Supportive Care in Cancer (2019) 27:1171–1180
https://doi.org/10.1007/s00520-019-04667-7

REVIEW ARTICLE

Incidence and severity of sexual dysfunction among women with breast cancer: a meta-analysis based on female sexual function index

Liwei Jing[1,2] · Chao Zhang[3] · Wei Li[4] · Feng Jin[5] · Aiping Wang[6]

Received: 26 September 2018 / Accepted: 17 January 2019 / Published online: 2 February 2019

Abstract

Purpose Previous meta-analyses have examined the prevalence of sexual dysfunction among women with cancer, but there is no breast cancer (BC)-specific study. We therefore conducted a meta-analysis to examine the prevalence and severity of female sexual dysfunction (FSD) in women with BC.

Methods We searched PubMed, Embase, Cochrane Library, CNKI, WanFang Data, and VIP for relevant studies published between April 2000 and January 2017. Data were extracted from studies which assessed FSD prevalence and sexual function in women with BC using the female sexual function index (FSFI). Meta-analyses were performed by pooling the prevalence rates of FSD and total FSFI scores. Meta regression was performed to explore the sources of heterogeneity.

Results We selected 19 published studies involving a total of 2684 women with BC. In this study population, overall FSD prevalence was 73.4% (95% confidence interval (CI) 64.0%, 82.8%), and the total FSFI score was 19.28 (95% CI 17.39, 21.16). Among Asian, American, and European women with BC, there were significant differences in FSD prevalence ($P < 0.001$), and there was marginally significant difference ($P = 0.07$) in sexual function between these groups. There was also a marginally significant difference between individuals from mainland China and from other countries in FSD prevalence ($P = 0.06$) and FSFI score ($P = 0.07$).

Conclusions Overall, women with BC have high FSD prevalence and low sexual function. American women with BC have a higher average FSD prevalence and lower average sexual function than Asian women with BC. The FSD prevalence in women with BC in mainland China was slightly higher than in other countries.

Keywords Breast cancer · Female sexual function index · Female sexual dysfunction · Prevalence · Meta-analysis

Liwei Jing and Chao Zhang contributed equally to this work.

✉ Aiping Wang
jianghaoran88@hotmail.com

[1] National Academy of Development and Strategy, Renmin University of China, No. 59 Zhongguancun Street, Haidian District, Beijing 100872, China

[2] College of Nursing and Rehabilitation, North China University of Science and Technology, No.21 Bohai Road, Caofeidian District, Tangshan 063210, Hebei, China

[3] Affiliated Hospital of North China University of Science and Technology, Tangshan 063210, Hebei, China

[4] Radiotherapy Department, Tangshan People's Hospital, No.65 Shengli Road, Lunan District, Tangshan 063001, Hebei, China

[5] Breast Surgery, First Affiliated Hospital of China Medical University, Heping District, Nanjing street, No. 155, Shenyang 110001, Liaoning, China

[6] Department of Nursing, First Affiliated Hospital of China Medical University, Heping District, Nanjing street, No. 155, Shenyang 110001, Liaoning, China

Introduction

Breast cancer (BC) is the most common form of cancer globally and the most commonly reported cause of cancer-related deaths among women [1]. Advances in the diagnosis and treatment of BC have improved long-term survival of due to which an increasing number of women are now surviving from BC. The 5-year survival rate for BC patients is approximately 76–92% globally [2], and approximately 80% in China [3] after systematic treatment. Female sexual dysfunction (FSD), which includes abnormalities in sexual desire, arousal, lubrication, satisfaction, orgasm, and dyspareunia, is one of the most common complications in women with BC [4].

In 2000, Rosen et al. [4] published the female sexual function index (FSFI), which assesses the abovementioned six sexual function-related domains. FSFI is currently one of the most widely used tools to assess female sexual function. It can be employed to assess the sexual feelings and

reactions of subjects during the previous 4 weeks prior to assessment. FSD is usually indicated by an FSFI score < 26.5. The FSFI can be used for self-assessment, and the survey has been used successfully in patients with malignant tumors. The prevalence of FSD [5–9] and the range of sexual function scores in women with BC differ greatly among published studies [5, 7, 10–13]. To our knowledge, there is no meta-analysis of the studies which estimated the prevalence of FSD and the degree of sexual function in women with BC using the FSFI in literature. This study was therefore designed to estimate FSD prevalence and assess sexual function in women with BC based on the FSFI scores. These results can be used to provide guidance for the clinical care of women with BC, and will offer an objective basis for health decision-making in this growing population.

Materials and methods

This meta-analysis was performed by following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines.

Literature database search strategy

We searched PubMed, Embase, the Cochrane Library, the Chinese National Knowledge Infrastructure Database (CNKI), the Chinese Wan Fang Database (WanFang Data), and the Chongqing VIP database (VIP), and retrieved Chinese and English FSFI studies examining FSD prevalence and sexual function in women with BC published between April 2000 and January 2017. We also manually searched the references sections of the selected papers to explore additional relevant literature. These searches were performed using a combination of subject words and keywords, which included the phrases "breast neoplasm" and "female sexual function". The following search string was used in PubMed: ((((((((((((((((((((((((((breast neoplasm) OR neoplasm, breast) OR neoplasms, breast) OR tumors, breast) OR breast tumors) OR breast tumor) OR tumor, breast) OR mammary neoplasms, human) OR human mammary neoplasms) OR neoplasm, human mammary) OR neoplasms, human mammary) OR mammary neoplasm, human) OR mammary carcinoma, human) OR carcinoma, human mammary) OR carcinomas, human mammary) OR human mammary carcinomas) OR mammary carcinomas, human) OR human mammary carcinoma) OR breast cancer) OR cancer, breast) OR cancer of breast) OR mammary cancer) OR malignant neoplasm of breast) OR malignant tumor of breast) OR breast carcinoma) OR cancer of the breast) AND (female sexual function).

Study selection and data extraction

Literature screening, data extraction, and cross-checking were carried out independently by two authors with the assistance of an expert in epidemiology and statistics. Disagreements regarding study selection were resolved in consultation with the fourth author. Relevant variables including name of the first author, year of publication, age, country and continent where the study was performed, type of study design, sample size, FSD prevalence, total FSFI score, intervention/exposure factors, and follow-up time were extracted according to a preformatted data extraction table. Missing data were obtained by contacting the authors of the respective studies. These variables were entered into Excel to create a database. The prevalence of FSD in women with BC was the primary endpoint of the present study.

The inclusion criteria were as follows: study (1) published in English or Chinese language; (2) published between April 2000 and January 2017 as the FSFI was first proposed in April 2000; (3) design was either observational (including cohort studies and cross-sectional studies) or interventional (including randomized controlled trial, and quasi-experimental studies); (4) participants were the female patients diagnosed with BC, regardless of race or disease course; (5) used FSFI to examine sexual function of women with BC during or after BC treatment (surgery, chemotherapy, radiotherapy, or endocrine therapy); and (6) recruited > 30 participants.

The exclusion criteria were as follows: (1) repeat studies with the same sample populations; (2) reviews, case reports, conference abstracts, letters, or comments; (3) the full text was unavailable; (4) the study subjects included non-BC, male, female homosexual, female bisexual, or transgender patients; and (5) the FSFI assessment was applied inappropriately in the study.

Quality assessment

As described by the assessment principles in JBI-MAStARI [14], quality assessment of the included studies was performed independently by the first and second authors, and disagreements were resolved by consensus or with the involvement of the fourth author, if necessary. There were 10 assessment items, with a total score of 0–10 (1 point per item) for quasi-experimental studies, and 9 assessment items with a total score of 0–9 (1 point per item) for cohort studies and cross-sectional studies; 1 was for "Yes" and 0 was for "No" or "Unknown". Studies with a quality score ≤ 4 were deemed to be of low quality, those with a quality score of 5–6 were deemed to be of medium quality, and those with a quality score ≥ 7 were deemed to be of high quality. All studies with a quality score ≥ 5 were included in this meta-analysis.

Statistical analysis

Meta-analysis of FSD prevalence rate or total FSFI scores was conducted using STATA software version 14.0 by pooling these indices and their 95% confidence intervals (CI) reported by the individual studies under random effects model. The statistical heterogeneity was assessed with I^2 and the Q test. $I^2 < 50\%$ and $P > 0.05$ (Q test) indicate low/moderate heterogeneity among included studies. Sensitivity analyses were performed by sequentially excluding studies and then observing the robustness of any changes in results. The publication bias of included studies was analyzed with Begg's rank test and Egger's regression analysis; $P > 0.05$ (for both Begg's rank test and Egger's regression analysis) indicates the absence of publication bias. Subgroup analyses were performed according to the age, publication year, area (country and continent) where the study was performed, sample size, type of study design, and study quality. Meta-regression analyses were performed using the CMA software version 2.0 to further explore the sources of heterogeneity.

Results

Literature search results

A total of 224 studies were identified, and 19 studies involving 2684 women with BC were ultimately included in this meta-analysis [5–13, 15–24] (Fig. 1). Fifteen of these studies analyzed FSD prevalence in women with BC ($n = 2137$) and 15 studies analyzed the total average FSFI scores in women with BC ($n = 2062$). Eleven of the 19 studies analyzed both FSD prevalence and female sexual function measured with FSFI.

Basic characteristics and quality of included studies

Important characteristics of the included studies are presented in Table 1. Four studies were published in Chinese, and 15 studies in English language. The studies were conducted in the following areas: East Asia, 6 studies [5, 6, 10, 15–17]; West Asia, 3 studies [8, 9, 12]; North America, 4 studies [11, 18, 19]; South America, 4 studies [11, 18, 19, 22]; Europe, 1 study [22]; Africa, 1 study [23]. Four studies were interventional [7, 9, 18, 19], all with quasi-experimental designs, and the remaining 15 studies were observational, including 3 cohort [6, 8, 15], and 12 cross-sectional studies [5, 10–13, 16, 17, 20–24].

Fifteen studies reported sufficient data to permit for a meta-analysis of the prevalence of FSD, including 3 quasi-experimental studies [7, 9, 19], 3 cohort studies [6, 8, 15], and 9 cross-sectional studies [5, 10–12, 16, 21–24]. These 15 studies included 2137 women with BC, of whom 1488 experienced FSD. Fifteen studies provided sufficient data to permit for a meta-analysis of total FSFI scores, including 3 quasi-experimental studies [9, 18, 19], 1 cohort study [8], and 11 cross-sectional studies [5, 10–13, 16, 17, 20, 22–24]. These 15 studies included a total of 2062 women with BC. The follow-up time in the quasi-experimental or cohort studies ranged from 30 days to 12 months. Most of the included studies described at least two or more clinical and demographic variables including age, sexual partners, and marital status. The clinical variables included the clinical stage, therapy, and surgery for BC. The quality of all included studies was medium or high.

Meta-analysis results

The heterogeneity test results of the 15 studies analyzing the FSD prevalence in women with BC indicated that there was significant heterogeneity among these studies ($I^2 = 98.8\%$, $P < 0.01$). Therefore, pooling was conducted under random effect model. The FSD prevalence in women with BC was thus found to be 73.4% (95% CI 64.0%, 82.8%) (Fig. 2).

The heterogeneity test results for the 15 studies evaluating the total FSFI scores of sexual function in women with BC indicated that there was significant heterogeneity among these studies ($I^2 = 97.60\%$, $P < 0.01$), so pooling was performed under random effect model. The average FSFI sexual function score in women with BC was 19.28 (95% CI 17.39, 21.16) (Fig. 3).

Subgroup analysis

To explore the sources of heterogeneity in this meta-analysis, subgroup analyses were performed with regard to the mean age, year of publication, country (mainland China and other countries), continent, sample size, type of study design, and literature quality for each study. The results showed that there were statistically significant regional differences between Asia, America, and Europe in FSD prevalence in women with BC ($P < 0.001$), and a marginally significant difference between mainland China and other countries ($P = 0.06$). However, there were no statistically significant differences among different ages, years of publication, sample sizes, types of study design, or literature quality ($P > 0.05$) (Table 2). There were marginally significant regional differences between Asia, America, and Africa ($P = 0.07$) and type of study design ($P < 0.05$) in total FSFI scores. There were no statistically significant differences among different ages, years of publication, countries (mainland China vs other countries), sample sizes, and literature quality ($P > 0.05$) in total FSFI scores (Table 3).

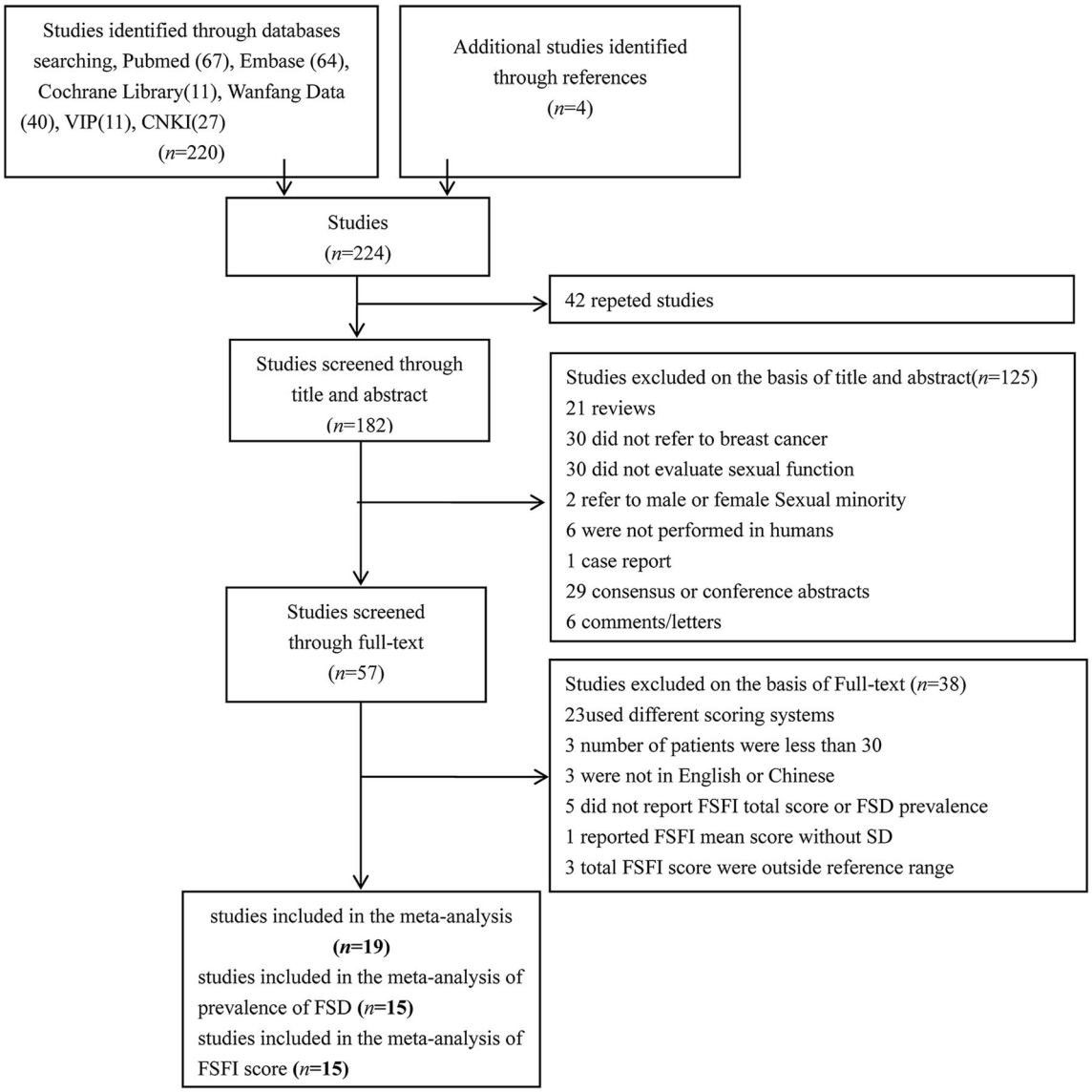

Fig. 1 Process of study screening and selection

Meta-regression analysis

To determine the sources of heterogeneity among the included studies, univariate meta-regression analyses were performed according to the mean age, year of publication, country, continent, sample size, type of study design, and quality of literature. The results revealed that different continents (America vs. Asia) were the main sources of heterogeneity in the meta-analysis of total FSFI scores in women with BC ($b = -4.05$, 95% CI 7.90, −0.20, $P = 0.04$). No other factors assessed in this meta-regression analysis were statistically significant.

Sensitivity analysis

For the sake of sensitivity analysis of the 15 studies included in the meta-analysis of the FSD prevalence among women with BC, we successively excluded either 4 studies from mainland China, one study from Europe, 5 studies with sample sizes < 100, and one study with the year of publication < 2012. The results revealed that the FSD prevalence in women with BC was 69.7% (95% CI 56.9%, 82.5%), 74.9% (95% CI 65.3%, 84.5%), 71.4% (95% CI 59.1%, 83.6%), and 73.9% (95% CI 64.1%, 83.7%), respectively, demonstrating no significant differences when compared to the results of overall meta-analysis (73.4%). This indicated that the study results were stable.

For sensitivity analyses of the 15 studies of the total FSFI scores in women with BC, we successively rejected either 3 studies from mainland China, one from Africa, 5 with a sample size < 100, and 3 with a publication year < 2012, and then sensitivity analyses were performed. The results showed that the total FSFI scores in women with BC were 19.53 (95% CI

Table 1 Characteristics and quality of the included studies

Study identity, Reference	Age	Continent	Country	Study type/cases	FSD	Total FSFI score			Intervene/exposure factors	Follow-up time	Literature quality (score)	Literature quality (grade)
					Number	Prevalence	Mean	SD				
Yang et al. 2015 [15]	51.0 ± 9.0	Asia	Mainland China	Cohort/115	96	88.78%	NA	NA	Surgery	3 months	6	Medium
Xie et al. 2016 [16]	36	Asia	Mainland China	Cross-sectional/98	87	83.81%	17.36	3.20	–	–	5	Medium
Qiang et al. 2015 [10]	43.7 ± 7.2	Asia	Mainland China	Cross-sectional/105	88	77.50%	20.86	4.53	–	–	5	Medium
Liu et al. 2015 [17]	44.9 ± 7.9	Asia	Mainland China	Cross-sectional/280	217	83.48%	16.70	4.93	–	–	6	Medium
Schover et al. 2014 [11]	63.4 ± 8.7	America	USA	Cross-sectional/129	120	93.02%	12.50	8.07	–	–	5	Medium
Schover et al. 2006 [19]	49.3 ± 8.4	America	USA	Quasi-experiment/47	31	65.96%	17.85	11.57	Peer counseling	3 months	8	High
Schover et al. 2011 [18]	54.4 ± 9.7	America	USA	Quasi-experiment/291	NA	NA	18.20	10.70	peer counseling	6–12 months	8	High
Sbitti et al. 2011 [20]	45.3 ± 5.2	Africa	Morocco	Cross-sectional/120	NA	NA	17.70	12.00	–	–	5	Medium
Safarinejad et al. 2013 [21]	37.2 ± 6.1	Europe	Italy	Cross-sectional/186	98	52.69%	NA	NA	–	–	7	High
Raggio et al. 2014 [22]	56.2 ± 8.8	America	USA	Cross-sectional/83	62	74.70%	16.89	10.92	–	–	5	Medium
Park et al. 2013 [5]	45.6 ± 7.1	Asia	Korea	Cross-sectional/200	124	62.00%	24.66	25.44	–	–	5	Medium
Paiva et al. 2016 [23]	52	America	Brazil	Cross-sectional/153	97	63.40%	20.62	9.17	–	–	6	Medium
Ozturk et al. 2016 [12]	47.0 ± 8.0	Asia	Turkey	Cross-sectional/100	NA	NA	27.44	4.86	–	–	6	Medium
Neto et al. 2013 [13]	48.7	America	Brazil	Cross-sectional/36	NA	NA	16.64	6.83	–		7	High
Lee et al. 2015 [6]	46	Asia	Korea	Cohort/269	85	31.60%	NA	NA	Surgery+hormonal therapy/chemotherapy	12 months	7	High
Juliato et al. 2017 [7]	48.8 ± 8.4	America	Brazil	Quasi-experiment/52	48	92.31%	NA	NA	Hormonal therapy	30 days	7	High
Harirchi et al. 2012 [8]	44.3 ± 8.6	Asia	Iran	Cohort/216	181	83.80%	22.10	5.89	Surgery+adjuvant therapy	3 months	6	Medium
Faghani et al. 2016 [9]	43.2 ± 4.6	Asia	Iran	Quasi-experiment/77	50	64.94%	21.30	6.60	Psychological intervention	4 weeks	7	High
Boquiren et al. 2016 [24]	49.0 ± 7.9	America	Brazil	Cross-sectional/127	104	81.89%	18.52	7.05	–	–	5	Medium

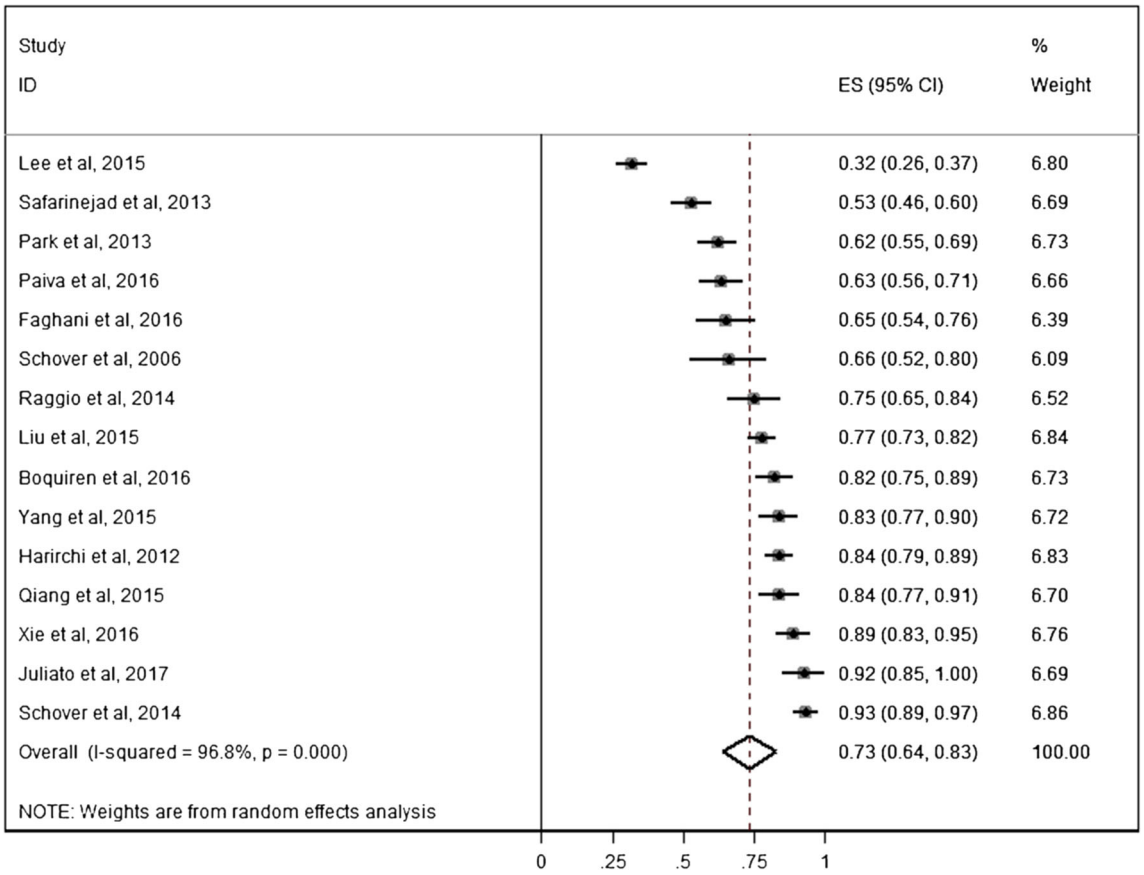

Fig. 2 Meta-analysis for the FSD prevalence in women with BC

17.00, 22.07), 19.38 (95% CI 17.42, 21.35), 19.88 (95% CI 17.30, 22.47), and 19.60 (95% CI 17.41, 21.79), respectively, demonstrating no significant differences when compared to the results of overall meta-analysis (19.28). This indicated that the study results were stable.

Assessment of publication bias

In the present study, funnel plots showed no significant asymmetry. Additionally, for both the meta-analysis of FSD prevalence and of the total FSFI scores in women with BC, no publication bias was detected based on Begg's rank test ($Z = 1.09$, $P = 0.276$; $Z = 0.20$, $P = 0.84$) or Egger's regression analysis ($t = -0.49$, $P = 0.629$; $t = 0.25$, $P = 0.807$).

Discussion

This study is the first FSFI-based meta-analysis of FSD prevalence and the sexual function scores focusing specifically on women with BC. The sample sizes of all included studies were ≥ 30. Sensitivity analyses indicated that the results were robust, and that there was no significant publication bias. The subgroup analyses indicated that neither FSD prevalence nor sexual function scores in women with BC were affected by age, year of publication, sample size, or quality of literature.

In this study, the pooled FSD prevalence in women with BC was 73.4% (95% CI 64.0%, 82.8%), which was greater than the 65.54% (95% CI 46.99%, 84.09%) previously reported by Maiorino et al. [25] This suggests that the FSD prevalence in women with BC is high, with approximately 75% of women with BC developing some degree of FSD. The above difference in FSD prevalence among women with BC may be because Maiorino et al. reviewed literature published through December 31, 2014, did not include Chinese literature databases in literature search, and therefore included 9 studies. In our meta-analysis, we reviewed literature by January 2017 and included 9 studies [6, 7, 9, 10, 15–17, 23, 24] published after 2015 of which four [10, 15–17] were published in mainland China. Laumann et al. [26] reported that 43% of American female patients developed FSD, whereas approximately 30–63% developed FSD in mainland China [27]. Our meta-analysis results indicate that the prevalence of FSD was higher in women with BC than in non-BC women, suggesting that women with BC constitute a high-risk group. This may be due to their BC-specific treatment experiences, such as body image changes after breast surgery, hormone treatments, changes in hormone levels after ovariectomy, and the physiological

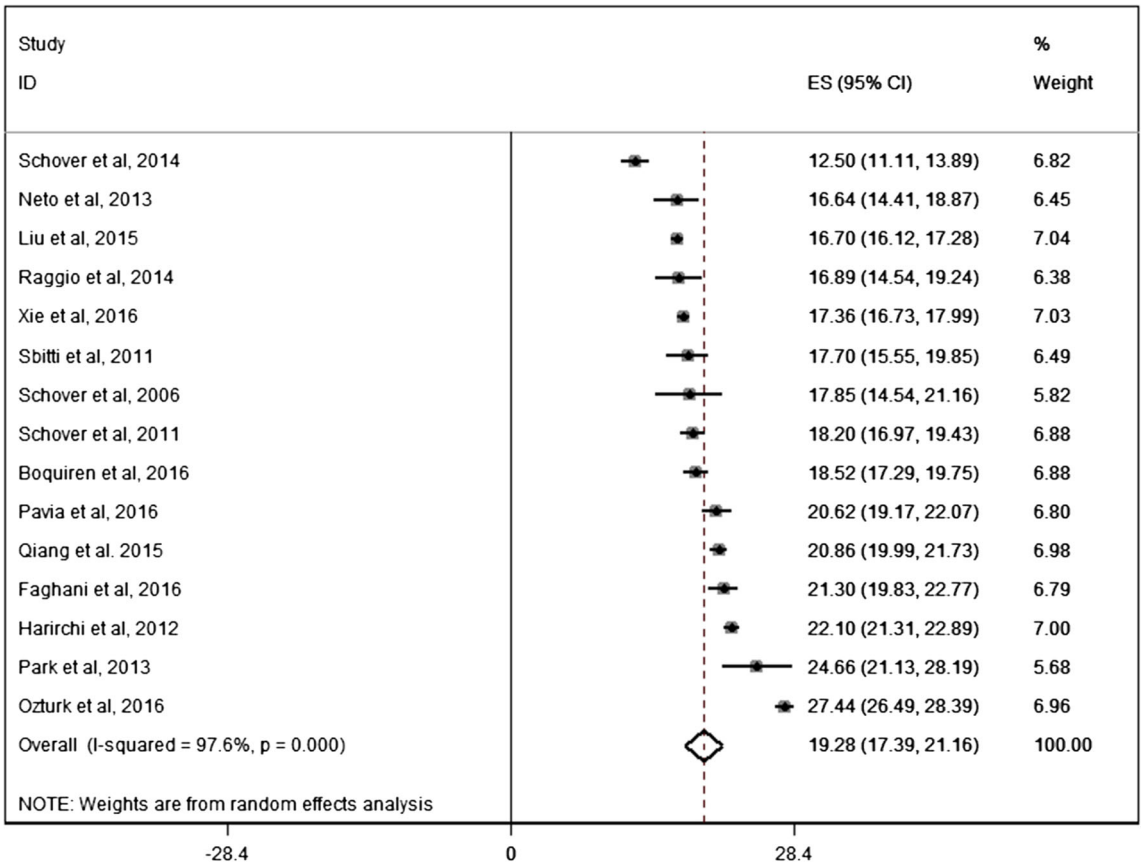

Fig. 3 Meta-analysis for the total FSFI score of sexual function in women with BC

and psychological effects of chemoradiotherapy. Given these findings, it is important that greater attention be paid to the sexual function changes affecting women with BC. These results may thereby help to increase the availability of assistance for women with BC who are facing sexual health problems.

Subgroup analysis showed that regarding FSD prevalence in women with BC, there were statistically significant regional differences between Asia, America, and Europe ($P < 0.001$), and a marginally significant difference between mainland China and other countries ($P = 0.06$). FSD prevalence in Asian, American, and European women with BC was 74.1% (95% CI 58.3%, 85.5%), 80.4% (95% CI 68.7%, 88.5%), and 52.7% (95% CI 45.5%, 59.8%), respectively. This indicates that the FSD is more prevalent in American women with BC as compared with those in Asia and Europe. These differences may be attributable to differences in ethnic, social, or cultural factors. In our meta-analysis, only one study was included in the European subgroup, therefore additional studies should be conducted to confirm the reliability of these regional differences. FSD prevalence in women with BC was 82.8% (95% CI 77.3%, 87.3%) in mainland China, which was higher than the 72.1% (95% CI 59.7%, 81.8%) observed in other countries, suggesting that Chinese women with BC are at a higher risk of developing FSD. In a survey of 609 non-BC women ≥ 20 years old who underwent a health checkup, Zhang et al. [28] found that FSD prevalence was 56.8% and that it increased with age, which was greater than 43% observed in American women [26]. This suggests that even among non-BC women, FSD prevalence is higher in mainland China than in America. Overall, there are no significant differences in BC diagnosis or treatment between America and China, so the differences in FSD prevalence in women with BC between these regions may instead be related to specific genetic or cultural factors. To date, there has been no epidemiological study comparing the risk factors for FSD in women with BC among different races or individuals from different continents.

Our meta-analysis revealed that total average FSFI score of women with BC was 19.28 (95% CI 17.39, 21.16), which was markedly lower than that in non-BC women (FSFI > 26.5 indicates normal sexual function), [4, 26] but consistent with the 19.58 (95% CI 17.64, 21.53) observed in the previous meta-analysis of Maiorino [25]. This indicates that the overall sexual function in women with BC is significantly worse than in non-BC women. The FSFI is an indicator that is based on sexual function and is affected by several social and psychological factors, with estrogen levels being the most important physiological factor influencing this sexual functionality.

Generally, natural menopause, drugs, or surgical castration can all contribute to reduced estrogen levels in women with

Table 2 Subgroup analysis for the prevalence of FSD in women with BC

Grouping factors		No. of studies	No. of women with BC	No. of FSD cases	Percent prevalence of FSD (95% CI)		Heterogeneity (I^2)	Q test among groups	*P* value*
Age	≤ 45	6	979	730	77.4	(63.9, 84.5)	92.47%	0.000	0.99
	> 45	9	1158	758	75.8	(60.6, 86.4)	95.88%		
Years of publication	< 2015	6	861	616	74.4	(60.5, 84.6)	93.40%	0.056	0.81
	≥ 2015	9	1276	872	76.5	(61.7, 86.8)	96.18%		
Country	Mainland China	4	598	488	82.8	(77.3, 87.3)	56.72%	3.504	0.06
	Other countries	11	1539	1000	72.1	(59.7, 81.8)	95.37%		
Continent	Asia	8	1360	928	74.1	(58.3, 85.5)	96.71%	17.11	0.000
	America	6	591	462	80.4	(68.7, 88.5)	87.99%		
	Europe	1	186	98	52.7	(45.5, 59.8)	–		
Sample size	> 100	10	1780	1210	73.8	(61.0, 83.6)	96.44%	0.368	0.54
	≤ 100	5	357	278	78.7	(66.1, 87.5)	82.10%		
Study design	Quasi-experiment	3	176	129	75.8	(56.0, 88.5)	82.15%	0.175	0.92
	Cohort	3	600	362	69.5	(27.8, 93.1)	98.64%		
	Cross-sectional	9	1361	997	77.0	(67.9, 84.1)	91.97%		
Literature quality	High	5	713	401	71.8	(47.5, 87.7)	96.69%	0.286	0.59
	Medium	10	1424	1087	77.4	(71.0, 82.7)	85.17%		

*Compare Q test's *P* value among groups

BC, and these reduced levels can induce or aggravate FSD, ultimately leading to manifestations of sexual dysfunction such as the absence of sexual desire, reduced sexual arousal, lack of vaginal lubrication, pain during intercourse, difficulty achieving orgasm, and genital hypoesthesia. The age, education, income, surgical procedures, chemoradiotherapy, and hormone treatments undergone by women with BC may all directly or indirectly affect one or more of these symptoms [29, 30] thus reducing their FSFI scores. The quality of one's sex life is an important dimension of overall quality of life,

Table 3 Subgroup analysis for the total FSFI of sexual function in women with BC

Grouping factors		No. of studies	No. of women with BC	Total FSFI score (95% CI)		Heterogeneity (I^2)	Q test among groups	*P* value*
Age	≤ 45	5	776	19.69	(17.36~21.91)	97.66%	0.070	0.79
	> 45	10	1286	19.09	(15.75~22.43)	97.68%		
Years of publication	< 2015	8	1122	18.24	(15.38~21.10)	95.74%	1.096	0.30
	≥ 2015	7	940	20.39	(17.56~23.22)	98.57%		
Country	Mainland China	3	483	18.28	(16.07~20.45)	96.86%	0.530	0.47
	Other countries	12	1579	19.53	(17.00~22.07)	97.28%		
Continent	Asia	7	1076	21.40	(18.48~24.32)	98.71%	5.425	0.07
	America	7	866	17.32	(15.15~19.48)	91.66%		
	Africa	1	120	17.70	(15.55~19.85)	–		
Sample size	> 100	10	1721	19.88	(17.30~22.47)	98.28%	1.196	0.27
	≤ 100	5	341	18.09	(16.75~19.99)	84.07%		
Study design	Quasi-experiment	3	415	19.27	(16.88~21.67)	81.61%	9.592	0.01
	Cohort	1	336	22.10	(21.31~22.89)	–		
	Cross-sectional	11	1311	19.04	(16.65~21.43)	98.04%		
Literature quality	High	4	451	17.16	(13.35~20.98)	96.07%	1.656	0.20
	Medium	11	1611	20.05	(17.86~22.25)	97.89%		

* Compare Q test's *P* value among groups

which is reduced by sexual hypofunction. Therefore, changes in the sexual function in women with BC should be evaluated both at baseline prior to surgery and at different phases during treatment in order to facilitate the early detection and diagnosis of FSD. We also suggest that sexual function-related care should be incorporated into routine care assessments, follow-ups, and interventions among women with BC to improve sexual function and quality of life.

The subgroup analysis showed that there were marginally significant regional differences between Asia, America, and Africa with regard to the sexual function scores of women with BC ($P = 0.07$), and the pooled total FSFI scores for these regions were 21.40 (95% CI 18.48, 24.32), 17.32 (95% CI 15.15, 19.48), and 17.70 (95% CI 15.55, 19.85), respectively. This suggests that the average sexual function of American women with BC is worse than that of Asian and African women with BC, which may be attributed to a clustering phenomenon. This clustering phenomenon may itself be associated with regional differences in culture, sex education, race, and hospital treatment methods [31–34]. There were also significant differences among different types of study designs ($P < 0.05$), which may be related to the literature quality associated with these different types of studies. Cohort studies and quasi-experimental studies are generally of good quality because they comply with the causal sequence and can effectively avoid recall bias. Cross-sectional studies are easily influenced by recall bias and reporting biases and can therefore be of poor quality.

In our meta-analysis, the results showed a high degree of heterogeneity. The subgroup analyses suggest that the sources of heterogeneity include different countries and continents where the studies were performed, as well as the different types of study designs. The meta-regression analysis further indicated that different areas where the studies were performed (America vs. Asia) were the primary sources of heterogeneity. Heterogeneity can also be associated with the following factors: (1) there are no objective standards for the diagnosis and assessment of FSD, and the FSFI is a self-report-based scale with subjective assessment results. (2) Different language translations of the FSFI were used across studies, and investigators interpreted these results privately with unknown scoring methods, potentially resulting in differences in patient comprehension and causing inconsistencies in the reliability and comparability of these results. (3) Some studies failed to completely report on or lacked any report of menopause, sexual partners, marital status, clinical stage, of therapeutic regimen. Therefore, we were unable to perform subgroup analyses based on these clinical and demographic factors to identify other potential sources of heterogeneity. Our subgroup analyses of the ages of subjects, the years of publication, sample sizes, and the quality of literature also failed to reduce this heterogeneity. The heterogeneity in the single-arm meta-analysis was primarily affected by differences in the sample size among the included studies, which is difficult to entirely control for, but it did not have a decisive impact on the accuracy of our study results [35]. Our meta-analysis results are more objective than the results of any one individual study.

This study has the following limitations. (1) Only studies in which the sexual function of women with BC was assessed using FSFI were included. (2) Single-arm observational studies were the dominant type of study design for the included studies. (3) The literature quality of included studies was mediocre. (4) The available studies all had a small sample size. (5) The available literature failed to investigate the severity of FSD more in depth via patient stratification. (6) We also could not conduct subgroup analysis for clinical stage, treatment regimen, and other possible factors that could have affected the outcomes achieved herein.

Conclusion

The regional differences of studies included in our meta-analysis introduced significant heterogeneity. Taken together, our results confirm that women with BC have a high prevalence of FSD and lower average sexual function. Relative to those in Asia, women with BC in America have a higher prevalence of FSD and lower average sexual function. FSD prevalence among women with BC is greater in mainland China than in other countries or areas. To improve the sexual health and quality of life for women with BC, active interventions aimed at treating or preventing FSD should be provided to patients during the diagnosis, treatment, and follow-up of BC.

Acknowledgements We thank Guangxiao Li, Department of Clinical Epidemiology and Evidence-based Medicine of China Medical University, for his kindly help.

Funding information This study was supported by National Natural Science Foundation of China (No. 81803106), Ph.D. Foundation of North China University of Science and Technology (No. BS2017057).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Human and animal rights This article does not contain any studies with human participants performed by any of the authors.

References

1. Joanna Briggs Institute Reviewers' Manual 2011 Edition [EB/OL] (2013-12-21). http://joannabriggs.org/Documents/sumari/Reviews%20Manual-2011.pdf. Accessed 18 Jan 2017.
2. Bartula I, Sherman KA (2013) Screening for sexual dysfunction in women diagnosed with breast cancer: systematic review and recommendations. Breast Cancer Res Treat 141:173–185
3. Bo Chen LZ (2013) Epidemiology progress on the influencing factors of female sexual dysfunction. Chin J Obstr Gynecol 48: 385–387
4. Boquiren VM, Esplen MJ, Wong J, Toner B, Warner E, Malik N (2016) Sexual functioning in breast cancer survivors experiencing body image disturbance. Psychooncology 25:66–76
5. Du J, Ruan X, Gu M, Bitzer J, Mueck AO (2016) Prevalence of and risk factors for sexual dysfunction in young Chinese women according to the female sexual function index: an internet-based survey. Eur J Contracept Reprod Health Care 21:259–263
6. Faghani S, Ghaffari F (2016) Effects of sexual rehabilitation using the PLISSIT model on quality of sexual life and sexual functioning in post-mastectomy breast cancer survivors. Asian Pac J Cancer Prev 17:4845–4851
7. Harirchi I, Montazeri A, Zamani Bidokhti F, Mamishi N, Zendehdel K (2012) Sexual function in breast cancer patients: a prospective study from Iran. J Exp Clin Cancer Res 31:20
8. Huber C, Ramnarace T, McCaffrey R (2006) Sexuality and intimacy issues facing women with breast cancer. Oncol Nurs Forum 33: 1163–1167
9. Juliato PT, Rodrigues AT, Stahlschmidt R, Juliato CR, Mazzola PG (2017) Can polyacrylic acid treat sexual dysfunction in women with breast cancer receiving tamoxifen? Climacteric 20:62–66
10. Laumann EO, Paik A, Rosen RC (1999) Sexual dysfunction in the United States: prevalence and predictors. JAMA 281:537–544
11. Lee M, Kim YH, Jeon MJ (2015) Risk factors for negative impacts on sexual activity and function in younger breast cancer survivors. Psychooncology 24:1097–1103
12. Liao MN, Chen SC, Lin YC, Chen MF, Wang CH, Jane SW (2014) Education and psychological support meet the supportive care needs of Taiwanese women three months after surgery for newly diagnosed breast cancer: a non-randomised quasi-experimental study. Int J Nurs Stud 51:390–399
13. Maiorino MI, Chiodini P, Bellastella G, Giugliano D, Esposito K (2016) Sexual dysfunction in women with cancer: a systematic review with meta-analysis of studies using the female sexual function index. Endocrine 54:329–341
14. Morton H, Gorzalka BB (2013) Cognitive aspects of sexual functioning: differences between East Asian-Canadian and Euro-Canadian women. Arch Sex Behav 42:1615–1625
15. Neto MS, de Aguiar Menezes MV, Moreira JR, Garcia EB, Abla LE, Ferreira LM (2013) Sexuality after breast reconstruction post mastectomy. Aesthet Plast Surg 37:643–647
16. Ozturk D, Akyolcu N (2016) Assessing sexual function and dysfunction in Turkish women undergoing surgical breast cancer treatment. Jpn J Nurs Sci 13:220–228
17. Paiva CE, Rezende FF, Paiva BS, Mauad EC, Zucca-Matthes G, Carneseca EC, Syrjanen KJ, Schover LR (2016) Associations of body mass index and physical activity with sexual dysfunction in breast cancer survivors. Arch Sex Behav 45:2057–2068
18. Park H, Yoon HG (2013) Menopausal symptoms, sexual function, depression, and quality of life in Korean patients with breast cancer receiving chemotherapy. Support Care Cancer 21:2499–2507
19. Quintard B, Constant A, Lakdja F, Labeyrie-Lagardere H (2014) Factors predicting sexual functioning in patients 3 months after surgical procedures for breast cancer: the role of the sense of coherence. Eur J Oncol Nurs 18:41–45
20. Raggio GA, Butryn ML, Arigo D, Mikorski R, Palmer SC (2014) Prevalence and correlates of sexual morbidity in long-term breast cancer survivors. Psychol Health 29:632–650
21. Rosen R, Brown C, Heiman J, Leiblum S, Meston C, Shabsigh R, Ferguson D, D'Agostino R Jr (2000) The female sexual function index (FSFI): a multidimensional self-report instrument for the assessment of female sexual function. J Sex Marital Ther 26:191–208
22. Safarinejad MR, Shafiei N, Safarinejad S (2013) Quality of life and sexual functioning in young women with early-stage breast cancer 1 year after lumpectomy. Psychooncology 22:1242–1248
23. Sbitti Y, Kadiri H, Essaidi I, Fadoukhair Z, Kharmoun S, Slimani K, Ismaili N, Ichou M, Errihani H (2011) Breast cancer treatment and sexual dysfunction: Moroccan women's perception. BMC Womens Health 11:29
24. Schover LR, Baum GP, Fuson LA, Brewster A, Melhem-Bertrandt A (2014) Sexual problems during the first 2 years of adjuvant treatment with aromatase inhibitors. J Sex Med 11:3102–3111
25. Schover LR, Jenkins R, Sui D, Adams JH, Marion MS, Jackson KE (2006) Randomized trial of peer counseling on reproductive health in African American breast cancer survivors. J Clin Oncol 24: 1620–1626
26. Schover LR, Rhodes MM, Baum G, Adams JH, Jenkins R, Lewis P, Jackson KE (2011) Sisters peer counseling in reproductive issues after treatment (SPIRIT): a peer counseling program to improve reproductive health among African American breast cancer survivors. Cancer 117:4983–4992
27. Shaohua Liu WQ, Chen Y, Wang Q, Li X (2015) Study for the influencing factors on the quality of life for women with breast cancer undergoing post-operative chemotherapy. J Nurs Training 30:2115–2118
28. Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A (2015) Global cancer statistics, 2012. CA Cancer J Clin 65:87–108
29. Wanmin Qiang SL, Wu P, Chen Y, Liu X (2015) The investigation of influencing factors on sexual life of the breast cancer patients undergoing chemotherapy. Tianjin J Nurs 23:213–215
30. Wanqing Chen RZ (2015) Incidence, mortality and survival analysis of breast cancer in China. Chin J Clin Oncol 13:173–185
31. Yang X (2015) Sexual function evaluation on the surgery or not of the breast cancer patients. Mod Med 04:493–495
32. Yule M, Woo JS, Brotto LA (2010) Sexual arousal in East Asian and Euro-Canadian women: a psychophysiological study. J Sex Med 7:3066–3079
33. Zhang AX, Pan LJ, Chen XY, Pan F, Kan YJ (2011) An investigation on female sexual dysfunction among urban Chinese women in Nanjing. Zhonghua Nan Ke Xue 17:488–491
34. Zhifen Xie QW, Zheng X, Ouyang C, Li L, Gong H, Zhang S (2016) Relationship between posttraumatic growth and quality of sexual life for productive breast cancer women after radical mastectomy. J Nurs Sci 31:15–18
35. Zhou ES, Falk SJ, Bober SL (2015) Managing premature menopause and sexual dysfunction. Curr Opin Support Palliat Care 9: 294–300