Preplanned Studies

Depressive Symptoms and Sleep Duration as Risk Factors for Breast Cancer — China, 2020

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Summary

What is already known about this topic?

Psychological and lifestyle factors are known to potentially play a significant role in the development of breast cancer. However, current evidence-based studies present controversial findings on the associations between depression, sleep duration, and breast cancer risk.

What is added by this report?

This study investigated the potential risk factors of depressive symptoms and short sleep duration for breast cancer within the Breast Cancer Cohort Study in Chinese Women. The findings revealed that women experiencing depressive symptoms and short sleep duration exhibited a heightened risk of developing breast cancer, particularly among the older population.

What are the implications for public health practice?

Public policy ought to prioritize early health education interventions targeting psychological factors in order to facilitate the prevention of breast cancer.

Breast cancer is the most common cancer and a leading cause of morbidity and mortality among women worldwide (*1*). In China, approximately 420,000 new breast cancer cases occur annually, accounting for 16.72% of all new cancer cases. Psychological and lifestyle factors, such as depression and poor sleep, may be more prevalent among breast cancer patients. Depression significantly impacts individuals' daily lives, affecting approximately 300 million people worldwide (*2*). In China, the prevalence rates of depression are 5.4% for women and 2.7% for men (*3*). Sleep is essential for emotional and physical health, and poor sleep habits may increase the risk of cancer and mental disorders (*4*). Persistent insomnia can exacerbate depressive symptoms; indeed, sleep disorders and depression often co-occur and interact. The roles of depression and sleep duration in breast cancer development have been investigated in numerous studies, but the results have been inconsistent.

This study aimed to examine the associations of depressive symptoms and sleep duration with breast cancer among Chinese women using data from the breast cancer cohort study in Chinese women (BCCS-CW). Our findings indicated that women with depressive symptoms experienced an increased risk of breast cancer, particularly in middle-aged and elderly age groups. These results suggest that breast cancer prevention measures and interventions should consider addressing psychological factors.

The BCCS-CW is a large prospective study conducted by the Chinese Center for Disease Control and Prevention across three provincial disease control centers and nine hospitals. The study collected standardized population-based data from Chinese Han women diagnosed with breast cancer. The study design has been previously reported in detail (*5*). The Ethics Committee of the Chinese Center for Disease Control and Prevention provided approval for the BCCS-CW study, and all participants gave written informed consent prior to participating in face-to-face interviews.

Between 2018 and 2020, the BCCS-CW enrolled 112,118 women who had previously been recruited for a population-based cohort study in 2008. A total of 63,495 women had standardized information collected for analysis in this study. However, only 63,018 participants were included in the final analysis. A total of 477 participants were excluded due to missing data for essential variables, depression scores, or sleep duration, or because of the presence of extreme values.

During the BCCS-CW, multiple data collection methods were employed, including questionnaires, physical measurements, surgical examinations, breast ultrasound and mammography, as well as laboratory tests. A self-developed questionnaire, validated by experts, was utilized to gather basic information via standardized face-to-face interviews carried out by trained and qualified interviewers. The collected data

encompassed demographic characteristics such as age and education level.

Depression was assessed in this study using the Center for Epidemiological Studies-Depression (CES-D) Scale, which is included in the BCCS-CW questionnaire and was originally developed for assessing depressive symptomatology in the general population. The CES-D Scale consists of 20 items that evaluate the feelings and behaviors of participants during the previous week. Each item is scored on a scale from 0 (not at all) to 3 (a lot), with higher CES-D scores indicative of more severe depressive symptoms. The total CES-D score ranges from 0 to 60, and scores over 19 are considered reflective of depression.

In this study, participants self-reported their sleep duration in response to the question: "In the past month, how much sleep did you get per night (in hours and minutes)?" Sleep durations ranging from 1 to 23 hours were considered valid and recorded in hours and minutes. Sleep duration was then categorized as follows: <7 hours, ≥7 hours and <9 hours (reference range), or ≥9 hours. Sleep satisfaction was assessed using a 5-point Likert scale, with questionnaire items scored as 1 for very satisfied, 2 for satisfied, 3 for neutral, 4 for dissatisfied, and 5 for very dissatisfied.

Statistical analyses were conducted using SPSS (version 25.0; IBM Corp., Armonk, NY, USA) and R (version 4.2.0; R Development Core Team, Vienna, Austria) software. Continuous data were reported as means±standard deviations, while categorical data were presented as numbers (percentages). For continuous variables, t-tests and analyses of variance were employed, whereas the chi-squared test was applied to categorical variables. Logistic regression analysis was utilized to calculate odds ratios (*OR*s) and 95% confidence intervals (*CI*s).

To identify factors associated with depression and sleep duration, univariate and multivariate logistic regression models were constructed employing the "enter" method, with breast cancer as the dependent variable. Significant factors in the univariate models were incorporated as independent variables in the multivariate model, which was adjusted for age, education, marital status, annual family income, and history of benign breast disease. A stratified analysis was also conducted according to menopausal status.

Trend tests were performed by categorizing sleep duration into three groups: less than 7 hours, between 7 and 9 hours, and 9 or more hours. Two-tailed *P*-

values of less than 0.05 were deemed statistically significant. The GGally R package was employed to create a matrix scatterplot depicting age groups, CES-D scores, and sleep duration.

A total of 63,018 Chinese women were included in the analysis, comprising 700 breast cancer cases. Baseline characteristics of the participants are displayed in Table 1. The average age at enrollment was 50.78±11.01 years. Among the participants, 53.05% had an education level of primary school or less, 68.29% had a monthly per capita household income of less than 3,000 CNY, 43.63% were postmenopausal, and more than 70% reported their families' economic and social status as average. There was a significant difference in age distribution between the breast cancer and control groups (t=7.35, P<0.001), and the mean CES-D score was higher in the breast cancer group (t=2.24, P=0.019). Additionally, the breast cancer group had a shorter sleep duration (t=−2.41, P=0.016) and a lower rate of sleep satisfaction compared to the control group (14.31% *vs.* 7.32%).

Figure 1 illustrates the distribution of depressive symptoms across various age groups. The average CES-D score and the likelihood of depression were observed to increase with age, particularly among older women. The prevalence of depression in each age group was as follows: 20–30 years, 3.2%; 31–40 years, 3.3%; 41–50 years, 2.8%; 51–60 years, 4.1%; 61–70 years, 5.8%; and >70 years, 6.9%.

Figure 2 displays the relationships among age group, CES-D score, and sleep duration, with linear correlations identified among these variables in both the breast cancer and control groups. For the entire cohort, a positive correlation was found between the CES-D score and age (r=0.130, P<0.001), whereas a negative correlation was observed between the CES-D score and sleep duration (r=−0.077, P<0.001). Additionally, a negative correlation was noted between sleep duration and age (r=−0.068, P<0.001).

The univariate logistic regression analysis revealed that the CES-D score, sleep duration, and sleep satisfaction were significantly associated with breast cancer risk (Table 2). After controlling for age, education level, average monthly income, and social status, participants with short sleep duration possessed an *OR* for incident breast cancer of 1.265 (95% *CI*: 1.045, 1.531), while those reporting low sleep satisfaction had an *OR* of 1.174 (95% *CI*: 1.071, 1.285).

Stratified analysis by menstrual status demonstrated that low sleep satisfaction (*OR*=1.162; 95% *CI*: 1.029,

TABLE 1. The demographic characteristics of the participants of the BCCS-CW, 2020.

Variable	Overall N (%)	Breast cancer N (%)	Control N (%)	t/χ^2	P value
Age, mean (SD)	50.78±11.01	53.34±9.22	50.75±11.02	7.35	<0.001
Sleep duration, mean (SD)	7.29±1.90	7.09±2.16	7.29±1.90	−2.41	0.016
CES-D score, median (IQR)	3.00 (7.00)	4.00 (6.00)	3.00 (7.00)	2.24	0.019
Education				8.60	0.014
Primary school and below	33,402 (53.05)	393 (56.30)	33,009 (53.01)		
Junior/senior high school/technical school	27,175 (43.16)	292 (41.83)	26,883 (43.18)		
Junior college and above	2,384 (3.79)	13 (1.87)	2,371 (3.81)		
Marital status				1.38	0.240
Unmarried	6,040 (9.58)	58 (9.29)	5,982 (9.60)		
Married	56,978 (90.42)	642 (91.71)	56,336 (90.40)		
Average monthly income, CNY				21.83	<0.001
<1,000	12,842 (20.40)	168 (24.07)	12,674 (20.36)		
1,000–2,999	30,147 (47.89)	355 (50.86)	29,792 (47.85)		
3,000–4,999	13,994 (22.23)	106 (15.19)	13,888 (22.31)		
≥5,000	5,978 (9.49)	69 (9.88)	5,909 (9.49)		
Menopause				89.64	<0.001
Yes	27,495 (43.63)	368 (52.57)	27,127 (43.53)		
No	32,453 (51.50)	258 (36.86)	32,195 (51.67)		
Benign breast disease history				2271.40	<0.001
Yes	933 (1.49)	162 (23.18)	771 (1.24)		
No	61,847 (98.51)	537 (76.82)	61,310 (98.76)		
Sleep satisfaction				33.55	<0.001
Very satisfied	13,542 (21.58)	96 (13.73)	13,446 (21.67)		
Satisfied	27,395 (43.65)	313 (44.78)	27,082 (43.64)		
Neutral	15,934 (25.39)	190 (27.18)	15,744 (25.37)		
Dissatisfied	5,502 (8.77)	94 (13.45)	5,408 (6.71)		
Very dissatisfied	382 (0.61)	6 (0.86)	376 (0.61)		
Economic status				22.72	<0.001
Very good	2,815 (4.47)	25 (3.58)	2,790 (4.48)		
Good	8,025 (12.75)	75 (10.74)	7,950 (12.77)		
Common	48,313 (76.73)	516 (73.93)	47,797 (76.77)		
Poor	3,333 (5.29)	67 (9.60)	3,266 (6.25)		
Very poor	475 (0.75)	15 (2.15)	460 (0.74)		
Social status				5.02	0.025
Very good	4,265 (6.77)	42 (6.02)	4,223 (6.78)		
Good	9,356 (14.86)	92 (13.18)	9,264 (14.88)		
Common	47,464 (75.39)	530 (75.93)	46,934 (75.38)		
Poor	1,659 (2.63)	30 (4.30)	1,629 (2.62)		
Very poor	217 (0.34)	4 (0.57)	213 (0.34)		

Abbreviation: IQR=interquartile range; BCCS-CW=the Breast Cancer Cohort Study in Chinese Women; SD=standard deviation; CNY=Chinese Yuan.

1.311) served as a risk factor for breast cancer in menopausal women (Table 3). In premenopausal women, both depression (OR=1.507; 95% CI: 1.010, 2.249) and low sleep satisfaction (OR=1.192; 95% CI: 1.024, 1.388) contributed to an elevated risk of breast cancer.
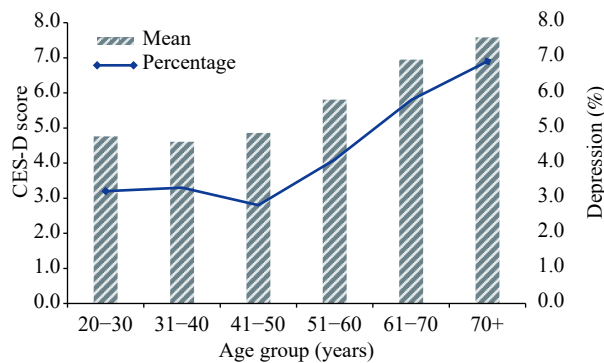
FIGURE 1. The distribution of depressive symptoms among Chinese women of different age groups in the BCCS-CW, 2020. Abbreviation: CES-D score=center for epidemiological studies-depression scale; BCCS-CW=the Breast Cancer Cohort Study in Chinese Women.

DISCUSSION

In this study, we examined population-based data from a large, ongoing prospective study involving Chinese Han women diagnosed with breast cancer. Our objective was to investigate whether depression and brief sleep duration serve as risk factors contributing to the onset of breast cancer. The findings suggest that depressive symptoms, limited sleep duration, and reduced sleep satisfaction could all be considered risk factors for the development of breast cancer. Consequently, it is crucial that preventive measures and interventions focus on addressing these psychological factors, given their potential impact on the progression of cancer.

Depression, a prevalent mental disorder, is characterized by its primary symptoms of low mood and anhedonia, which can significantly impede an individual's ability to lead a normal life. In this study, 4.4% of the female participants were found to be suffering from depression, with the CES-D scores displaying an increase with age. Notably, the highest prevalence of depression (6.9%) was observed among participants who were 70 years or older, aligning with findings from earlier studies (2).

Prior to accounting for potential confounders, our findings revealed an association between breast cancer incidence and depression, consistent with earlier prospective studies (6). Although multivariable logistic regression results did not corroborate this association across the entire cohort, it remained evident among the premenopausal population. Nevertheless, the overall epidemiological evidence supporting an association between depression and breast cancer remains inconclusive (7–8). Discrepancies among study findings may be attributed to variations in lifestyle and cultural factors across countries, as well as the inclusion of age groups with differing breast cancer incidence rates. To validate these findings, additional large-scale prospective cohort studies are warranted.

Insufficient sleep has been found to negatively impact individuals' health and increase the risk of cancer. Furthermore, poor sleep quality may contribute to compromised immune function and heightened risk of metabolic disorders, potentially leading to obesity and implications for melatonin release. However, the precise mechanisms underpinning these relationships remain elusive. In our study, we observed a link between low sleep satisfaction and increased risk of breast cancer among Chinese women. Specifically, we found that short sleep duration (OR=1.265, P=0.016) constituted a risk factor for breast cancer, while long sleep duration (OR=1.164, P=0.206) did not. Nevertheless, our subgroup analyses did not yield significant associations between sleep duration and breast cancer risk.

Notably, prior research investigating the connection between sleep and breast cancer has produced inconsistent findings (9). Several prospective studies and meta-analyses (10) have not substantiated the association between sleep duration and breast cancer risk. Potential explanations for these discrepancies include variations in criteria for categorizing sleep duration across studies as well as potential biases arising from participants' self-reported data.

The present study has several limitations that warrant acknowledgment. Firstly, the data were derived from the BCCS-CW study, in which depressive symptoms and sleep characteristics were assessed only once. Consequently, the analysis was restricted to examining the associations between depression, sleep duration, and sleep satisfaction with
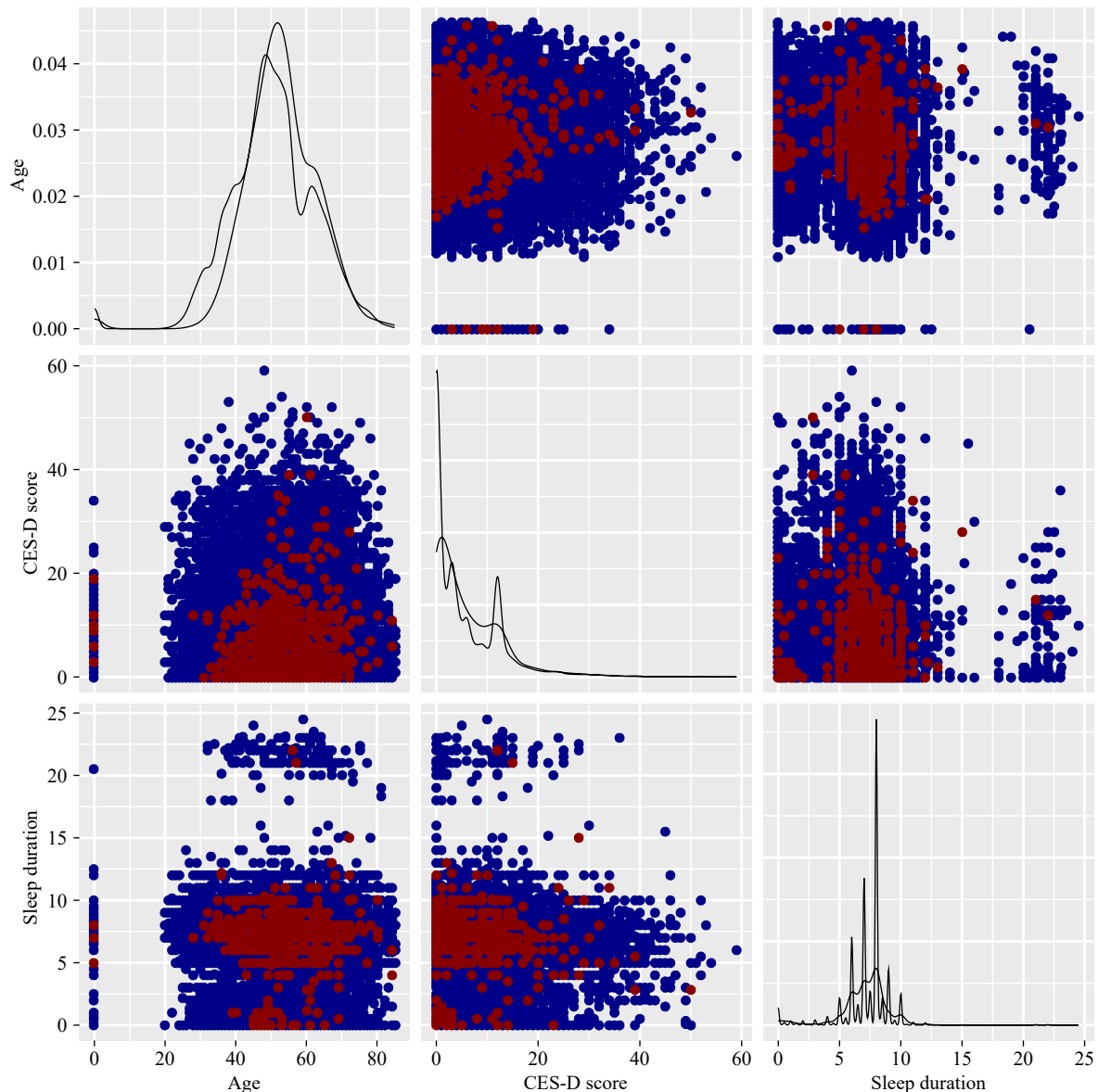
FIGURE 2. The correlation between age group, CES-D score, and sleep duration in the BCCS-CW, 2020.
Note: In the presented figure, red dots correspond to the breast cancer group, while blue dots represent the control group. The histograms positioned diagonally illustrate the distribution of age, CES-D scores, and sleep duration. Meanwhile, the scatterplots positioned above and below the diagonal display the relationships between these variables.
Abbreviation: CES-D score=center for epidemiological studies-depression scale. BCCS-CW=the Breast Cancer Cohort Study in Chinese Women.

breast cancer within the Chinese female population. Furthermore, it is only possible to hypothesize if these variables have a causal connection to breast cancer incidence. Lastly, potential information bias might exist due to the reliance on self-reported subjective feelings of participants for certain variables.

The results of this research suggest that public policy should prioritize early psychological interventions and health education as preventative measures for breast cancer, particularly in premenopausal women. Additionally, it is essential to conduct large-scale,

prospective cohort studies with follow-up assessments to determine the causal relationships and identify the most effective time for intervention.

TABLE 2. Univariate and multivariate logistical regression analyses of correlates of breast cancer.

Variable	Univariate analyses		Multivariate analyses	
	OR (95% *CI*)	*P* value	*OR* (95% *CI*)	*P* value
Age	1.021 (1.015, 1.028)	<0.001	1.021 (1.013, 1.030)	<0.001
CES-D score	1.102 (1.002, 1.023)	0.020	1.005 (0.994, 1.017)	0.359
Sleep satisfaction	1.263 (1.167, 1.367)	<0.001	1.174 (1.071, 1.285)	0.001
Average monthly income (CNY)	0.874 (0.800, 0.954)	0.003	0.966 (0.875, 1.067)	0.498
Social status	1.154 (1.108, 1.308)	0.025	0.988 (0.863, 1.132)	0.865
Education				
Primary school and below	Reference	1	Reference	1
Junior/senior high school/technical school	0.912 (0.783, 1.062)	0.238	1.156 (0.966, 1.384)	0.113
Junior college and above	0.461 (0.265, 0.801)	0.006	0.805 (0.450, 1.438)	0.463
Sleep duration				
7–9 h	Reference	1	Reference	1
<7 h	1.529 (1.281, 1.825)	<0.001	1.265 (1.045, 1.531)	0.016
≥9 h	1.148 (0.909, 1.449)	0.248	1.164 (0.920, 1.472)	0.206

Abbreviation: CES-D score=Center for epidemiological studies depression scale; *OR*=ddds ratio; *CI*=confidence interval; CNY=Chinese Yuan.

TABLE 3. Multivariate logistical regression analyses in the subgroups divided by menstrual status.

Variable	Menopausal		Premenopausal	
	OR (95% *CI*)	*P* value	*OR* (95% *CI*)	*P* value
Age	1.033 (1.018, 1.048)	<0.001	0.988 (0.974, 1.002)	0.092
Depression	0.145 (0.020, 1.036)	0.054	1.507 (1.010, 2.249)	0.045
Sleep satisfaction	1.192 (1.024, 1.388)	0.024	1.162 (1.029, 1.311)	0.015
Average monthly income (CNY)	1.088 (0.925, 1.281)	0.310	0.834 (0.724, 0.961)	0.012
Social status	1.033 (0.832, 1.283)	0.767	1.014 (0.832, 1.236)	0.891
Education				
Primary school and below	Reference	1.000	reference	1.000
Junior/senior high school/technical school	1.132 (0.848, 1.510)	0.399	1.192 (0.935, 1.520)	0.157
Junior college and above	0.757 (0.368, 1.556)	0.488	1.795 (0.556, 5.791)	0.328
Sleep duration				
7–9 h	Reference	1.000	reference	1.000
<7 h	1.322 (0.956, 1.828)	0.091	1.237 (0.956, 1.600)	0.106
≥9 h	1.135 (0.763, 1.688)	0.531	1.230 (0.896, 1.689)	0.201

Abbreviation: *OR*=Odds ratio; *CI*=Confidence interval; CNY=Chinese Yuan.

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