavioral research: A primer. *Frontiers in Public Health, 6*, 149. https://doi.org/10.3389/fpubh.2018.00149

Boedt, T., Dancet, E., Speelman, N., Spiessens, C., Matthys, C., & Fong, L., S (2023). Belgian fertility Clinic Staff Value Healthy Lifestyle Promotion but Lack Access to a structured lifestyle modification Programme: An observational study. *Gynecologic and Obstetric Investigation, 88*(5), 278–285. https://doi.org/10.1159/000531139

Cam, M. O., & Baysan-Arabaci, L. (2010). Qualitative and quantitative steps on attitude scale construction. *Turkish Journal of Research & Development in Nursing/Hemşirelikte Araştırma Geliştirme Dergisi, 12*(2). https://dergipark.org.tr/tr/pub/hemarge/issue/52709/695121

Cristodoro, M., Zambella, E., Fietta, I., Inversetti, A., & Di Simone, N. (2024). *Dietary Patterns and Fertility Biology*, 13(2), 131. https://doi.org/10.3390/biology13020131.

DeVellis, R. F., & Thorpe, C. T. (2021). *Scale development: Theory and applications*. Sage.

Ekka, R. (2014). *Research methodology and data analysis in humanities and social sciences*. Laxmi Book Publication.

Emokpae, M. A., & Brown, S. I. (2021). Effects of lifestyle factors on fertility: Practical recommendations for modification. *Reproduction and Fertility, 2*(1), R13–R26. https://doi.org/10.1530/RAF-20-0046

Esin, M. N. (2014). *Data collection methods and tools & reliability and validity of data collection tools. Research process in nursing, application and critical* (pp. 193–233). Nobel Medicine Book Houses.

Gaskins, A. J., Nassan, F. L., Chiu, Y. H., Arvizu, M., Williams, P. L., Keller, M. G., & EARTH Study Team. (2019). Dietary patterns and outcomes of assisted reproduction. *American Journal of Obstetrics snd Gynecology, 220*(6), 567–e1. https://doi.org/10.1016/j.ajog.2019.02.004

Gautam, R., Priyadarshini, E., Nirala, J., & Rajamani, P. (2021). Impact of nonionizing electromagnetic radiation on male infertility: An assessment of the mechanism and consequences. *International Journal of Radiation Biology*, 1–22. https://doi.org/10.1080/09553002.2020.1859154

Gençtürk, N., Yıldız Karaahmet, A., Shafaati Laleh, S., & Guksu, Z. (2024). The relationship between infertility and sleep quality in women: Systematic review and meta-analysis. *Actas urologicas Espanolas, 48*(3), 185–203. https://doi.org/10.1016/j.acuroe.2023.12.002

Hayran, M., & Hayran, M. (2011). *Basic Statistic for Health Research*. Ofset Matbaacılık Publishing, Ankara.

Johnson, R. B., & Christensen, L. B. (2014). *Educational research: Quantitative, qualitative, and mixed approaches*. Sage.

Karagoz, Y. (2016). *SPSS and AMOS 23 Applied statistical analysis*. Nobel Academic Publishing.

Kartal, M., & Bardakçı, S. (2018). *Reliability and validity analysis with SPSS and AMOS applied examples*. Akademisyen Publishing.

Lateef, O. M., & Akintubosun, M. O. (2020). Sleep and Reproductive Health. *Journal of Circadian Rhythms, 18*, 1. https://doi.org/10.5334/jcr.190

Latkovikj, M. T., & Popovska, M. B. (2019). Online research about online research: Advantages and disadvantages. *E-methodology, 6*(6), 44–56. https://doi.org/10.15503/emet2019.44.56

Leisegang, K., & Dutta, S. (2021). Do lifestyle practices impede male fertility? *Andrologia, 53*(1), e13595. https://doi.org/10.1111/and.13595

Li, L. J., Chow, A., Gaskins, A. J., Lee, J. N. J., Choolani, M., Kennedy, B. K., & Zhang, C. (2023a). Modifiable socioeconomic and lifestyle risk factors for female infertility in Asia: A systematic review from the population health perspective. *F&S Reviews, 4*(1), 78–99. https://doi.org/10.1016/j.xfnr.2022.09.001

Li, Q. L., Wang, C., Cao, K. X., Zhang, L., Xu, Y. S., Chang, L., Liu, Z. H., Yang, A. J., & Xue, Y. X. (2023b). Sleep characteristics before assisted reproductive technology treatment predict reproductive outcomes: A prospective cohort study of Chinese infertile women. *Frontiers in Endocrinology, 14*, 1178396. https://doi.org/10.3389/fendo.2023.1178396

Llaneza, P., Llaneza, D., & Fernandez-Ferrera, C. (2017). High frequency of sleep disorders and oocyte retrieval. *Fertility and Sterility, 108*(3), e352. https://doi.org/10.1016/j.fertnstert.2017.07.1030

Meyers, A. J., & Domar, A. D. (2021). Supported mobile applications and internet-based technologies to mediate the psychological effects of infertility: A review. *Reproductive BioMedicine Online, 42*(3), 679–685. https://doi.org/10.1016/j.rbmo.2020.12.004

Mínguez-Alarcón, L., Williams, P. L., Souter, I., Ford, J. B., Hauser, R., & Chavarro, J. E. (2024). Women's preconception psychological stress and birth outcomes in a fertility clinic: The EARTH study. *Frontiers in Global Women's Health, 5*, 1293255. https://doi.org/10.3389/fgwh.2024.1293255

Nagórska, M., Lesińska-Sawicka, M., Obrzut, B., Ulman, D., Darmochwał-Kolarz, D., & Zych, B. (2022). Health related behaviors and life satisfaction in patients undergoing infertility treatment. *International Journal of Environmental Research and Public Health, 19*(15), 9188. https://doi.org/10.3390/ijerph19159188

Ozdamar, K. (2016). *Eğitim, sağlık ve davranış bilimlerinde ölçek ve test geliştirme yapısal eşitlik modellemesi [Scale and test development structural equation modeling in education, health and behavioral sciences]*. Nisan Kitabevi.

Piercy, K. L., Troiano, R. P., Ballard, R. M., Carlson, S. A., Fulton, J. E., Galuska, D. A., & Olson, R. D. (2018). The physical activity guidelines for americans. *Jama, 320*(19), 2020–2028. https://doi.org/10.1001/jama.2018.14854

Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. *Research in Nursing & Health, 29*(5), 489–497. https://doi.org/10.1002/nur.20147

Practice Committee of the American Society for Reproductive Medicine and the Practice Committee of the Society for Reproductive Endocrinology and Infertility. Electronic address: asrm@asrm.org (2022). Optimizing natural fertility: A committee opinion. *Fertility and sterility, 117*(1), 53–63. https://doi.org/10.1016/j.fertnstert.2021.10.007.

Romualdi, D., Ata, B., Bhattacharya, S., Bosch, E., Costello, M., Gersak, K., Homburg, R., Mincheva, M., Norman, R. J., Piltonen, T., Santos-Ribeiro, D., Scicluna, S., Somers, D., Sunkara, S., Verhoeve, S. K., H. R., & Le Clef, N. (2023). Evidence-based guideline: Unexplained infertility. *Human Reproduction (Oxford England), 38*(10), 1881–1890. https://doi.org/10.1093/humrep/dead150

Şahin, M. G., & Öztürk, N. B. (2018). Scale development process in educational field: A content analysis research. *Kastamonu Eğitim Dergisi, 26*(1), 191–199. https://doi.org/10.24106/kefdergi.375863

Savelieva, K., Jokela, M., & Rotkirch, A. (2023). Reasons to postpone childbearing during fertility decline in Finland. *Marriage & Family Review, 59*(3), 253–276. https://doi.org/10.1080/01494929.2022.2083283

Souza, M. D. C. B. D., Silva, L. A. B. D., Sequeira, F. F., Antunes, A., R. D., & Souza, M. M. D. (2023). The management of infertility for primary care physicians. *Women & Health, 63*(3), 194–203. https://doi.org/10.1080/03630242.2023.2165599

Soysal, S. (2023). Çok Boyutlu Test Yapılarında Alfa, Tabakalı Alfa Ve Omega Güvenirlik Katsayılarının Karşılaştırılması. *Ahmet Keleşoğlu Eğitim Fakültesi Dergisi (AKEF) Dergisi, 5*(1), 213–236. https://doi.org/10.38151/akef.2023.51

Torkel, S., Wang, R., Norman, R. J., Zhao, L., Liu, K., Boden, D., Xu, W., Moran, L., & Cowan, S. (2024). Barriers and enablers to a healthy lifestyle in people with infertility: a mixed-methods systematic review. *Human Reproduction Update*, dmae011. Advance online publication. https://doi.org/10.1093/humupd/dmae011

Xie, F., You, Y., Guan, C., Gu, Y., Yao, F., & Xu, J. (2022). Association between physical activity and infertility: A comprehensive systematic review and meta-analysis. *Journal of Translational Medicine, 20*(1), 237. https://doi.org/10.1186/s12967-022-03426-3

Yang, J., Song, Y., Gaskins, A. J., Li, L. J., Huang, Z., Eriksson, J. G., & Zhang, C. (2023). Mediterranean diet and female reproductive health over lifespan: A systematic review and meta-analysis. *American Journal of Obstetrics and Gynecology*. https://doi.org/10.1016/j.ajog.2023.05.030

Yanik, F., & Tokat, M. A. (2024). Sleep quality, perceived stress and associated factors in women undergoing IVF treatment: Short-term longitudinal study. *Journal of Reproductive and Infant Psychology*, 1–16. https://doi.org/10.1080/02646838.2024.2339481

Zhang, H., Hua, L., & Liu, D. (2024). Effects of physical activity on infertility in reproductive females. *Reproductive Biology and Endocrinology: Rb&E, 22*, 62. https://doi.org/10.1186/s12958-024-01234-6

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.