Original Article

Prevalence of Depression and Sleep Disturbances among Postmenopausal and Perimenopausal Women in Ernakulam District

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ABSTRACT

Background: The hormonal shifts and physiological changes during menopause, including perimenopause and postmenopause, significantly affect women's mental health, often causing depression and sleep disruptions. The objectives of this study are to estimate the prevalence of depression and sleep disturbances among perimenopausal and postmenopausal women and to find the associated risk factors. **Materials and Methods:** In a community setting, 462 women aged 45–60 years were chosen from 23 clusters using probability proportional to size sampling. Sociodemographic information was collected through standardized surveys, whereas depression levels were measured with Beck's Depression Inventory-II and sleep quality with the Pittsburgh Sleep Quality Index. Statistical analysis was done using SPSS version 21. **Results:** The prevalence of depression among the study participants was 33.3% (95% confidence interval [CI]: 29%, 37%), whereas poor sleep quality was found in 37% (95% CI: 36%, 39%). Factors such as low socioeconomic status (adjusted odds ratios [aOR] =1.64), recent negative life events (aOR =2.27), lack of social media usage (aOR =2.77), and being unmarried/ widowed (aOR =2.1) were identified as independent predictors of depression. Living in urban areas (aOR =1.69), low socioeconomic status (aOR =1.96), and inadequate intake of fruits and vegetables (aOR =0.43) were identified as independent predictors for sleep disturbances. **Conclusions:** This study highlights a notable burden of depression and sleep disruptions among menopausal women. Tackling these challenges necessitates accessible mental healthcare, educational workshops on stress management and sleep habits, nutritional guidance, and peer support networks. Incorporating these measures into health initiatives and policies holds promise for mitigating these concerns and enhancing overall well-being.

KEYWORDS: *Depression, perimenopause, postmenopause, sleep*

INTRODUCTION

*P*erimenopause and early postmenopause present challenges such as mood swings, sleep issues, and hot flashes, impacting work, relationships, and self-care.[1] Depression and sleep disturbances place a substantial burden on menopausal women, adversely affecting their quality of life and overall health. Limited awareness and poor adherence to lifestyle changes further contribute to significant mental and physical health challenges during menopause.[2] As the existing health policies fail to address the specific challenges faced by women approaching menopause,

healthcare professionals must identify at-risk women and tailor services to their needs, considering cultural norms and gender-sensitive approaches. This study aims to investigate the prevalence of depression and sleep disturbances among perimenopausal and postmenopausal women and identify potential predictors and risk factors.

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MATERIALS AND METHODS

Study design and setting

A community-based cross-sectional study was conducted in both rural and urban regions of Ernakulam District, situated in the central part of Kerala, Southern India. This district has a total population of 3,282,388, with 31.93% residing in rural areas and 68.07% in urban areas.[3]

Selection and description of participants

Inclusion criteria

Women in the age category of 45–60 years who are residing in that area for at least 6 months.

Exclusion criteria

- Women on hormonal therapy
- History of hysterectomy
- Women currently on treatment for psychiatric disorders.

Working definitions of perimenopausal and postmenopausal women

- Perimenopausal women were characterized as those who experienced irregular menstrual cycles, which were defined as periods lasting <23 days, more than 35 days, or differing by more than 5 days, or who had not experienced menstrual bleeding for less than a year[4]
- Women who reported not having their menses for longer than a year were considered postmenopausal.[4]

Sample size

Based on the previous research done by by Yadhav V *et al.*, the prevalence of depression among postmenopausal and perimenopausal women was 42.47%. Applying the formula, sample size, $n = (Z^2.1 - \alpha/2) P (1 - P)/d^2$ where, Z = constant, P = prevalence, $Q = 1 - P$, and d = error margin, with 95% confidence and relative error of 15%, the calculated sample size was found to be 231.

Sampling technique

A sampling frame of 64 community development blocks/towns within Ernakulam district was prepared using the 2011 District Census Handbook. The clusters were arbitrarily set to 20, including panchayat, municipality, and corporation areas. Due to the varying population sizes within these clusters, a probability proportional to size sampling method was used to ensure that each cluster's chance of being selected was proportional to its population size. The sampling interval was calculated as 156,742 by dividing the total population of 3,134,841 by the number of clusters 20. A random number was generated to select the first cluster, and subsequent clusters were chosen by adding the sampling interval to this random number. This method resulted in selecting 12 panchayats, 4 municipalities, and 4 divisions from Kochi Corporation. To achieve the required sample size of 462, a design effect of 2 was applied. This led to the selection of 23 or 24 individuals from each cluster.

Technical information

Sociodemographic factors such as age, education, marital status, occupation, residential area, family structure, and socioeconomic status were evaluated using a pretested semi-structured questionnaire. Depression severity was assessed with the Beck Depression Inventory II (BDI II), a 21-item tool rating depressive symptoms on a 4-point Likert scale (0–3), with total scores ranging from 0 to 63.[5] The scores 1–10 indicate normal ups and downs, 11–16 signifies mild mood disturbance, 17–20 suggest borderline clinical depression, 21–30 represent moderate depression, 31–40 indicate severe depression, and scores over 40 denote extreme depression.

The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality and patterns over the past month. This self-reported questionnaire evaluates seven components: Subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. It includes 19 self-rated questions and 5 questions for a roommate or bed partner, if available. The 19 self-rated items produce seven component scores, each ranging from 0 to 3.[6] The PSQI questions were graded on a scale from 0 (no difficulty) to 3 (extreme difficulty), producing scores that matched the scale's domains. A score of more than five was regarded as a substantial sleep disturbance. The values range from 0 to 21.[7]

A digital sphygmomanometer was used to measure the blood pressure. Two readings were taken at 20 minutes interval, and the average of these 2 values was considered the final blood pressure value for that patient.

Weight (in kg) was measured using a digital weighing machine and height was measured with nonstretchable measuring tape.

Statistics

Data analysis was performed using IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp. Qualitative variables were presented as proportions, whereas quantitative variables were expressed as mean ± standard deviation. Univariate analysis using the Chi-square test was done to assess associations between categorical variables and depression/sleep disturbances. Multivariate logistic regression was conducted to identify independent risk factors, expressed as adjusted odds ratios (OR) with 95% confidence intervals (CIs). The Mann–Whitney *U* test was used to compare mean differences in sleep component scores between postmenopausal and perimenopausal groups. $P < 0.05$ was considered statistically significant.

Ethical approval

Approval was obtained from the Dissertation Review Committee and Institutional Ethics Committee of Amrita School of Medicine (IEC Number: ECASM-AIMS-2023-005). Written informed consent was obtained from each participant in the local language before data collection.

RESULTS

The average age of participants was 53.6 ± 5.8 years. Among the participants, 70.1% were postmenopausal, whereas 29.9% were perimenopausal. More than half of the participants (56.1%) resided in rural areas. A greater proportion (54.5%) were from nuclear families, whereas 44.8% belonged to three-generation families. Almost all participants (96.4%) lived in their own homes. Less than half (46.2%) received education up to high school, whereas 16.55% had only primary school education. The majority (80.3%) were currently married, whereas 17.5% were widows. Two-thirds of participants (64.1%) were homemakers and 21.3% were employed. Data regarding socioeconomic status showed that 64.3% were above the poverty line (APL) category. A significant portion (87.9%)

had families of more than three members and more than three-fourths (79.7%) had more than three children.

The distribution of study participants based on health status and social support profile is depicted in Table 1.

The prevalence of depression among the study participants was 33.3% (95% CI: 29%–37%). Among the study participants, the prevalence of mild, borderline, moderate, and severe depression was 18.4%, 8.4%, 5.4%, and 1.1%, respectively, whereas 66.7% had no depression according to the tool Supplementary Figure 1. Variations in depression levels were observed between postmenopausal and perimenopausal women which is depicted in Figure 1.

Specifically, the prevalence of depression among postmenopausal women (n = 324) was 36.4% (95% CI: 32%, 40%), whereas among perimenopausal women, the prevalence was 26.1% (95% CI: 24%, 28%).

Assessment of sleep quality using PSQI revealed that the majority (63%) were good sleepers, whereas 37% were poor sleepers Supplementary Figure 2. The prevalence of poor sleep among postmenopausal women (n = 324) was 41.4% with 95% CI (37%–45%) and among

Table 1: Distribution of study participants based on health status and social support profile

Variables	Category	Frequency (n=462), n (%)
Any event negatively affecting life within the last 10 years? (death of spouse or relatives, separation from loved ones, financial loss)	Present	51 (11)
	Absent	411 (89)
Emotional support from family/friends/relatives during times of need	Yes	444 (96.1)
	No	18 (3.9)
Interaction with friends neighbors/social groups (get-togethers, family functions, religious groups, or self-help groups such as Kudumbashree)	Good	342 (74)
	Poor	120 (26)
Social media usage	Present	272 (59.1)
	Absent	189 (40.9)
History of postpartum depression	Present	7 (1.5)
	Absent	455 (98.5)
Physical activity (MET min/week)	<600	372 (80.5)
	≥600	90 (19.5)
Morbidities (dyslipidemia, diabetes, hypertension, cardiovascular disease, and thyroid disorders)	Nil	255 (55.2)
	1	111 (24)
	Multimorbidity	96 (20.8)
Age at menopause (years)	<48	119 (36.7)
	≥48	205 (63.3)
Current Intake of supplements (iron, calcium, and Vitamin D)	Yes	96 (20.8)
	No	366 (79.2)
Blood pressure	Normal	67 (14.5)
	Prehypertension	209 (45.2)
	Hypertension	186 (40.3)
BMI	Underweight	10 (2.2)
	Normal	89 (19.3)
	Overweight	106 (22.9)
	Obese	257 (55.6)
Daily consumption of vegetables and fruits	Yes	51 (11)
	No	411 (89)

BMI: Body mass index, MET: Metabolic equivalent of task

perimenopausal women (*n* = 138) was 26.8% with 95% CI (23%–30%).

Variations in mean score values were observed based on menopausal status [Figure 2]. The global PSQI scores of the patients (*n* = 462) ranged from 0 to 18 with a mean score of 5.2 ± 3.1. Notably, perimenopausal women exhibited higher mean values for components such as sleep quality, sleep latency, sleep duration, sleep efficiency, disturbances, and sleep dysfunction compared to postmenopausal women.

Univariate analysis was done to determine the association between depression and its determinants among the study participants Supplementary Table 1. Sociodemographic factors including family type, marital status, education, socioeconomic status, body mass index, and menopausal status demonstrated significant associations with depression, indicated by *P* < 0.05. In addition, among factors concerning morbidity and social support, events exerting a negative impact on life within the past 10 years, interaction with friends, neighbors, and social groups, emotional support from family and relatives during times of need, and nonusage of social media exhibited significant associations with depression. Furthermore, analysis of dietary factors revealed that daily consumption of fruits and vegetables and intake of supplements such as iron and calcium displayed significant associations with depression.

The outcomes of the multivariable logistic regression analysis using the backward conditional method as depicted in Table 2 were expressed in terms of adjusted OR (aOR). APL category, presence of any recent negative event affecting life, unmarried/widow status, and nonusage of social media were found to be independent predictors of depression in menopausal women.

A univariate analysis test done to find the factors associated with poor sleep showed that several factors including the location of the house, age of participants, type of family, marital status, education level, socioeconomic status, presence of morbidities, menopausal status, social media usage, and daily consumption of fruits and vegetables showed significant associations with poor sleep quality with *P* < 0.05 Supplementary Table 2. Moreover, out of the 171 participants identified as having poor sleep quality, 100 were also found to be experiencing depression.

Table 2: Multivariate logistic regression analysis to identify independent predictors of depression among the study participants

Variable	Crude OR (95% CI)	Adjusted OR (95% CI)	*P*
Socioeconomic status			
BPL	2.5 (1.6–3.7)	1.64 (1.05–2.5)	0.02
APL	Reference	Reference	
Any event negatively affecting the life in the past 10 years			
Present	3.01 (1.66–5.45)	2.27 (1.17–4.40)	0.014
Absent	Reference	Reference	
Marital status			
Unmarried/widow/divorced	3.13 (1.95–5.04)	2.1 (1.20–3.73)	0.017
Currently married	Reference	Reference	
Social media usage			
No	3.8 (2.5–5.7)	2.77 (1.79–4.29)	<0.001
Yes	Reference	Reference	

CI: Confidence interval, OR: Odds ratio, BPL: Below the poverty line, APL: Above poverty line
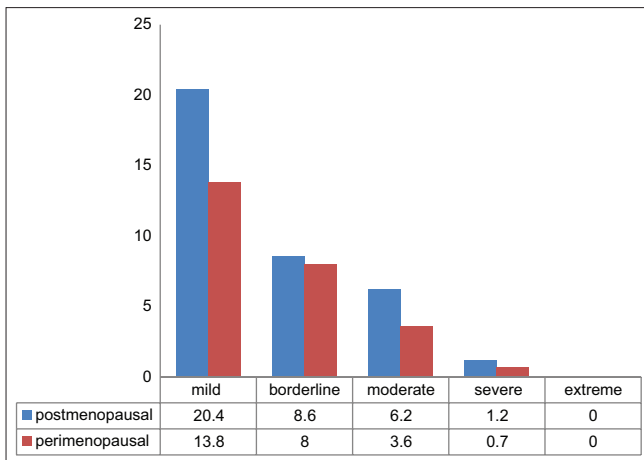
Figure 1: Levels of depression among postmenopausal and perimenopausal women using Beck Depression Questionnaire II. The vertical axis represents the percentage of women, and the horizontal axis displays the different levels of depression severity. The data are presented in bar chart format, with separate bars for postmenopausal and perimenopausal women at each depression level. BDQ II: Beck Depression Questionnaire II
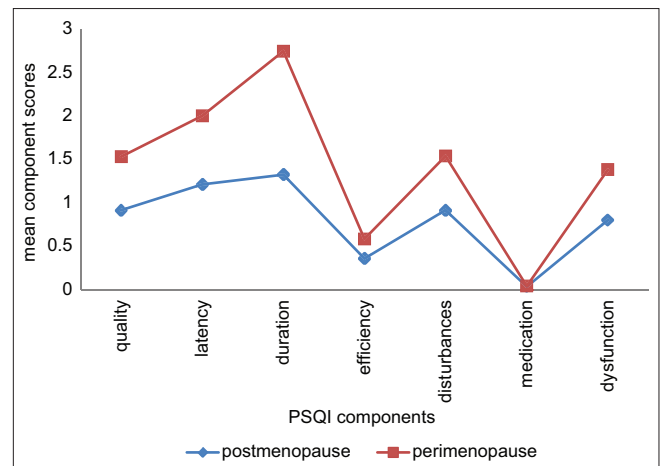
Figure 2: Profile of Pittsburgh Sleep Quality Index components in perimenopause and postmenopause. Each component is represented on the x-axis, whereas the mean component scores are plotted on the y-axis. The blue line represents the scores for postmenopausal women, and the orange line represents the scores for perimenopausal women. PSQI: Pittsburgh sleep quality index

However, multivariate regression [Table 3] showed the following factors such as the urban location of house, below poverty line (BPL) category, and inadequate intake of fruits and vegetables as the independent predictors of poor sleep quality.

Since this is a cross-sectional study, we could not pinpoint the temporal association between sleep and depression. However, it was found that among the 171 participants identified with poor sleep quality, 100 were also experiencing depression, and out of 154 participants with depression, 100 had poor sleep quality.

The component scores were expressed in median (interquartile range) and were compared using the Mann–Whitney U test Supplementary Table 3. Total PSQI scores were significantly higher in postmenopausal than in premenopausal women (5 [3, 7] vs. 4, [2, 6] $P < 0.05$). Several of the PSQI subscale scores, specifically subjective sleep quality, sleep latency, sleep disturbances, and daytime dysfunction scores also differed significantly according to menopausal status.

DISCUSSION

In this cross-sectional study with 462 participants including both perimenopausal and postmenopausal women from Ernakulam district, the overall prevalence of depression was determined to be 33.3% (95% CI: 29%, 37%). Among them, 18.4% experienced mild depression, 8.4% had borderline depression, 5.4% exhibited moderate depression, 1.1% had severe depression, and 66.7% had no depression according to the tool. The prevalence of sleep disturbances among these women was 37% (95% CI: 36%, 39%).

The current study identified a depression rate of 36.4% among postmenopausal women surpassing the findings of the MEDiterranean Island Study

conducted in 2014 which reported a prevalence of 21% among postmenopausal women.[8] In addition, an intercontinental review highlighted varying degrees of depressive disorders among menopausal women across different regions, with South America reporting the highest average percentage at 74%, followed by Europe (61.3%), Asia (49%), North America (36%), and Australia (32.5%).[9] A recent meta-analysis by Yadav *et al*. suggested that the prevalence of depression among perimenopausal and postmenopausal Indian women was approximately 42.47%, slightly higher than the figures observed in the current study.[10] These comparisons underscore the variability in depressive symptom prevalence among postmenopausal women across different studies and regions.

This study also explored the relationship between various factors such as sociodemographic characteristics, life events, social support, and diet and their association with depression among the participants. Women classified as below the poverty line were 1.64 times more likely to develop depression compared to those above the poverty line (95% CI: 1.05–2.5), as supported by Bansal *et al*.'s study which found that mild-to-moderate depression was more common among individuals with middle socioeconomic status.[11] Unmarried, widowed, or divorced women had 2.1 times higher odds of experiencing depression compared to currently married women consistent with findings from the study by Unsal *et al*. which identified unmarried status as a significant risk factor (OR =1.65).[12] Similarly, having a companion throughout the menopausal transition may help prevent depression in women, according to a study by Alam MM *et al*.[13] Furthermore, it was discovered that widows were more vulnerable than currently married women to suffer from anxiety problems.[14] A statistically significant association was found between recent experiences of negative life events and the risk of depression. Recent negative life events can lead to depression by triggering chronic stress, negative cognitive appraisals, grief from loss, social isolation, biological changes, and traumatic experiences, overwhelming individuals' coping mechanisms. This result is reliable with a prior study by Gibbs *et al*. in 2013, which also highlighted that recent negative life events were predictive of distinctive changes in depression scores.[15] Extensive use of social media platforms has been linked to heightened feelings of depression, anxiety, loneliness, and low self-esteem, especially among adolescents.[16] However, it was interesting to observe a contradictory finding where depression was more common among menopausal women who did not use any form of social media (aOR =2.77, 95% CI: 1.79, 4.29). This could be attributed to the lack of support networks or access to

Table 3: Multivariate logistic regression analysis to identify the determinants of poor sleep quality among the study participants

Variable	Crude OR (95% CI)	Adjusted OR (95% CI)	*P*
Location of house			
Urban	1.91 (1.30–2.81)	1.69 (1.13–2.54)	0.01
Rural	Reference	Reference	
Socioeconomic status			
BPL	2.3 (1.55–3.42)	1.96 (1.29–2.98)	0.001
APL	Reference	Reference	
Daily consumption of vegetables and fruits			
Yes	0.37 (0.18–0.77)	0.43 (0.20–0.91)	0.02
No	Reference	Reference	

CI: Confidence interval, OR: Odds ratio, BPL: Below the poverty line, APL: Above poverty line

information and resources among women who do not engage with social media, potentially leading to feelings of isolation.

This research revealed that the overall prevalence of sleep disturbances among the participants was 37% (95% CI: 36%, 39%). A systematic analysis and meta-analysis carried out by Xu and Lang demonstrated that the prevalence of sleep disturbances was elevated in perimenopausal, postmenopausal, and surgically menopausal women compared to those who were premenopausal.[17] Among the postmenopausal women, 134 (41.4%) reported experiencing poor sleep quality. A meta-analysis examining the global prevalence of sleep disorders during menopause conducted by Salari *et al.* found that the overall prevalence of sleep disorders among postmenopausal women was 51.6%.[18] Similarly, 37 (26.8%) perimenopausal women were identified as having poor sleep quality, which aligns with the findings of a study conducted by Zhang *et al.*, where they reported that 24.51% of perimenopausal women experienced poor sleep.[19]

This study highlighted that individuals with lower socioeconomic status (BPL) were notably prone to poor sleep quality, aligning with Hall *et al.*'s findings on the link between chronic stress from lower socioeconomic status and sleep disruptions.[20] This propensity for poor sleep quality among lower socioeconomic individuals in our study may be due to factors such as shift work, irregular schedules, economic hardships, and financial concerns, which are more common among women in this group.

Interestingly, urban residents were 1.69 times more likely to suffer from poor sleep compared to their rural counterparts. This could be attributed to evolving lifestyles, work-related stress, and environmental factors such as pollution. A hectic lifestyle can contribute to both inadequate sleep quality and unhealthy eating habits.

Studies have shown an association between poor sleep quality and low consumption of vegetables and fish. Our research indicates that a daily intake of fruits and vegetables can have a positive impact on sleep quality supporting the findings by Katagiri.[21] This might be due to the presence of vitamins, minerals, and antioxidants which are essential for overall health, including sleep regulation. Certain nutrients, such as magnesium and potassium found in fruits and vegetables such as bananas and leafy greens, can help relax muscles and promote better sleep.[22] In addition, Jansen *et al.* found that a diet rich in fruits and vegetables is associated with better sleep quality, whereas a less healthy diet is linked to poorer sleep quality in middle-aged women.[23]

Many studies have documented a strong connection between depression and low-quality sleep. Our study also found a notable association between poor sleep quality and depression. However, due to our cross-sectional design, we could not establish a definitive temporal relationship between these factors.

Strengths

1. The use of the cluster sampling method ensures a more efficient and practical way of selecting participants from the population, enhancing the study's feasibility and reducing sampling bias
2. The study has the power to identify potential risk factors associated with depression and sleep disturbances which provides valuable insights for developing targeted interventions and prevention strategies tailored to this population
3. Given the high prevalence of depression and sleep disturbances in postmenopausal or perimenopausal women, this study addresses an important public health issue with findings having the potential to contribute to improved healthcare practices and policies in this area.

Limitations

1. Both the Beck Depression Questionnaire II (BDQ II) and PSQI rely on self-reported data, which may be subject to biases such as social desirability bias or recall bias, potentially affecting the accuracy of the findings
2. The BDQ II and PSQI may not assess other menopausal symptoms (e.g., hot flashes and mood swings), which could influence the relationship between depression, sleep disturbances, and menopausal status. This limitation may lead to an incomplete understanding of the factors influencing mental health and sleep in this population
3. The study was conducted in a specific geographic area, potentially limiting the generalizability of the findings to other populations or cultural contexts.

CONCLUSIONS

This study found out high prevalence of depression and poor sleep quality among the study population through a community-based approach covering both urban and rural areas. Factors such as low socioeconomic status, recent negative life events, lack of social media usage, and being unmarried, widowed or divorced were identified as independent predictors of depression. In addition, living in urban areas, having a low socioeconomic status, being postmenopausal, and having inadequate intake of fruits and vegetables were recognized as potential risk factors for sleep disturbances.

Recommendations

Women's health clinics and menopause support groups should provide psychoeducation on coping and resilience. Online platforms should foster peer support to combat isolation. Peripheral healthcare facilities should collaborate to offer affordable mental health services, utilizing fee reductions and telemedicine. Workplaces should include stress management workshops to improve sleep quality. Recommendations for better sleep include maintaining a consistent sleep schedule, reducing screen time before bed, and creating a relaxing sleep environment. Urban areas should implement noise reduction measures. Nutritional counseling by dietitians should emphasize the benefits of fruits, vegetables, and specific nutrients for sleep. Women should also be informed about sleep clinics and hormone replacement therapy. Adopting these approaches will create a holistic support system for the mental well-being and sleep quality of perimenopausal and postmenopausal women. Hence, this research aims to advance comprehensive and gender-sensitive strategies for fostering and delivering mental healthcare. This, in turn, guarantees the welfare and standard of life for women navigating through the menopausal phase.

Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Results of univariate analysis to test for association between depression and risk factors

Variable	Depression status		Crude OR (with 95% CI)	P
	Present (*n*=154), *n* (%)	Absent (*n*=308), *n* (%)		
Location of house				
Rural	90 (33)	183 (67)	0.96 (0.6–1.4)	0.84
Urban	64 (33.9)	125 (66.1)		
Age (years)				
<53	55 (28.6)	137 (71.4)	0.69 (0.46–1.03)	0.07
≥53	99 (36.7)	171 (63.3)		
Religion				
Hindu	78 (34.5)	148 (65.5)	0.90	0.87
Christian	48 (32.2)	101 (67.8)	0.99	
Muslim	28 (32.2)	59 (67.8)	1	
Type of family				
Nuclear	69 (27.4)	183 (72.6)	1.8 (1.22–2.66)	0.003
3 generation/joint	85 (40.5)	125 (59.5)		
Living in				
Own house	149 (33.4)	297 (66.6)	1.1 (0.37–3.2)	0.85
Rent	5 (31.3)	11 (68.8)		
Marital status				
Unmarried/divorced/widow	50 (54.9)	41 (45.1)	3.13 (1.95–5.04)	<0.001
Currently married	104 (28)	267 (72)		
Education				
High school and below	116 (41.1)	166 (58.9)	2.6 (1.7–4.0)	<0.001
Above high school	38 (21.1)	142 (78.9)		
Occupation				
Unemployed (including housewives	108 (33)	219 (67)	0.95 (0.62–1.4)	0.82
Employed	46 (34.1)	89 (65.9)		
Socioeconomic status				
BPL	77 (46.7)	88 (53.3)	2.5 (1.6–3.7)	<0.001
APL	77 (25.9)	220 (74.1)		
Number of members in the family				
<3	19 (33.9)	37 (66.1)	1.03 (0.5–1.8)	0.92
≥3	135 (33.3)	271 (66.7)		
Number of children				
0	4 (33.3)	8 (66.7)	1	0.48
1–2	118 (32.1)	250 (67.9)	1.05 (0.31–3.5)	
≥3	32 (39)	50 (61)	0.78 (0.21–2.80)	
History of postnatal depression				
Present	2 (28.6)	5 (71.4)	0.79 (0.15–4.1)	1.00
Absent	152 (33.4)	303 (66.6)		
Physical activity (*n*=145)				
<600 MET min/week	128 (34.4)	244 (65.6)	1.29 (0.78–2.13)	0.35
≥600 MET min	26 (28.9)	64 (71.1)		
Morbidity				
Nil	78 (30.6)	177 (69.4)	1	0.09
One morbidity	35 (31.5)	76 (68.5)	1.61 (1.04–2.74)	
Multimorbidity	41 (42.7)	55 (57.3)	1.69 (0.91–2.86)	
Any event negatively affecting life (within the past 10 years)				
Present	29 (56.9)	22 (43.1)	3.01 (1.66–5.45)	<0.001
Absent	125 (30.4)	286 (69.6)		
Menopausal status				
Postmenopause	118 (36.4)	206 (63.6)	1.63 (1.04–2.52)	0.03
Perimenopause	36 (26.1)	102 (73.9)		
Age at menopause (years)				

Contd...

Variable	Depression status		Crude OR (with 95% CI)	P
	Present (*n*=154), *n* (%)	Absent (*n*=308), *n* (%)		
<48	50 (42)	69 (58)	1.46 (0.91–2.32)	0.11
≥48	68 (33.2)	137 (66.8)		
Interaction with friends, neighbors, and social groups				
Good	103 (30.1)	239 (69.9)	0.58 (0.38–0.89)	0.013
Poor	51 (42.5)	69 (57.5)		
Emotional support from family and relatives in needs				
Present	144 (32.4)	300 (67.6)	0.38 (0.14–0.99)	0.04
Absent	10 (55.6)	8 (44.4)		
Social media usage				
No	96 (50.8)	93 (49.2)	3.8 (2.5–5.7)	<0.001
Yes	58 (21.2)	215 (78.8)		
Intake of supplements (iron, calcium, and Vitamin D)				
No	131 (35.8)	235 (64.2)	1.79 (1.05–2.96)	0.029
Yes	23 (24)	73 (76)		
Blood pressure				
Normal	20 (29.9)	47 (70.1)	1	0.74
Prehypertension	69 (33)	140 (67)	1.26	
Hypertension	65 (34.9)	121 (65.1)	1.09	
BMI				
Nonobese	79 (38.5)	126 (61.5)	1.52 (1.03–2.24)	0.03
Obese	75 (29.2)	182 (70.8)		
Daily consumption of vegetables and fruits				
Yes	7 (13.7)	44 (86.3)	0.28 (0.12–0.65)	0.002
No	147 (35.8)	264 (64.2)		

CI: Confidence interval, OR: Odds ratio, BPL: Below the poverty line, APL: Above poverty line, MET: Metabolic equivalent task, BMI: Body mass index
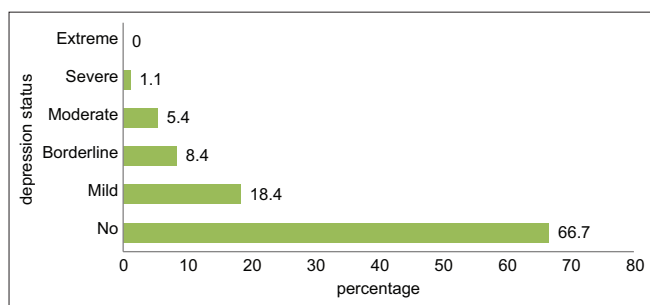
Supplementary Figure 1: Prevalence of depression among the study participants based on the Beck's Depression Inventory II
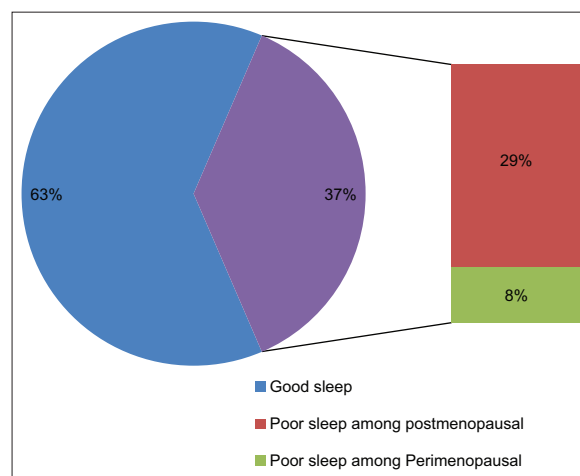
Supplementary Figure 2: Sleep quality among perimenopausal and postmenopausal women

Supplementary Table 2: Results of univariate analysis to test for association between poor sleep quality and risk factors

Variable	Sleep quality		Crude OR (with 95% CI)	P
	Poor (*n*=171), *n* (%)	Good (*n*=291), *n* (%)		
Location of house				
Rural	84 (30.8)	189 (69.2)	0.52 (0.35–0.76)	0.001
Urban	87 (46)	102 (54)		
Age (years)				
<53	60 (31.3)	132 (68.8)	0.65 (0.44–0.96)	0.03
≥53	111 (41.1)	159 (58.9)		
Religion				
Hindu	87 (38.5)	139 (61.5)	1	0.43
Christian	49 (32.9)	100 (67.1)	0.93 (0.56–1.54)	
Muslim	35 (40.2)	52 (59.8)	1.27 (0.82–1.97)	
Type of family				
Nuclear	82 (32.5)	170 (67.5)	0.65 (0.44–0.95)	0.02
3 generation/joint	89 (42.4)	121 (57.6)		
Residence status				
Own	166 (37.2)	280 (62.8)	1.3 (0.44–3.81)	0.62
Rent house	5 (31.3)	11 (68.8)		
Marital status				
Currently married	128 (34.5)	243 (65.5)	0.58 (0.37–0.93)	0.02
Unmarried/widow/divorced	43 (47.3)	48 (52.7)		
Education				
High school and below	124 (44)	158 (56)	2.22 (1.47–3.33)	<0.001
Above high school	47 (27.1)	133 (73.9)		
Occupation				
Unemployed including housewives	117 (35.8)	210 (64.2)	0.83 (0.55–1.26)	0.39
Employed	54 (40)	81 (60)		
Socioeconomic status				
BPL	82 (49.7)	83 (50.3)	2.3 (1.55–3.42)	<0.001
APL	89 (30)	208 (70)		
Number of members in the family				
<3	24 (42.9)	32 (57.1)	1.32 (0.75–2.32)	0.33
≥3	147 (36.2)	259 (63.8)		
Number of children				
Nil	4 (33.3)	8 (66.7)	1	0.05
1–2	127 (34.5)	241 (65.5)	1.8 (1.11–2.93)	
≥3	40 (48.8)	42 (51.2)	1.9 (0.53–6.80)	
History of postnatal depression				
Present	3 (42.9)	4 (57.1)	1.2 (0.28–5.7)	0.71
Absent	168 (36.9)	287 (63.1)		
Physical activity (MET min/week)				
<600	140 (37.6)	232 (62.4)	1.14 (0.70–1.86)	0.44
≥600	31 (34.4)	59 (65.6)		
Morbidities				
Nil	82 (32.2)	173 (67.8)	1	0.04
Any one	45 (40.5)	66 (59.5)	1.24 (0.71–2.15)	
Multimorbidity	44 (45.8)	52 (54.2)	1.78 (1.10–2.88)	
Any event negatively affecting life				
Absent	152 (37)	259 (63)	0.98 (0.54–1.80)	0.97
Present	19 (37.3)	32 (62.7)		
Menopausal status				
Postmenopause	134 (41.4)	190 (58.6)	1.95 (1.24–2.98)	0.003
Perimenopause	37 (26.8)	101 (73.2)		
Age at menopause (years)				

Contd...

Variable	Sleep quality		Crude OR (with 95% CI)	*P*
	Poor (*n*=171), *n* (%)	Good (*n*=291), *n* (%)		
<50	80 (44.4)	100 (55.6)	1.33 (0.85–2.08)	0.20
≥50	54 (37.5)	90 (62.5)		
Interaction with friends/neighbors/social groups				
Good	129 (37.7)	213 (62.3)	1.12 (0.72–1.73)	0.59
Poor	42 (35)	78 (65)		
Emotional support from family/friends/relatives in need				
Present	162 (36.5)	282 (63.5)	0.57 (0.22–1.47)	0.24
Absent	9 (50)	9 (50)		
Social media usage				
No	88 (46.6)	101 (53.4)	1.9 (1.35–2.93)	<0.001
Yes	83 (30.4)	190 (69.6)		
Intake of supplements				
No	140 (38.3)	226 (61.7)	1.2 (0.80–2.09)	0.28
Yes	31 (32.3)	65 (67.7)		
BMI				
Nonobese	76 (37.1)	129 (62.9)	1.005 (0.68–1.46)	0.98
Obese	95 (37)	162 (63)		
Blood pressure				
Normal	23 (34.3)	44 (65.7)	1	0.88
Prehypertension	78 (37.3)	131 (62.7)	1.15 (0.64–2.07)	
Hypertension	70 (37.6)	116 (62.4)	1.01 (0.67–1.52)	
Daily consumption of vegetables and fruits				
Daily	10 (19.6)	41 (80.4)	0.37 (0.18–0.77)	0.006

CI: Confidence interval, OR: Odds ratio, BPL: Below the poverty line, APL: Above poverty line, MET: Metabolic equivalent task, BMI: Body mass index

Supplementary Table 3: Comparison of total Pittsburgh sleep quality index and subscale scores using Mann–Whitney *U*-test among the postmenopausal and perimenopausal women

PSQI components	Menopausal status		*P*
	Postmenopause (*n*=324), median (IQR)	Perimenopause (*n*=138), median (IQR)	
Subjective sleep quality	1 (0–1)	0 (0–1)	<0.001
Sleep latency	1 (0–2)	1 (0–1)	<0.001
Sleep duration	1 (1–2)	1 (1–2)	0.25
Sleep efficiency	0 (0–0)	0 (0–0)	0.15
Sleep disturbance	1 (1–1)	1 (0–1)	<0.001
Use of sleep medication	0 (0–0)	0 (0–0)	0.36
Daytime dysfunction	1 (0–1)	1 (0–1)	0.009

IQR: Interquartile range, PSQI: Pittsburgh sleep quality index