

Sexual function in women in the climacteric: cross-sectional study

Função sexual em mulheres no climatério: estudo transversal

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RESUMO | INTRODUÇÃO: O climatério constitui uma fase do ciclo vital da mulher, representando a transição entre o período reprodutivo e o não reprodutivo. **OBJETIVO:** Avaliar a função sexual em mulheres climatéricas por meio do Questionário Quociente Sexual-Versão Feminina (QS-F). **MÉTODO:** Estudo transversal, com um grupo de 66 mulheres climatéricas submetidas à avaliação da função sexual por meio do Questionário Quociente Sexual-Versão Feminina (QS-F) e através do escore total do QS-F, foi definido o padrão de desempenho/satisfação sexual. **RESULTADOS:** O padrão de desempenho/satisfação sexual mais predominante foi o de regular a bom (37,9%) e 52,9% das mulheres participantes afirmaram que costumam pensar em sexo "às vezes" a "nunca". **CONCLUSÃO:** A maioria das mulheres entrevistadas teve padrão de desempenho/satisfação sexual de regular a bom, sem significativas alterações da função.

PALAVRAS-CHAVE: Sexualidade. Função sexual. Disfunção sexual. Climatério. Mulheres.

ABSTRACT | INTRODUCTION: The climacteric is a phase of the woman's life cycle, representing a transition between the reproductive and non reproductive periods. **OBJECTIVE:** Evaluate sexual function in women through the Sexual Quotient Questionnaire – Female Version (QS-F). **METHODS:** Cross-sectional study with a group of 66 climacteric women who underwent sexual function assessment using the Sexual Quotient Questionnaire - Female Version (QS-F) and through the total QS-F score, the sexual performance / satisfaction pattern was defined. **RESULTS:** The standard of sexual performance/satisfaction most prevalent were from good to normal (37.9%), whereas the standard unfavorable and null, both had a sample of 4.5% and 52.9 of the participating women stated that they often think of sex "sometimes" or "never." **CONCLUSION:** The majority of the women interviewed had a standard of sexual performance / satisfaction between regular and good, without any significant alteration of function.

KEYWORDS: Sexuality. Sexual function. Sexual dysfunction. Climacteric. Women.

Introduction

The climacteric adopted a phase of woman's life cycle that occurs approximately between 40 and 65 years of age, from a progressive physiological hypoestrogenism until suspension of hormonal ovaries activity, registering the transition between reproductive and nonreproductive periods¹.

The reduction in estrogen levels results in impaired pelvic support and lubrication of vaginal mucosa, which may interfere in sexual function of those women, due to the fact that pelvic diaphragm structures are hormonally dependent²⁻⁶.

Sexual complaints can manifest themselves throughout all female reproductive life, however in the climacteric phase, women become more susceptible to sexual dysfunctions (SD)⁷. A Female Sexual Dysfunction (FSD) is characterized as a public health problem and for women in that stage of life, 62% of this population, in particular, reduced libido and difficulty in arousal, favoring in sexual interference, personal distress, impact on quality of life and interpersonal relationships⁸.

The most frequent symptoms of alteration in sexual function are loss of desire, reduced frequency of sexual activity, pain during or after the course, decreased vaginal sensitivity and difficulties with arousal and orgasm, resulting in abandonment of sexual life, when compared to men^{3,9-12}.

Considering a voltage research aimed at identifying changes in the phases of the cycle of sexual responses and sexual dysfunctions in the Brazilian climacteric period, probably due to the consequences of analyzes of cultural issues, the pre-sent study aimed to assess sexual function in climacteric women, through to the Sexual Quotient-Female Version (QS-F).

Methodology

This is a cross-sectional observational survey conducted between November 2018 and February 2019.

In the sample of accidental nonprobabilistic type, 66 women aged between 35 and 65 years from the UNASP Polyclinic, sexually active and with a steady partner in past six months, regardless of marital status, were included. Women who were pregnant, breastfeeding, puerperium or using hormone replacement therapy, cognitive impairment that made it impossible to understand the issues and illiteracy were excluded.

The volunteers signed the Free and Informed Consent Form and filled out the Sexual Quotient, female version (SQ-F), which is a questionnaire composed of ten self-responsive questions, developed and validated specifically for Brazilian female population, by the Study Program in Sexuality at the Institute of Psychiatry, Hospital das Clínicas, Faculty of Medicine, University of São Paulo. This questionnaire assesses the phases of sexual response cycle, and another domains: desire and sexual interest (questions 1, 2 and 8), preliminaries (question 3), personal arousal and attunement with the partner (questions 4 and 5), comfort (questions 6 and 7), orgasm and satisfaction (questions 9 and 10), to identification of specific dysfunctions and sexual difficulties¹³.

Two envelopes were delivered, one for the consent form and the other for the form and questionnaire. Those are deposited in two sealed boxes, like an urn, with no identification of the volunteers. After the delivery and completion of SQ-F, if they identified any dysfunction in their scores, and if they wished, they were instructed that they could seek out the researchers and be guided and referred to specialized care.

The data were analyzed and tabulated using Excel program. Categorical data (marital status, children, religion, father education, mother education, family income, individual income, aspects related to sexuality and FSFI scores) were pre-sented in absolute frequency, while the numerical data (age) was presented in terms of mean and standard deviation and presented in form of tables.

This study is part of a project that was approved by the Ethics and Research Committee (CEP) at the Center University of São Paulo (UNASP), CAAE number 01599718.1.0000.5377, as governed by resolution 466/12 of the National Health Council.

Results

The age range of the 66 women evaluated in this study ranged from 35 to 65 years old, with a mean age of 52.36 years, median 52.50 and standard deviation (SD) 8.20. Of the interviewees, the majority 55 (83%), are married; in relation to religiosity, 39 (59%) are catholic. As for family income 41 (62%) women said they received 1 to 3 minimum wages; and regarding individual income, 29 (44%) women said that they hadn't income (Table 1).

Table 1. Sociodemographic data, applied to climacteric women, obtained through the form, be-tween the period of November 2018 to February 2019

	Average ± SD	Median	n (%)
Age	52,36 ± 8,2	52,5	
Marital status			
Single			7 (11)
Married			55 (83)
Children			
Without children			3 (4)
1			12 (18)
2			25 (38)
3			15 (23)
4 or more			11 (17)
Religion			
Catholic			39 (59)
Evangelical			21 (32)
None			2 (3)
Other			4 (6)
Father education			
Elementary School			23(35)
Middle School			6 (9)
High School			6 (9)
University			2 (3)
Did not study			15 (23)
Do not know			14 (21)
Mother education			
Elementary School			21(32)
Middle School			5 (8)
High School			6 (9)
University			2 (3)
Did not study			20 (30)
Do not know			12 (18)
Family income			
Until 1 minimum wage			11 (17)
1 to 3 wages			41 (62)
3 to 6 wages			13 (20)
12 to 15 wages			1 (1)
Individual income			
No income			29 (44)
Until 1 minimum wage			18 (27)
1 to 3 wages			16 (25)
3 to 6 wages			1 (1)
12 to 15 wages			2 (3)

SD, standard deviation; n, frequency; %, percentage.

About sex education, 40 (61%) women reported did not have any type of education in the past; about impact of family sex education, 25 (38%) said that it did not affect anything; with regard to level of sexual satisfaction, 33 (50%) women said it was good; the decrease of libido compared to the current phase of life, 52 (79%) reported that there was no change; and when it comes to sexual frequency, 21 (32%) women said that they practice once a week (Table 2).

Table 2. Aspects related to sexuality, applied to climateric women, obtained through the form, between the period of November 2018 to February 2019

	n (%)
Sexual education	
None	40 (61)
Verry little	15 (23)
More or less	6 (9)
Quite	2 (3)
Extremely (always)	3 (4)
Sexual education impact	
None	25 (38)
Verry little	15 (23)
More or less	14 (21)
Quite	8 (12)
Extremely (always)	4 (6)
Decreased libido	
No	52 (79)
Verry little	6 (9)
More or less	5 (8)
Quite	3 (4)
Degree of sexual satisfaction	
Bad	5 (8)
Good	33 (50)
Regular	16 (24)
Excellent	12 (18)
Satisfaction with body image	
Verry little	13 (20)
More or less	32 (48)
Quite	6 (9)
Extremely (always)	15 (23)
Conversation with partner about sexuality	
No	11 (17)
Verry little	11 (17)
More or less	11 (17)
Quite	17 (25)
Extremely (always)	16 (24)
Partner's satisfaction with their body image	
No	1 (1)
Verry little	5 (8)
More or less	24 (36)
Quite	19 (29)
Extremely (always)	17 (26)
Sexual information received	
No	42 (64)
Verry little	8 (12)
More or less	8 (12)
Quite	6 (9)
Extremely (always)	2 (3)
Practice masturbation?	
Yes	6 (9)
Sometimes	8 (12)
Rarely	1 (2)
No	51 (77)
Sexual frequency	
1 time per week	21 (32)
2 times per week	16 (24)
3 times per week	20 (30)
4 or more times per week	9 (14)

n, frequency; %, percentage.

The responses of climacteric women in relation to the ten questions of the SQ-F can be seen in table 3. Questions 1,2, and 8 of the SQ-F refer to domain desire and sexual interest. The first question, option "sometimes" was the most chosen by women interviewed, being 23 (34.8%). Question 2, the answer "always" was the most indicated, 24 (36.3%), that is, the majority said that interest in sex is sufficient to participate in sexual intercourse with desire. Question 8, the option "always" was the most indicated, being 23 (34.8%), they are able to get involved, without being distracted during the sexual act.

Question 3 is related to foreplay, most women answered "always", with 36 (54.5%) meaning that foreplay encourages them to continue sexual intercourse. Questions 4 and 5 are related to the arousal domain personal and attunement with the partner. Question 4 had the answer "always", with the highest percentage being 27 (40.9%). In the fifth question, 31 (46.9%) chose the answer "always".

Questions 6 and 7 are associated with personal comfort. Question 6 had the answer "always", as the most chosen, being 31 (47%), they soon manage to relax their vagina enough to facilitate penetration. The seventh question had the answer "never" as the most pointed out by women, 27 (40.9%) of which it can be observed that most of them reported never feeling pain during sexual intercourse.

Questions 9 and 10 correspond to orgasm and sexual satisfaction. Question 9 had the answer "always" as the most chosen, with 22 (33.3%) saying that they reach orgasm during sexual intercourse. The tenth question showed that 27 (40.9%) woman reported that "always" the degree of satisfaction during sexual intercourse results in the desire to have sex other times, on other days.

Women tended to choose the answer "always" in most questions, except for question 7, which the option "never" was the most chosen and question 1, which the option "sometimes" was the most chosen.

Table 3. Final answers, applied to climacteric women, obtained through the SQ-F, between the period of November 2018 to February 2019

Questions	Never	Rarely	Sometimes	50% of times	Most of times	Always	Total
n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
1	7 (10,6%)	5 (7,5%)	23 (34,8%)	7 (10,6%)	12 (18,2%)	12 (18,2%)	66 (100%)
2	2 (3,3%)	5 (7,5%)	14 (21,2%)	9 (13,6%)	12 (18,1%)	24 (36,3%)	66 (100%)
3	2 (3,3%)	4 (6%)	9 (13,6%)	10 (15,1%)	5 (7,5%)	36 (54,5%)	66 (100%)
4	7 (10,6%)	5 (7,5%)	9 (13,6%)	6 (9%)	12 (18,2%)	27 (40,9%)	66 (100%)
5	2 (3,3%)	4 (6%)	13 (19,6%)	4 (6%)	12 (18,2%)	31 (46,9%)	66 (100%)
6	4 (6%)	3 (4,5%)	18 (27,3%)	7 (10,6%)	13 (19,7%)	31 (47%)	66 (100%)
7	27 (40,9%)	10 (15,1%)	15 (22,7%)	3 (4,5%)	3 (4,5%)	8 (12,1%)	66 (100%)
8	7 (10,6%)	3 (4,5%)	14 (21,2%)	9 (13,6%)	10 (15,1%)	23 (34,8%)	66 (100%)
9	4 (6%)	5 (7,5%)	15 (22,7%)	7 (10,6%)	13 (19,7%)	22 (33,3%)	66 (100%)
10	3 (4,5%)	6 (9%)	9 (13,6%)	10 (15,1%)	11 (16,7%)	27 (40,9%)	66 (100%)

n, frequency; %, percentage.

Of the total sample, 19 women (28.7%) had a score <60, indicating sexual dys-function according to the SQ-F. According to the score of this quotient, 37.9% of the women interviewed reported a standard of regular to good and 33.33% had a good to excellent standard. However, despite the majority referring to a pattern of sexual satisfaction from regular to good, the unfavorable pattern to regular was present in a considerable percentage of the sample (19.7%) (Table 4).

Table 4. Result of sexual performance/satisfaction, applied with climacteric women, obtained through the SQ-F, between the period of November 2018 to February 2019

	n	%
Good to excellent	22	33,3
Regular to good	25	37,9
Unfavorable to regular	13	19,7
Bad to unfavorable	3	4,5
Null to bad	3	4,5
TOTAL	66	100%

n, frequency; %, percentage.

Discussion

The present study evaluated sexual function in climacteric women, and demonstrated a frequency of 28.7% of SD, with the domains, hypoactive sexual desire and pain complaint during sexual intercourse being the most affected. This result was mainly due to the use of the SQ-F, specifically designed to assess the sexual function of women and assist in the diagnosis of DSF¹². This value, however, was lower than the 67% detected in a national study with 370 women 40 to 65 years old, age group similar to this research, but that used a different evaluation instrument, the Female Sexual Function Index (FSFI)⁸.

The sexual life in the climacteric phase as well as all the others, needs to be understood in a broader context, taking into account previous sexual experiences, the historical, social, economic, cultural and religious context, which the woman is inserted, where they have been restricted many times to the satisfaction of her partner and to reproduce, suppressing her desire and interfering the sexual response of those women^{14,15}.

It was observed, that the frequency of SD detected by the SQ-F was less than the sexual dissatisfaction described by women. Some studies converge that a sexual alteration should only be considered as DS when it causes distress in women and discomfort reflected in dissatisfaction with sexual intercourse¹⁵.

Sexual symptoms are prevalent throughout the woman's reproductive life, however, during the

climacteric, in the case of healthy women, that can change is the type of sexual response, that becomes more lenient and less intense, as a result of the decrease in estrogen, which favors sexual dysfunction (SD), especially impairment in domain of desire and sexual interest^{11,16}. This corroborates the present study relative to question 1 of SQ-F, related to sexual desire, 52.9% of women participants stated that they usually think about sex "sometimes" to "never".

It was noticed that was not reduction about frequency of sexual activity among the women surveyed, and this fact can be attributed to emotional intimacy with their partner, a presence of a steady partner and encouragement to talk among them^{17,18}. Sexual activity is part of the conservation of the couple's intimate relationship and helps to reduce feelings of loneliness and isolation¹⁹.

In the sample studied, there was a predominance of dyspareunia, but was not consequent reduction in frequency of sexual intercourse and sexual satisfaction remained for most of those women. Studies show is a decrease in frequency of sexual activity with aging, a decrease in sexual desire, a decrease in lubrication in the face of sexual stimulation, which can cause dyspareunia, characterized by pain in sexual intercourse, a fact that may compromise a woman's sexual functioning²⁰.

The partner function in a relationship to female sexuality, care was taken with the satisfaction and orgasm of their partners. The partner's concern with

sexual satisfaction and the presence of orgasms was related to the reach “most of the time” to “always” of having orgasms in climacteric women. These data confirm the relevance of the partner in female sexual performance and marital relationships in the satisfactory sexual response for these women¹⁵.

Although, practice of masturbation is a strategy in female anorgasmia, many women who reach orgasm through masturbation or sexual stimulation other than coitus, may be distressed by such a situation¹⁵. May explain the 77% rate of the interviewees in the research, do not practice masturbation.

For the women in the present study, feeling good/excellent was a protective factor for the occurrence of SD and was associated with improvement in several domains of sexual response, is not about less satisfaction and pleasure. A better self-perception was evidenced in a study that verified the association between high sexual satisfaction and a greater sense of purpose in life.²¹ However, changes in the climacteric can constitute an unconscious subterfuge to avoid sexual intercourse that offer dissatisfaction⁸.

An integrative approach is necessary to prevent, minimize or treat sexual dysfunctions arising from that phase, with pelvic physiotherapy contributing to the resolution of SD and improving quality of life of these women²².

It is relevant to point out as a limitation of the present research, because the sexual function of the volunteers' partners was not assessed, the percentage of DSF may not have been reliable to the existing reality, since the presence of male sexual problems can directly or indirectly the sexual life of their partners, making them believe to be dysfunctional.

The exclusion of illiterate women, was due to the fact that it was believed that the help of another person in reading the questionnaire and marking the answers could interfere in the result, can also be considered as a limitation of this study, since this population could have added important value to the research results.

New studies are needed about the complexity of the sexual response, also about to importance of understanding the factors that may influence domains of sexual function in the climacteric and understanding the changes that occur during the aging process.

Conclusion

The physiological changes of the climacteric aren't the most causes of extinction of sexual women's behavior. The changes produce a sexual response in life cycle, it doesn't determine the end of the sexual life of interviewed women.

It was concluded that the majority of women climacteric interviewed, show a sexual performance and satisfaction pattern, between regular and good, analyzed by QS-F, without major changes in sexual function.

Author contributions

Vaz MLT participated in the design, search and interpretation of data. Barreiros BR and Oliveira NR participated in the collection of research data, statistical analysis of research data, interpretation of results and writing of the scientific article.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

References

1. Ferreira ALCG, Souza AI, Amorim MMR. Prevalência das disfunções sexuais femininas em clínica de planejamento familiar de um hospital escola no Recife, Pernambuco. *Rev Bras Saúde Mater Infant.* 2007;7(2):143-150. doi: [10.1590/S1519-38292007000200004](https://doi.org/10.1590/S1519-38292007000200004)
2. Oliveira AHFV, Vasconcelos LQP, Nunes EFC, Latorre GFS. Contribuições da fisioterapia na incontinência urinária no climatério. *Rev Ciênc Méd.* 2017;26(3):127-133.
3. Piecha VH, Ebling SBD, Peisza GM, Silva MM, Silva SO. Percepções de mulheres acerca do climatério. *Rev Pesqui Cuid Fundam.* 2018;10(4):906-912. doi: [10.9789/2175-5361.rpcfo.v10.6259](https://doi.org/10.9789/2175-5361.rpcfo.v10.6259)
4. Thornton K, Chervenak J, Neal-Perry G. Menopause and sexuality. *Endocrinol Metab Clin North Am.* 2015;44(3):649-661. doi: [10.1016/j.ecl.2015.05.009](https://doi.org/10.1016/j.ecl.2015.05.009)
5. Lorenzi DRS, Catan LB, Moreira K, Ártico GR. Assistência à mulher climatérica: novos paradigmas. *Rev Bras Enferm.* 2009;62(2):287-293. doi: [10.1590/S0034-71672009000200019](https://doi.org/10.1590/S0034-71672009000200019)

6. Prado DS, Mota VPLP, Lima TIA. Prevalência de disfunção sexual em dois grupos de mulheres de diferentes níveis socioeconômicos. *Rev Bras Ginecol Obstet.* 2010;32(3):139-43. doi: [10.1590/S0100-72032010000300007](https://doi.org/10.1590/S0100-72032010000300007)
7. Sarti CD, Graziottin A, Mincigrucci M, Ricci E, Chiaffarino F, Bonaca S et al. Correlates of sexual functioning in Italian menopausal women. *Climacteric.* 2010;13(5):447-456. doi: [10.3109/13697130903491026](https://doi.org/10.3109/13697130903491026)
8. Cabral PU, Canário AC, Spyrides MH, Uchôa SA, Eleutério Jr J, Gonçalves AK. Determinants of sexual dysfunction among middle-aged women. *Int J Gynecol Obstet.* 2013;120(3):271-274. doi: [10.1016/j.ijgo.2012.09.023](https://doi.org/10.1016/j.ijgo.2012.09.023)
9. Polizer AA, Alves TM. Perfil da satisfação e função sexual de mulheres idosas. *Fisioter Mov.* 2017;22(2):151-158.
10. Crema IL, Tilio R, Campos MTA. Repercussões da menopausa para a sexualidade de idosas: revisão integrativa da literatura. *Psicologia: Ciência e Profissão.* 2017;37(3):753-769. doi: [10.1590/1982-3703003422016](https://doi.org/10.1590/1982-3703003422016)
11. Santos LJ, Leão APF, Gardenghi G. Disfunções sexuais no climatério. *Reprodução & Climatério.* 2016;31(2):86-92. doi: [10.1016/j.recli.2016.08.001](https://doi.org/10.1016/j.recli.2016.08.001)
12. Alves ERP, Costa AM, Bezerra SMMS, Nakano AMS, Cavalcanti AMTS, Dias MD. Climatério: a intensidade dos sintomas e o desempenho sexual. *Texto Contexto Enferm.* 2015;24(1):64-71. doi: [10.1590/0104-07072015000590014](https://doi.org/10.1590/0104-07072015000590014)
13. Abdo CHN. Quociente sexual feminino: um questionário brasileiro para avaliara atividade sexual da mulher. *Diagn Tratamento.* 2009;14(2):89-1.
14. Kingsberg S. Hypoactive sexual desire disorder: When is low sexual desire a sexual dysfunction? *J Sex Med.* 2010;7(8):2907-2908. doi: [10.1111/j.1743-6109.2010.01948.x](https://doi.org/10.1111/j.1743-6109.2010.01948.x)
15. Santos SMP, Golçalves RL, Azevedo EB, Pinheiro AKD, Barbosa CA, Costa KNF. A vivência da sexualidade por mulheres no climatério. *Rev Enferm UFSM.* 2014;4(1):113-122. doi: [10.5902/217976928819](https://doi.org/10.5902/217976928819)
16. Correia LS, Brasil C, Silva MD, Silva DFC, Amorim HO, Lordêlo P. Função sexual e qualidade de vida de mulheres: um estudo observacional. *Rev Port Med Geral Fam.* 2016;32(6):405-409.
17. Valadares AL, Pinto Neto AM, Osis MJ, Conde DM, Sousa MH, Costa-Paiva L. Sexuality in Brazilian women aged 40 to 65 years with 11 years or more of formal education: associated factors. *Menopause.* 2008;15(2):264-269. doi: [10.1097/gme.0b013e31813c687d](https://doi.org/10.1097/gme.0b013e31813c687d)
18. Cavalcanti IF, Farias PN, Ithamar L, Silva VM, Lemos A. Função sexual e fatores associados à disfunção sexual em mulheres no climatério. *Rev Bras Ginecol Obstet.* 2014;36(11):497-502. doi: [10.1590/SO100-720320140004985](https://doi.org/10.1590/SO100-720320140004985)
19. Choi KB, Jang SH, Lee MY, Kim KH. Sexual life and self-esteem in married elderly. *Arch gerontol geriatr.* 2011;53(1):17-20. doi: [10.1016/j.archger.2010.08.011](https://doi.org/10.1016/j.archger.2010.08.011)
20. Gass ML, Cochrane BB, Larson JC, Manson JE, Barnabei VM, Brzyski RG et al. Patterns and predictors of sexual activity among women in the Hormone Therapy trials of the Women's Health Initiative. *Menopause.* 2011;18(11):1160-1171. doi: [10.1097/gme.0b013e3182227ebd](https://doi.org/10.1097/gme.0b013e3182227ebd)
21. Prairie BA, Scheier MF, Matthews KA, Chung-Chou HC, Hess R. Higher sense of purpose in life is associated with sexual enjoyment in midlife women. *Menopause.* 2011;18(8):839-844.
22. Batista NMTL, Oliveira AN, Nunes EFC, Latorre GFS. Força e coordenação motora da musculatura do assoalho pélvico e a função sexual feminina. *IJHE.* 2017;2(1):10-15. doi: [10.4322/ijhe.2016.013](https://doi.org/10.4322/ijhe.2016.013)