

# Sexual Dysfunction in Iranian Older Women and its Predictors: A Cross- Sectional Study

**Masoumeh Rajabi- Naeeni**

Iran University of Medical Sciences

**Tahereh Dehdari** (✉ [dehdari.t@iums.ac.ir](mailto:dehdari.t@iums.ac.ir))

Iran University of Medical Sciences

**Mansoureh Jamshidimanesh**

Iran University of Medical Sciences

**Leila Janani**

Iran University of Medical Sciences

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## Research Article

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# Abstract

**Background:** The population of older women is rapidly increasing in every country in the world, including Iran. Given the effect of Sexual Function (SF) and sexual health on older women's health, the present study was conducted to determine Sexual Dysfunction (SD) and the factors predicting it in Iranian older women in Karaj.

**Methods:** The present cross-sectional study was conducted on 550 eligible older women selected by stratified cluster sampling from those visiting health centers in Karaj between October 2019 and February 2020. Data were collected using self-report questionnaires including demographic questionnaire, the hospital anxiety and depression scale (HADS), and the Female Sexual Function Index (FSFI). To take account of the effect of sampling design on the analyses, survey command in Stata-14 was used.

**Results:** A total of 94.5% of the participating women had SD, 74.4% reported desire disorder, 79.8% arousal disorder, 57.6% lubrication disorder, 65.3% orgasm disorder, and 72.2% sexual dissatisfaction, and 52.4% had dyspareunia. The participating women's SF had significant relationships with physical activity, hysterectomy, spouse's SD, and the intimate and emotional closeness with the spouse ( $P<0.05$ ). SF had significant inverse relationships with age, duration of marriage and menopause, anxiety, and depression ( $P<0.001$ ). Nonetheless, SF had no significant relationship with occupation, education, smoking, and type and frequency of childbirth. The results of the linear regression test showed that the duration of menopause ( $B=-0.04$ ,  $P=0.023$ ), spouse's SD ( $B=-0.95$ ,  $P<0.001$ ), intimacy ( $B=13.89$ ,  $P<0.001$ ), emotional closeness ( $B=6.49$ ,  $P<0.001$ ), anxiety ( $B=-0.08$ ,  $P=0.033$ ), and depression ( $B=-0.24$ ,  $P<0.001$ ) predicted the participating women's SF significantly.

**Conclusion:** The majority of the participating women had SD. Attention mental health, spousal relationship, and spouse's sexual health may have significant positive effects on the sexual health of Iranian older women.

## Background

Due to increased life expectancies and improved health care services, the older adult population of all countries is rapidly increasing in the world, including Iran. Reports in 2020 show that 9.9% of Iran's population consists of people over age 60 years, and this figure is expected to increase to 20.7% by 2040 and 31.2% by 2050 (1). The recent demographic changes are so salient that population aging is considered a global emergency. Aging has many physical, psychological, social and economic consequences, although its effect on health is of paramount importance(2).

The results of a study by World Health Organization (WHO) on global ageing and adult health (SAGE) in select countries showed that people's health score reduces significantly with age (3). In the meantime, sexual health is one of the main aspects of reproductive health that significantly affects people's quality of life (4). Studies have shown that 73% of people aged 57 to 64 years, 53% of those aged 65 to 74 years, and 26% of older adults aged 75 to 85 years are sexually active(5). It is therefore crucial to consider

sexual health and function as part of older adults' health. Moreover, women's Sexual Function (SF) demands greater attention, since the cycle of sexual responses are mediated by complex psychological, social and biological interactions in women (6). Women's sexual health is the outcome of the interaction of vascular, neurological, hormonal, and psychological factors and is affected by personal factors, interpersonal relationships, cultural issues, beliefs, and attitudes(7). Sexual dysfunction(SD) is one of the common and curable problems that contributes to emotional stresses and marital problems(8). Researches were conducted in other countries have reported a prevalence of 68–86.5% for SD in postmenopausal and older women(7). This dysfunction is affected by a variety of factors. A study on older men and women showed that sexual activity reduces with age, and this reduction was more prominent in women than men(9). Another study conducted in Britain showed that 17% of women and 27% of men over 60 years of age suffer from at least one medical problem that affects their sexual activity(10). According to other studies, people with appropriate physical activity are less affected by SD. Moreover, the levels of sexual desire, arousal, and orgasm were lower in women who had undergone hysterectomy(11).

Some studies have shown that the individual's psychological state can contribute to the development of SD (8, 12). Depression is one of the most common psychological factors affecting the incidence of SD. Depression leads to a decline in interpersonal and social relationships. Most studies conducted on depressed women have reported the loss of libido. Moreover, it is more difficult for depressed women to reach sexual arousal and orgasm(8). Anxiety disorders also have a negative relationship with sex in women, but their effect on men is negligible. In general, SD is experienced more frequently in people with anxiety compared to those without(12).

Studies have shown that the prevalence and incidence of many of these physical and psychological disorders and their predisposing factors increase with age(13). Moreover, women also experience the changes caused by menopause as they age, which affect their SF(7). Based on the results of studies conducted in other countries, SF is affected by factors such as age, duration of marriage, pelvic surgery, multiparity, menopause, hysterectomy, and chronic diseases(14–16).

Although extensive studies have been conducted in other countries on older women's sexual issues and despite the importance of determining SF to help design interventions for improving the sexual health and quality of life of older adults(17). our review of literature showed no studies on SF in Iranian older women. Given the personal, social, and cultural differences between older women in Iran and in other countries and the need to know the status of this dysfunction for future planning, the present study was conducted to determine SD and its predictors in Iranian older women in Karaj.

## **Methods**

### **Study Design and Participants**

The present cross-sectional study was conducted to determine SD and its predicting factors among a sample of Iranian older women referral to health care facilities in the city of Karaj between October 2019

and February 2020 in accordance with the Declaration of Helsinki guidelines. The study was approved by the Ethics Committee of Iran University of Medical Sciences (Code: IR.IUMS.REC.1398.612).

The study inclusion criteria were: Willingness to take part in the study, age over 60 years, having a spouse, not having any cognitive or memory disorders, ability to speak and establish an acceptable rapport, not participating in other research interventions, and the completion of a written informed consent form. The participants were able to leave the study at any stage if they wished.

with a specific accuracy(19) and considering a confidence interval of 95%, standard deviation of 8, error (d)=1, clustered sampling (taking into account a design effect of 2), and 10% withdrawal rate, the sample size was calculated as 547, and ultimately, 550 women were included in the study.

The method used in this study to select the samples was stratified cluster sampling, which was carried out in two stages: In the first stage, three districts were defined based on the social, economic, and cultural contexts, and all the health centers in Karaj were categorized based on these to three districts. Ten health centers were then randomly selected from each district. In the next stage, trained questioners explained the study objectives to older women who visited the selected centers, and the willing candidates were included in the study. A total of 550 older women entered the study (18 to 19 women from each health center).

## **Instruments**

A socio-demographic questionnaire, the female sexual function index, and the hospital anxiety and depression scale were used. These questionnaires were completed by three trained questioners for the participants through face-to-face interviews. The completion of the questionnaires took 20 minutes on average for each participant.

1. The socio-demographic questionnaire inquired about variables such as age, education, type and frequency of childbirth, history of chronic diseases (cardiovascular diseases, hypertension, and liver, renal and gastrointestinal diseases, etc.), details about menopause, level of emotional closeness and intimacy with the spouse, and variables such as physical activity and hysterectomy (Additional file1).
2. The Female Sexual Function Index (FSFI) has 19 items in six dimensions, including sexual desire (2 items), arousal (4 items), lubrication (4 items), orgasm (3 items), sexual satisfaction (3 items) and pain (3 items). Each item scores from 1 to 5 points in the dimension of sexual desire and from 0 to 5 in the other dimensions (Additional file2). The subject's score in each part is calculated as the sum of the scores of the items in that part. Then, the sum of the scores of the items in that part is multiplied by the coefficient of that part to find the final score. This coefficient is 0.6 for sexual desire, 0.3 for arousal and lubrication, and 0.4 for orgasm, satisfaction, and pain. The maximum score is 6 for each dimension, and 36 for overall SF. Higher scores indicate better SF, and a score of 28 and higher suggests normal function (20). The validity and reliability of the original version of the FSFI were confirmed by Rosen in 2000, and in Iran, by Mohammadi in 2012 (20, 21).

3. The Hospital Anxiety and Depression Scale (HADS), which assesses anxiety and depression using a few questions with simple and comprehensible wording for this age group, has 14 items (Additional file3). The scale of answers to the items is ordinal and has four options, and each item is scored from 0 to 3 points, where 0 indicates no disorder and 3 indicates depression or anxiety. Each dimension's score is then summed up, and the respondent's score in each dimension thus varies from 0 to 21. In each dimension, a score from 0 to 7 is considered normal, 8 to 10 borderline, and 11 and higher indicates depression or anxiety. Moreover, the odd-numbered items assess anxiety and the even ones assess depression (22). The validity and reliability of this questionnaire have been confirmed in many studies conducted in different countries (23-25), including Iran (26).

## Data analysis

The data distribution was assessed using graphs, indices, and the Shapiro-Wilks test. The quantitative variables were reported in terms of mean (standard deviation), and median [interquartile range] and the qualitative ones in terms of frequency (percentage). Given the sampling type, all the data analyses were carried out in survey command at Stata-14. To assess the concurrent effects of the variables on sexual function, a linear regression analysis was performed on all the variables with  $P < 0.2$  in the univariate analysis.

## Ethics

The present study was approved by the Ethics Committee of Iran University of Medical Sciences (Code: IR.IUMS.REC.1398.612). The participants were fully briefed on the study objectives, confidentiality of the data, and their right to leave the study if they wished. Finally, the older adults willing to take part were included in the study after they gave their written consent.

# Results

## Study sample characteristics

The majority of the participants were younger than age 70 years (91%). A total of 55.4% had less than four children. Most participants had been married for more than 40 years (72.5%), and reported the duration of their menopause as less than 20 years (81.3%).

The results showed that 29.8% of the participants had no physical activity and 42.2%, 27.6%, and 0.4% had little, moderate, and high levels of physical activity, respectively. According to the HADS, 54.2% of the participants showed no depression symptoms, and 23.8% were on the borderline, while 22% showed depression symptoms. Also, 55.1% of the participants had no anxiety symptoms, 21.5% were on the borderline, and 23.4% reported anxiety symptoms. Most participants had hypertension (57.3%), but most of them had no other chronic diseases. Other demographic characteristics of the participants was shown in table 1.

Since very few participants were smokers (n=14, 2.5%) or had cancer (n=10, 1.8%), these two variables were eliminated from the final analysis.

**Table1** Demographic characteristic of the participants

<b>Quantitative variables</b>		<b>Mean (SD)</b> <b>*Median [IQR]</b>
Age(years)		64.83(3.93)
Parity		4.84(2.25)
Length of marriage (years)		44.84(7.15)
Duration of menopause(years)		15.36(6.01)
Physical activity (minute/week)		*60[0-150]
Number of self-reporter chronic diseases		1.89(1.48)
Depression		7.12(4.25)
Anxiety		7.45(4.75)
<b>Qualitative variables</b>		<b>Number (%)</b>
<b>Education level</b>	Illiterate	194(35.3)
	Primary or high school	274(49.8)
	Diploma or university	82(14.9)
<b>Employment status</b>	Housewife	511(92.9)
	Employed/retired	39(7.1)
<b>Mode of delivery</b>	Vaginal	454(82.5)
	Cesarean or assistant	96(17.5)
	Vaginal	
<b>Menopausal status</b>	natural	468(85.1)
	Medical or surgical	82(14.9)
<b>hysterectomy status</b>	yes	101(18.4)
	no	449(81.6)
<b>Spouse sexual dysfunction</b>	yes	133(24.2)
	no	417(75.8)
<b>intimacy</b>	Good	300(54.6)
	moderate	97(17.6)

	week	153(27.8)
<b>Emotional closeness</b>	Very close	310(56.4)
	Somewhat close	93(16.9)
	Not at all close	147(26.7)
<b>Cardiovascular disease</b>	No	446(81.3)
	Yes	104(18.7)
<b>Hypertension</b>	No	235(42.7)
	Yes	315(57.3)
<b>Hyperlipidemia</b>	No	320(58.2)
	Yes	230(41.8)
<b>Diabetes</b>	No	404(73.5)
	Yes	146(26.5)
<b>kidney disease</b>	No	510(92.7)
	Yes	40(7.3)
<b>Liver disease</b>	No	519(94.4)
	Yes	31(5.6)
<b>Gastrointestinal disease</b>	No	473(86)
	Yes	77(14)
<b>urinary incontinence</b>	No	483(87.7)
	Yes	67(12.2)
<b>History of stroke or MI</b>	No	528(96)
	Yes	22(4)

### Prevalence of SD and its domains

Based on the FSFI, SD was observed in 520 (94.5%) of the participating older women in Karaj, including 42.4% with mild dysfunction, 17.2% moderate, and 34.9% severe dysfunction. Dysfunction was observed in different dimensions of SF, as follows: Sexual desire =74.4%, arousal =79.8%, lubrication =57.6%, orgasm =65.3%, satisfaction =72.2%, and pain =52.4%. The results showed that although dysfunction was observed in all the dimensions of SF, the highest prevalence pertained to the arousal and desire dimensions. Total and domain scores of the FSFI are presented in Table 2.

**Table2** Female sexual function index (total and domain scores)

	Mean (SD)	Minimum	Maximum	Cut off point
Desire score	2.37(1.12)	1.2	6	3.3
Arousal score	1.92(1.45)	0	6	3.4
Lubrication score	2.41(1.89)	0	6	3.4
Orgasm score	2.33(1.88)	0	6	3.4
satisfaction score	2.38(1.58)	0.8	6	3.8
pain score	3.08(2.39)	0	6	3.8
Total score	14.52(9.86)	2	33.9	28

### **Predictor factors of SD**

The results showed that the duration of menopause ( $B=-0.04$ ,  $P=0.023$ ), spouse's sexual dysfunction ( $B=-0.95$ ,  $P<0.001$ ), intimacy ( $B=13.89$ ,  $P<0.001$ ), emotional closeness ( $B=6.49$ ,  $P<0.001$ ), anxiety ( $B=-0.08$ ,  $P=0.033$ ), and depression ( $B=-0.24$ ,  $P<0.001$ ) were the ultimate predictors of SD in the participating older women (Tables 3, 4 and 5).

**Table3** Relationship between demographic characteristic of the participants and total score of FSFI

<b>Quantitative variables</b>		<b>Mean(SD)</b>	<b>P value€</b>
Age(years)		64.83(3.93)	<0.001*
Parity		4.84(2.25)	0.559
Length of marriage (years)		44.84(7.15)	<0.001*
Duration of menopause(years)		15.36(6.01)	<0.001*
Physical activity (minute/week)		87.8(87.31)	0.007*
Number of self-reporter chronic diseases		1.89(1.48)	0.011*
Depression		7.12(4.25)	<0.001*
Anxiety		7.45(4.75)	<0.001*
<b>Qualitative variables</b>		<b>Mean(SD)</b>	<b>P value€</b>
		<b>FSFI total score</b>	
<b>Education level</b>	Illiterate	13.57(9.91)	0.097
	Primary or high school	14.84(9.82)	
	Diploma or university degree	15.72(9.81)	
<b>Employment status</b>	Housewife	14.58(9.81)	0.675
	Employed/retired	13.78(10.67)	
<b>Mode of delivery</b>	Vaginal	14.52(9.83)	0.986
	Cesarean or assistant	14.54(10.06)	
<b>Menopausal status</b>	natural	14.66(9.94)	0.439
	Medical or surgical	13.72(9.42)	
<b>hysterectomy status</b>	Yes	15.02(9.72)	0.014*
	No	12.32(10.24)	
<b>Spouse sexual dysfunction</b>	Yes	15.28(9.81)	0.004*
	No	12.13(9.68)	
<b>intimacy</b>	Good	22.48(4.01)	<0.001*
	moderate	10.38(4.79)	
	week	1.54(0.24)	
<b>Emotional closeness</b>	Very close	22.25(4.14)	<0.001*
	Somewhat close	9.34(4.90)	

	Not at all close	1.50(0.03)	
<b>Cardiovascular disease</b>	No	14.88(9,79)	0.060
	Yes	10.09(10,09)	
<b>Hypertension</b>	No	15.24(9,46)	0.256
	Yes	13.99(10,14)	
<b>Hyperlipidemia</b>	No	14.59(9,69)	0.848
	Yes	14.43(10,12)	
<b>Diabetes</b>	No	14.89(9,64)	0.052
	Yes	13.52(10,43)	
<b>kidney disease</b>	No	14.79(9,81)	0.050
	Yes	11.12(10,09)	
<b>Liver disease</b>	No	14.56(9,85)	0.735
	Yes	13.85(10,28)	
<b>Gastrointestinal disease</b>	No	14.74(9,81)	0.221
	Yes	13.22(10,16)	
<b>urinary incontinence</b>	No	14.55(9,85)	0.879
	Yes	14.32(10,03)	
<b>History of stroke or MI</b>	No	14.76(9,80)	0.004*
	Yes	8.78(9.90)	

\*P value is significant

€ obtain from Survey command at Stata

**Table4** The result of multiple linear regression analysis based on the variable with  $p < 0.2$  in univariate analysis for sexual dysfunction

ADJ R2=0.88		Unstandardized B	Std. Error	P value
Age		-0.071	0.06	0.209
Length of marriage		-0.01	0.01	0.996
Duration of menopause		-0.08	0.03	0.028*
Physical activity		0.002	0.001	0.061
Number of self-reporter chronic diseases		0.23	0.18	0.223
Depression		-0.24	0.05	<0.001*
Anxiety		-0.07	0.03	0.057
Hysterectomy		-0.12	0.29	0.676
Spouse sexual dysfunction		-1.04	0.25	<0.001*
Education level	Illiterate			0.890
	Primary or high school	-0.015	0.30	0.959
	Diploma or University	-0.22	0.47	0.645
intimacy	Good			<0.001
	moderate	7.15	0.89	<0.001*
	week	14.08	0.88	<0.001*
Emotional closeness	Very close			<0.001
	Somewhat close	1.08	0.60	0.083
	Not at all close	6.42	0.87	<0.001*
Cardiovascular disease		-0.40	0.36	0.272
Diabetes		-0.20	0.34	0.549
kidney disease		-0.36	0.64	0.578
History of stroke or MI		-0.19	0.97	0.844

\*P value is significant

**Table5** Final predictors of sexual dysfunction in Iranian elderly women according to multiple linear regression analysis

ADJ R2=0.88		Unstandardized B	Std. Error	P value
Duration of menopause		-0.04	0.01	0.023*
Depression		-0.24	0.04	<0.001*
Anxiety		-0.08	0.03	0.033*
Spouse sexual dysfunction		-0.95	0.24	<0.001*
Intimacy	Good			<0.001
	moderate	6.96	0.78	<0.001*
	week	13.89	0.84	<0.001*
Emotional closeness	Very close			<0.001
	Somewhat close	1.14	0.54	<0.045*
	Not at all close	6.49	0.82	<0.001*

\*P value is significant

## Discussion

According to the results, the prevalence of SD in the participating older women was 94.5%. In agreement with the present study, the prevalence of SD in Iranian women of reproductive age has been reported as 98.5%, 91%, and 80.6% in three studies (27-29). Another study conducted in Iran reported the prevalence of SD in older women group as 81.5% (28). In two studies conducted on older women in Britain and the US, the prevalence of SD was reported as 55.7% and 71%, respectively(30, 31). Also, according to community-based studies, the prevalence of SD was 25% to 63% in women of all ages(32), and 68% to 86% in postmenopausal and older women(7). The present findings showed that SD was more frequent in Iranian older women compared to other countries.

In the present study, arousal and desire were the most common dysfunctional dimensions. In agreement with the present study, in a study conducted in Iran(33) and several studies in other countries(10, 34, 35), dysfunction in sexual desire and arousal was more prevalent in older women. In contrast, in a study conducted on British older women, Mitchell et al. showed that, after sexual desire, lubrication was the more prevalent dysfunction dimension(30). In another study, Hughes et al. observed that lubrication was the more prevalent dimension of sexual dysfunction after desire in older women in the US(31). The disparity in the results appears to be due to the differences in the questionnaires used. In older women assessed using the standard FSFI, sexual desire and arousal were more prevalent than the other dysfunctions.

The present findings showed that the duration of menopause was one of the factors predicting SF in the study subjects. In agreement with these results, in the study by Lonnèe-Hoffmann et al. on

postmenopausal Australian women, the SF score reduced as the duration of menopause increased(36). In another study on postmenopausal Malaysian women, Dhillon et al. showed a reduction in SF after menopause, which seems to have been due to postmenopausal dyspareunia, reduced lubrication, and sexual desire(37). In a review of literature on postmenopausal SF, Hayes & Dennerstein reported that, following menopause, sexual desire and the frequency of sexual relations reduce while SD exacerbates with increases in age and the duration of menopause(38). In another review study, Nazarpour confirmed that the hormonal and physical consequences of menopause are a predictor of SD. Clearly, many physiological, anatomic, and hormonal changes occur with age and the onset of menopause that directly and indirectly affect women's SF(7).

In the present study, the most important and significant predictor of SD was emotional closeness and intimacy to the spouse. Women who had greater intimacy and emotional closeness to their spouse enjoyed a better SF. In their studies on women of reproductive age in Iran, Masoumi et al. and Tehrani et al. emphasized the predictive effect of satisfaction with the marriage and the relationship with the spouse on SD(39, 40). In another study, Chizari et al. showed that women who have a happier family life and love their spouse have a more favorable SF(41). In another study on older women, Mernone et al. showed that the spousal relationships, which involves intimacy and emotional support, is a major predictor of women's SF(42). In a qualitative study, Harder et al. reported that intimacy with the spouse is a key factor in older women's SF. In short, intimacy consists of five components, including commitment, interdependence, emotional intimacy, cognitive intimacy, and physical intimacy(43). Physical and emotional intimacy lead to sexual intimacy, and in turn, sexual intimacy is focused on physical closeness and sexual intercourse. That is, sexual intimacy does not only involve sexual intercourse, but also caressing, cuddling, and emotional and physical touch. Examining older women's intimacy should be carried out with the knowledge that hormonal changes and physical illnesses affect women's sexual intimacy. In general, sexual desire and physical intimacy are apparently affected by various aspects, including the quality of the relationship with the spouse and the partner's health status (physical, psychological, and sexual), just as the spouse's sexual function was among the predictors of sexual dysfunction in the participating older women in this study(44).

The present findings showed that depression and anxiety were among the significant predictors of SD in older women. In agreement with these findings, studies conducted on Iranian women of reproductive age have shown that psychological factors are strong predictors of women's SD(45-47). In a review study, McCabe et al. showed that depression and anxiety and the relationship between spouses are among the confirmed risk factors of SD in women(11). Anxiety is regarded as the main component of SD in Barlow's cognitive model(48). Research has also shown that depressed people feel persistent numbness, helplessness, worthlessness and guilt, and their SF is affected by the anticipation of failure(49). Anxiety and depression may lead to SD, and inversely, SD may cause anxiety and depression symptoms. When dealing with stressors, women are likely to experience some degrees of depression or anxiety symptoms. These neurological, physiological and cognitive processes cause changes in the expression of emotional states, which create similar changes in the person's capacity for sexual responsiveness(50). Saberi et al. also showed that depression and anxiety directly affect Iranian women's SF(8).

Overall, despite the reduction in sexual desire and activity in old age, the effect of psychological status and the intimacy and emotional closeness between spouses still affects older adults' SF and is considered an important factor in older adults' sexual relationships (44).

## **Strengths and Limitations**

Although this is the first study on sexual dysfunction and its predictors in Iranian older women, the questions were answered in a self-reporting form, which constitutes a limitation of this study, and to resolve this limitation, the participants were trained and their ambiguities were answered. Although Karaj is a city welcoming many immigrants and though its residents have different cultures, it was not possible to examine all the different ethnicities residing there. A similar study is therefore recommended to be conducted in other geographical regions of Iran as well.

## **Conclusion**

The participating older women in the study did not have a favorable SF, and the majority had SD. Their mental health, spousal relationship, and spouse's sexual health had a significant effect on Iranian older women's SF. Considering these factors in the design of interventions to improve older women's SF may help promote the effectiveness of these interventions.

## **Abbreviations**

FSFI: Female Sexual Function Index

HADS: Hospital Anxiety and Depression Scale

SD: Sexual Dysfunction

SF: Sexual Function

## **Declarations**

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### **Authors' contributions**

MRN, TD, MJ and LJ conceived and developed the idea for the paper and revised the manuscript. MRN contributed to data collection. LJ contributed to statistical interpretations. All authors read and approved the final manuscript

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## **Availability of data and materials**

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

## **Ethics approval and consent to participate**

The Ethics Committee of Iran University of Medical Sciences has approved study protocol (IR.IUMS.REC.1398.612). A written informed consent form signed and dated by subjects and investigators at the beginning of the study (in Persian).

Participations were free and could withdraw at whatever point the person feels they were unable to continue. The personal information of participants kept secret before, during, and after study.

## **Consent for publication**

A written consent to publish the information and data of the participants was obtained.

## **Competing interests**

The authors declare that they have no competing interests

## **Author details**

1PhD, MPH student, School of public health, Iran University of Medical Sciences, Tehran, Iran.2PhD, Associate Professor, Department of Health Education & Health Promotion, School of public health, Iran University of Medical Sciences, Tehran, Iran. 3PhD, Associate Professor, Department of Midwifery and Reproductive Health, School of Nursing and Midwifery, Iran University of Medical Sciences, Tehran, Iran.4 PhD, Associate Professor, Department of Biostatistics, School of Nursing and Midwifery, Iran University of Medical Sciences, Tehran, Iran.

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