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Patterns of the Risk for Depression among Midlife Women: The SWAN Study

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Abstract

Midlife women are particularly vulnerable to depressive symptoms as well as other health challenges such as sleep disturbances and vasomotor symptoms. This paper investigates the differences in patterns and demographic distributions between the group of midlife women with an elevated risk for depression versus the group without. The Center for Epidemiological Studies Depression Scale was used to evaluate risk for depression across eleven assessments from the Study of Women's Health Across the Nation. Women with higher risk for depression were more likely to report poorer sleep satisfaction and reduced sleep efficiency among other health challenges. The implications and limitations of this study as well as possible future directions were also discussed.

Keywords

Midlife Women, Menopause, Depression, Sleep, Health, The SWAN Study

1. Introduction

Midlife is often considered to encompass the period between the ages of 40 to 60 (Infurna et al., 2020). This period is often marked by health challenges and changes in cognitive functions for women (Bowman et al., 2021). The Study of Women's Health Across the Nation (SWAN) surveyed over 16,000 midlife women and found that 38% reported sleep disturbances (Kravitz et al., 2008). Sleep issues, such as restlessness and trouble falling asleep, have been found as a significant risk factor for health challenges like diabetes, stroke, and cardiovascular disease (Grandner et al., 2012; Clark et al., 2016). It is evident that investigating disrupted sleep is crucial and consequential.

Aside from primary sleep disorders such as Insomnia Disorder and Nightmare Disorder, sleep disturbances have been used as a diagnostic criterion for depressive disorders like Major Depressive Disorder and anxiety disorders such as Post-

Traumatic Stress Disorder (American Psychological Association, 2013). Polysomnographic abnormalities present among participants with primary insomnia has also been found in participants with depression (Freeman et al., 2020). Therefore, it is possible that clinically significant depressive symptoms, which has been present in 23% of midlife women, is a modifiable risk factor at play (Bromberger et al., 2007).

Previous researchers have shown that the link between depression and sleep disturbances could be bidirectional. Meta-analyses reported that the presence of insomnia increased the likelihood of the development, recurrence, and worsening of depressive symptoms. On the other hand, existing depression was linked to an elevated risk of developing and worsening symptoms of sleep disturbances (Bao et al., 2017). Among midlife women, an 8-year longitudinal study has isolated depressive symptoms as a meaningful and independent predictor of trouble falling asleep (Pien et al., 2008). Moreover, those who experienced depressed mood also reported increased severity of early morning awakening (Woods & Mitchell, 2010). In addition to predicting singular elements of sleep disturbances, depressive symptoms are shown in linkage with multidimensional measure of sleep health. Using actigraphy-assessed data from the SWAN Sleep Study, Bowman and colleagues (2021) stated that elevated symptoms of depression were not only related to decreased sleep satisfaction and alertness but also overall worsened sleep throughout 29 nights of wearing wrist actigraphy. This small pile of literature has demonstrated that the relationship between depression and sleep disturbances maintains for midlife women.

Given the prevalence and importance of depressive symptoms among midlife women, scientists have also been exploring the patterns and determinants to distinguish potential risk factors. Specifically, menopausal transition has been identified as a period that made women particularly vulnerable to falling prey to depression (Bromberger et al., 2007). Efforts have been put into recognizing underlying causes of this increased susceptibility. Menopausal status and ethnicity, for example, have been explored as potential factors. Researchers have found that during the perimenopause phase, which can last up to 6 years, women are 14 times more likely to struggle with depression than premenopausal women (Schmidt et al., 2004). No difference, however, has been discovered between various ethnicity groups (Brown et al., 2014). Furthermore, vasomotor symptoms have also been one of focus and the results are mixed. After controlling for menopausal phase, physical activeness, and self-reported current health status, increased depressive symptoms have been found to associate with both daytime and nocturnal hot flashes (Brown et al., 2008). With data from the SWAN study, a multiethnic community study has also established the connection between psychological stress, such as feeling depressed or blue, and hot flashes and night sweats (Bromberger et al., 2001). On the other hand, when using information from the Seattle Midlife Women's Health Study, researchers have only found a significant association between hot flashes and depressed mood on individual level but failed to do so when calculating in aggregate (Dennerstein et al., 2004). Similarly, from a 2006 study,

the severity of vasomotor symptoms of depressive perimenopausal group wasn't significantly higher than that of the non-depressive group (Öztürk et al., 2006).

The current study aims to organize and expand the existing knowledge of sleep health and depression of midlife women. Through investigating longitudinal data, this paper assesses the differences and patterns between the group of midlife women with an elevated risk for depression and the group without. Demographic characteristics (e.g., race and age), somatic symptoms (e.g., sleep problems and vasomotor symptoms), and physical health-related factors (e.g., use of medication) are all considered. With measures from more than 2000 participants collected over a decade, this analysis tests three specific hypotheses. First of all, it is hypothesized that women with an elevated risk for depression would experience lower sleep satisfaction and reduced sleep efficiency. Secondly, women of the elevated risk group would report more pronounced somatic symptoms and worse overall physical health. Last but not least, there would be a consistent and significant difference in race, age, and menopausal status distribution between the two groups.

2. Methods

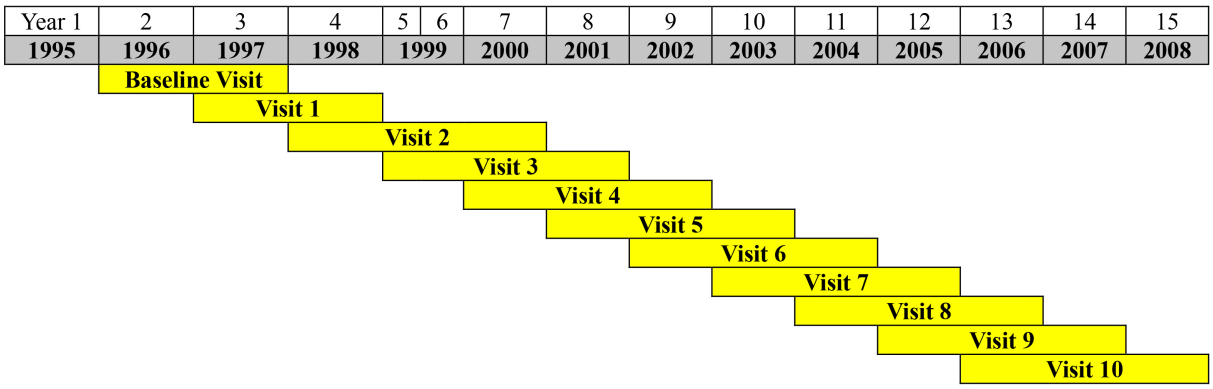

Figure 1. Timeline and data structure for the full sample. All measures were assessed throughout the Baseline Visit (1996-1997) to Visit 10 (2007-2008).

This study employed longitudinal data from the Study of Women's Health Across the Nation (hereafter referred to as the SWAN study) whose purpose was to measure how women's health changes as they age and navigate the menopausal transition. For the baseline visit that was conducted from January 1996 to December 1997, eligible women were required to be 42 - 52 years old and had a uterus and at least one ovary. Within the three months prior to the assessment, they must have experienced at least one menstrual period and had not taken any hormone medications (e.g., birth control pills and estrogen or progesterone preparations). A total of 3302 eligible participants were recruited from seven clinical sites (Ann Arbor, MI; Boston, MA; Chicago, IL; Alameda and Contra Costa County, CA; Los Angeles, CA; Jersey City, NY; Pittsburg, PA). Participants were of 5 different race and/or ethnicity: Caucasian, African America, Hispanic, Chinese, and Japanese.

All questions were translated into Spanish, Cantonese, and Japanese and could be effectively administered by trained bilingual interviewers.

As of the time this paper was written, SWAN has completed the baseline and 16 follow-up visits while publishing raw data from the baseline visit to Visit 10. Most of the calculations discussed later in this paper use data from all eleven visits. Figure 1 demonstrates the overall timeline and how the data was structured for the whole sample.

Measures

Risk for depression

The frequency of each participant's depressive symptoms was measured by the 20-item Center for Epidemiological Studies Depression (CES-D) Scale (Radloff, 1977). Questions were delivered orally by the SWAN study administrators at each follow-up visit. Scores range from 0 (rare or no occurrence during the past week) to 3 (most or all of the time during the past week). Item 11, which asked if the participant's sleep was restless, was removed to avoid repeating and confounding with sleep health variables. Before excluding item 11, the highest possible score was 60 and the cut off indicating potentially clinically significant depression was 16 (Weissman et al., 1977). Since the scale employed here has a possible maximum score of 57, after adjusting proportionally, this study used a cutoff at 15.2. In other words, the CES-D score was used not only as a continuous variable (0 - 57) but also as a dichotomous variable with ≥15.2 showing an elevated risk for depression. The scale is used as a screening tool for depressive symptoms. Its cutoff score identifies an elevated risk for depression rather than a formal clinical diagnosis. CES-D has demonstrated good internal consistency ($\alpha = 0.85$) and adequate validity ($r = .56$ for self-reported scores correlating with nurse-clinician's ratings) (Bowman et al., 2021).

Sleep health

To provide a more comprehensive understanding, instead of using singular measures, sleep health was calculated from two dimensions: satisfaction and efficiency. Satisfaction measured if the participants' sleep was restless, how their typical night's sleep was, and the quality of their sleep. Efficiency included whether the participants had trouble falling asleep, were waking up several times per night, and were waking up early. Each factor had a corresponding question administered to the participants. The higher the score, the less the satisfaction and efficiency.

Vasomotor symptoms

Vasomotor symptoms measured if participants reported hot flashes, cold sweats, and night sweats throughout the previous two weeks. Like sleep health variables, the higher the score, the more pronounced vasomotor symptoms they were experiencing.

Physical health

Aside from measuring participants' self-reported overall health (scores ranging from 1 "Excellent" to 5 "Poor"), factors related to physical health also included whether participants were taking medication for sleep or nervous condition. Specifically, the study assessed if participants were taking at least one type of sleep or

nervous medication.

Statistical Analyses

All analyses were conducted using Jupyter Notebook Version 7.2.2. All cells with negative values, which meant either "N/A" or "Missing", were excluded. Groups were compared using *t*-tests and distributions of categorical variables (such as age, race, and menopausal status) were calculated using Chi-square. Cohen's *d* and Cramér's *V* were also computed to show effect size. Finally, Fisher's method was employed to investigate whether there was evidence of a consistent effect across multiple visits. For all tests, $p < .05$ was considered statistically significant.

3. Results

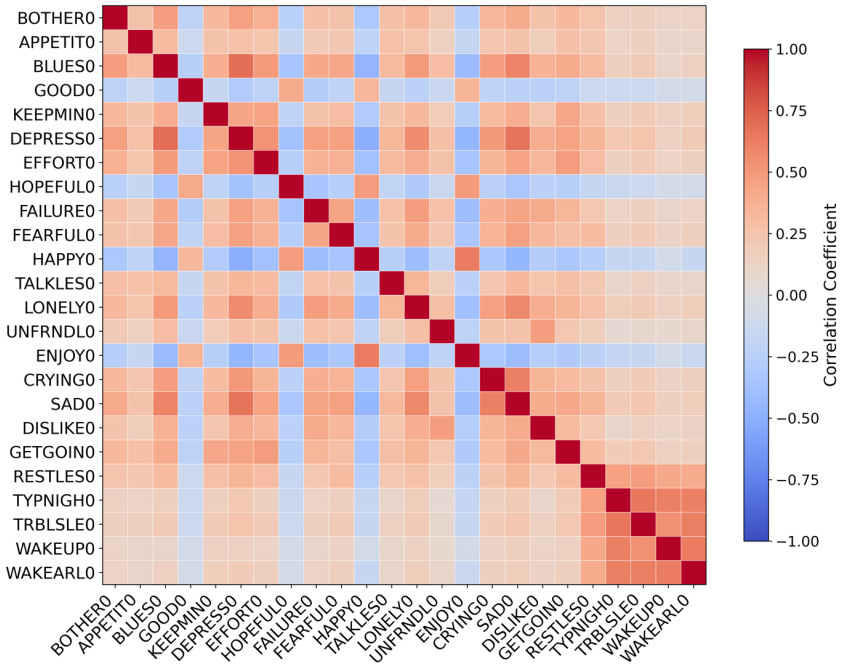

Figure 2. Heatmap of the Pearson correlation matrix of 19 depression variables and 5 sleep variables from baseline dataset (1996-1997)—Part 1. Warm colors represent positive correlations while cool colors indicate negative correlations. All cells have a correlation value with the significance level of $p < .001$. Variables: **BOTHER0** = bothered by things; **APPETIT0** = appetite was poor; **BLUES0** = felt blue; **GOOD0** = felt good; **KEEPMIN0** = trouble keeping mind on tasks; **DEPRESS0** = felt depressed; **EFFORT0** = everything was an effort; **HOPEFUL0** = felt hopeful; **FAILURE0** = felt life had been a failure; **FEARFUL0** = felt fearful; **HAPPY0** = felt happy; **TALKLES0** = talked less than usual; **LONELY0** = felt lonely; **UNFRNDL0** = felt people were unfriendly; **ENJOY0** = enjoyed life; **CRYING0** = had crying spells; **SAD0** = felt sad; **DISLIKE0** = felt people disliked me; **GETGOIN0** = could not get going; **RESTLES0** = restless sleep; **TYPNIGH0** = typical night's sleep quality; **TRBLSLE0** = trouble falling asleep; **WAKEUP0** = waking up during the night; **WAKEARL0** = waking up too early. Higher values reflect higher symptom frequency, except for **GOOD0**, **HOPEFUL0**, **HAPPY0**, and **ENJOY0**, whose higher values reflect more positive affect. Thus, negative correlations with symptoms are expected. Additionally, the cluster on the bottom right corner shows the associations among related sleep variables; thus, positive correlations are also expected within the cluster.

Across 11 datasets, the averaged CES-D score was low but the SD and range were large (8.1 ± 8.5, range: 0 - 55). This pattern started in baseline visit (9.6 ± 9.3, range: 0 - 51) and persisted throughout the 10 follow-ups (Visit 1, 8.4 ± 8.7, range 0 - 55; Visit 2, 8.3 ± 8.5, range 0 - 55; Visit 3, 8.2 ± 8.3, range 0 - 48; Visit 4, 8.2 ± 8.4, range 0 - 52; Visit 5, 8.3 ± 8.2, range 0 - 50; Visit 6, 7.7 ± 8.4, range 0 - 50; Visit 7, 7.5 ± 8.4, range 0 - 55; Visit 8, 7.2 ± 8.9, range 0 - 45; Visit 9, 7.1 ± 7.9, range 0 - 50; Visit 10, 7.0 ± 7.9, range 0 - 52). Moreover, around 47% of the sample met the criteria for elevated risk for depression (CES-D ≥ 15.2) at one or more visits.

Data from baseline visit were used to visualize correlations of depression variables and sleep variables, shown in Figure 2. It is worth noting that the variable measuring participant's sleep quality was not part of the questionnaire used in the baseline visit; thus, the analysis only included 5 sleep variables instead of 6. The result supported construct validity: negative affect variables like BOTHER0 ("I was bothered by things that usually don't bother me") and reverse-coded positive affect variables such as GOOD0 ("I felt I was just as good as other people") demonstrated strong positive intercorrelation within their own clusters. Furthermore, confirming the findings of previous literature, increased sleep disturbances were associated with more frequent depressive symptoms. The heatmaps in Figure 2, as a preliminary analysis, highlighted how disrupted sleep might contribute to or result from worsened mental states.

Somatic symptoms

Table 1. Sleep satisfaction of elevated risk vs non-elevated risk for depression. Restlessness, Typical Night's Sleep, and Sleep Quality were assessed and compared across two groups. The table presents average differences in mean, average p-values from independent t-tests, Cohen's d effect sizes, and Fisher's combined χ^2 and corresponding p-values. Higher scores reflect poorer sleep satisfaction.

	Average diff in mean	Average p	Cohen's d	Fisher's χ^2	Fisher's p
Restlessness	0.74	0.01	0.72	1652.08	0.00
Typical Night's Sleep	0.49	0.23	0.42	420.95	6.16×10^{-86}
Sleep Quality	0.50	6.15×10^{-6}	0.24	381.74	2.43×10^{-71}

Participants' sleep restlessness was measured using variable RESTLES (present in questionnaire from baseline visit to visit 10), typical night's sleep using TYPNIGH (present in questionnaire from baseline visit to visit 3), and sleep quality using SLEEPQ (present in questionnaire from visit 3 to visit 10). Table 1 showed the information for sleep satisfaction of the group with elevated risk for depression and the group without. Group with an increased risk for depression experienced significantly greater restlessness and poorer sleep quality. These effect sizes, though moderate, were statistically robust and consistent across visits. For typical night's sleep, while the average p-value for between-group difference is above .05,

the overall effect was significant when aggregated with Fisher's method. In other words, there was a consistent difference between the two groups' typical night's sleep throughout the visits.

Table 2. Sleep efficiency of elevated risk vs non-elevated risk for depression. Trouble falling asleep, waking up several times, and waking up early were assessed and compared across two groups throughout all eleven visits. The table presents average differences in mean, average *p*-values from independent *t*-tests, Cohen's *d* effect sizes, and Fisher's combined χ^2 and corresponding *p*-values. Higher scores reflect poorer sleep efficiency.

	Average diff in mean	Average *p*	Cohen's *d*	Fisher's χ^2	Fisher's *p*
Trouble Falling Asleep	0.73	0.03	0.46	665.39	1.53×10^{-126}
Waking Up Several Times	0.52	0.08	0.31	395.94	2.82×10^{-70}
Waking Up Early	0.71	0.09	0.45	660.81	1.41×10^{-125}

Table 3. Vasomotor symptoms of elevated risk vs non-elevated risk for depression. Hot flashes, cold sweats, and night sweats were assessed and compared across two groups throughout all eleven visits. The table presents average differences in mean, average *p*-values from independent *t*-tests, Cohen's *d* effect sizes, and Fisher's combined χ^2 and corresponding *p*-values. Higher scores indicate more pronounce vasomotor symptoms.

	Average diff in mean	Average *p*	Cohen's *d*	Fisher's χ^2	Fisher's *p*
Hot Flashes	0.25	0.17	0.18	156.94	2.32×10^{-22}
Cold Sweats	0.21	0.11	0.17	131.80	1.20×10^{-17}
Night Sweats	0.24	0.06	0.19	154.50	6.74×10^{-22}

Regarding sleep efficiency, "trouble falling asleep" was assessed with variable TRBLSLE, "waking up several times per night" using WAKEUP, and "waking up early" using WAKEARL. These 3 variables were all present in questionnaires used from the baseline visit to Visit 10. As demonstrated in Table 2, like satisfaction measures, individuals showing an elevated risk for depression reported less efficient sleep compared to the other group. These effects had also been found consistent across visits as well.

According to *t*-tests, none of the between-group differences in vasomotor symptoms were statistically significant. However, small Fisher's *p*-values showed overall evidence that participants with higher risk for depression consistently reported more hot flashes, cold sweats, and night sweats across visits (Table 3).

Physical health

As shown in Table 4, women in the higher risk group, throughout visits, were more likely to take at least one type of nervous medications including tranquilizers, sedatives, sleeping pills, and anti-depressants. Consequently, they also self-

reported poorer overall health. On the other hand, neither t-test nor Fisher's method found evidence that suggested the group with higher risk was more likely to take at least one type of sleep medications.

Table 4. Use of medication and self-reported overall health of elevated Risk vs non-elevated risk for Depression. Taking at least one type of nervous medication, taking at least one type of sleep medication, and overall health were assessed and compared across two groups throughout all eleven visits. The table presents average differences in mean, average *p*-values from independent *t*-tests, Cohen's *d* effect sizes, and Fisher's combined χ^2 and corresponding *p*-values. Higher scores indicate more likely to take medications and poorer overall health.

	Average diff in mean	Average *p*	Cohen's *d*	Fisher's χ^2	Fisher's *p*
Nervous Medication	0.16	0.08	0.38	481.29	5.76×10^{-88}
Sleep Medication	0.01	0.38	0.04	31.04	0.10
Overall Health	0.59	0.06	0.44	576.47	2.58×10^{-109}

Distribution

The racial composition of women with elevated risk for depression differed significantly compared to that of the non-elevated risk group. Chinese Americans were less likely to be in the higher risk group whereas White Americans and Japanese/Japanese Americans were overrepresented in the group that met the cutoff score (Figure 3).

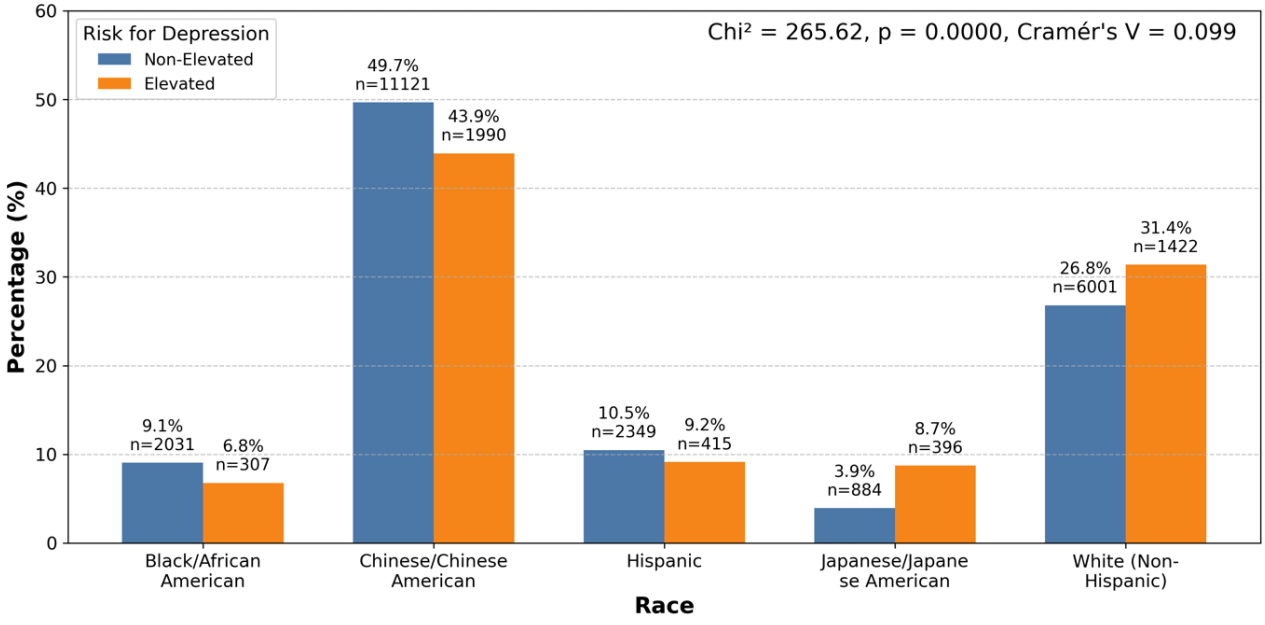

Figure 3. Race distribution by depression risk group from baseline visit across all follow-ups. Each bar represents the proportion of that racial group classified as elevated or non-elevated risk for depression. Each participant was counted more than once—one for each follow-up visit they completed. Percentages and raw counts (*n*) are displayed above each bar. Statistical comparison was conducted using Chi-square test of independence and effect size was measured by Cramér's *V*.

A statistically significant association had been found between menopausal status and depression. As demonstrated in Figure 4, women in early perimenopausal phase made up the largest portion of both groups but were overrepresented in the elevated risk group. In comparison, naturally postmenopausal women were more likely to report fewer depressive symptoms. Pre-menopausal women comprised of roughly 14% of each group. Other categories were more evenly distributed and very few women were pregnant or breastfeeding when being assessed. Although the Chi-square yields a significant *p*-value, a small Cramér's *V* implied that menopausal status alone accounts for only a modest portion of the variance in depression risk.

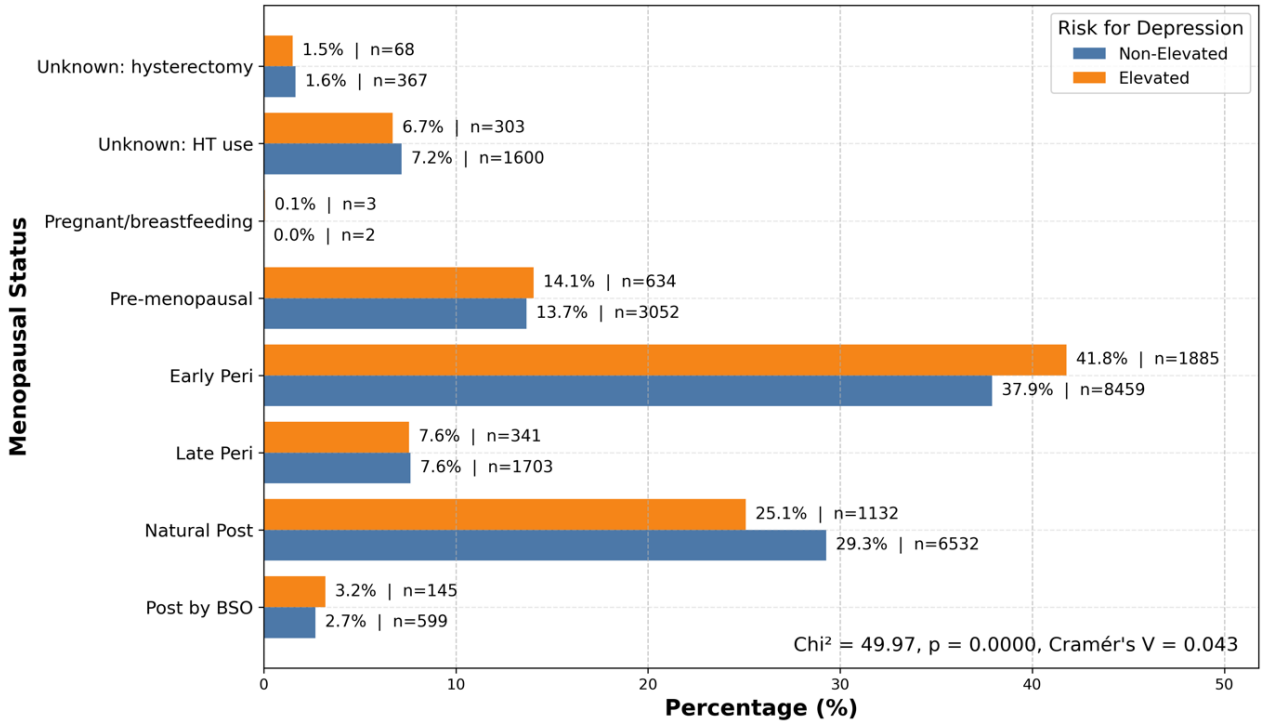

Figure 4. Menopausal status distribution by depression risk group from baseline visit across all follow-ups. Each bar represents the proportion of that racial group classified as elevated or non-elevated risk for depression. Each participant was counted more than once—one for each follow-up visit they completed. Percentages and raw counts (*n*) are displayed above each bar. Statistical comparison was conducted using Chi-square test of independence and effect size was measured by Cramér's *V*.

Finally, age has been found to be significantly correlated with depression as well. The majority of women fell within the range of 47 to 52. Specifically, women between the ages of 42 to 50 were more likely to report clinically significant depressive symptoms. Women of 49 and 50 years old made up the largest portion of the elevated risk group. In contrast, women older than 50 demonstrated healthier mental state with women of 51 years old taking up the most portion of the low-risk group. Like race and menopausal status, despite statistical significance, Cramér's *V* was only less than .01. In other words, the difference in age distribution did not contribute to large disparities between reported depressive symptoms of two groups (Figure 5).

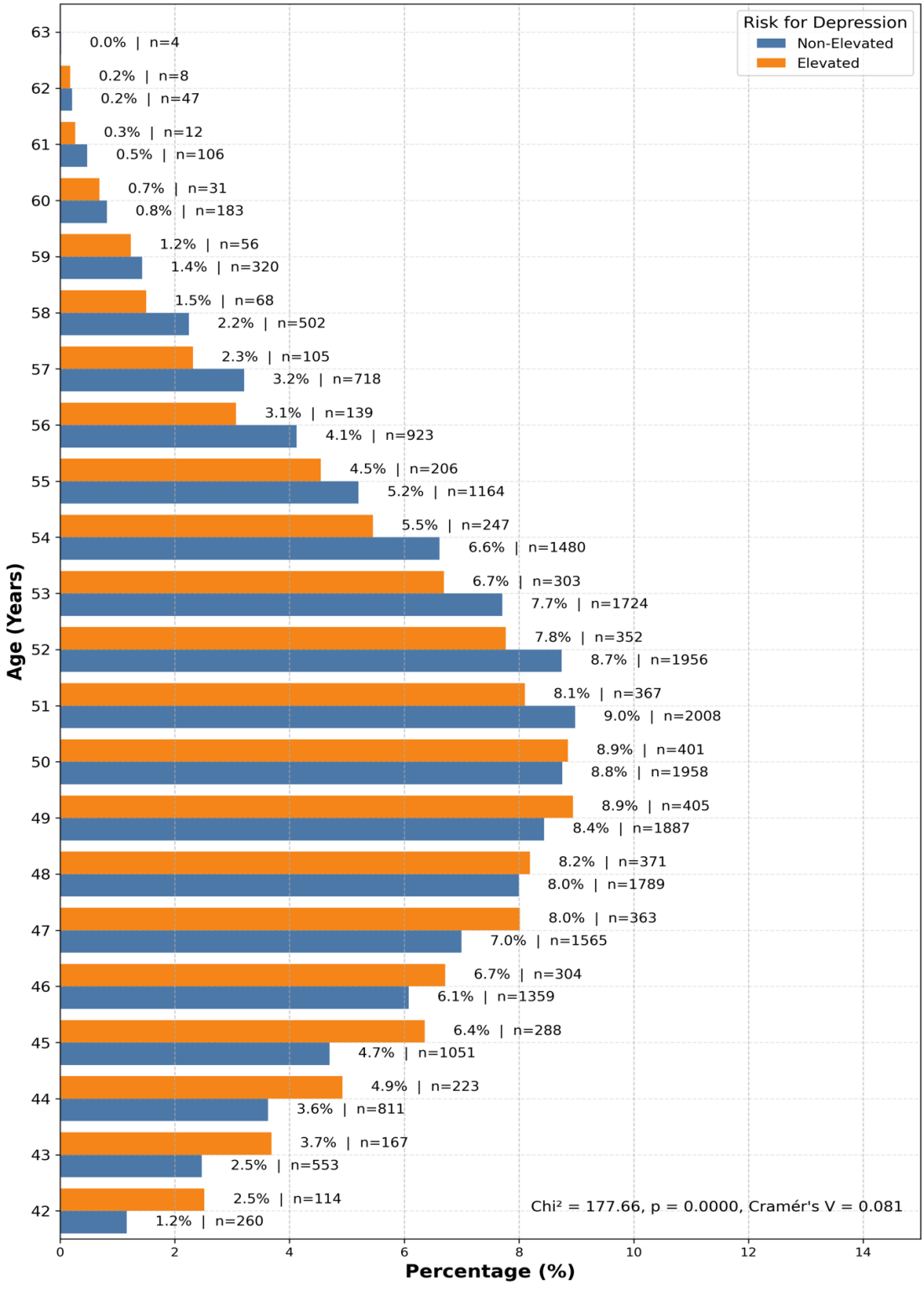

Figure 5. Age status distribution by depression risk group from baseline visit across all follow-ups. Each bar represents the proportion of that racial group classified as elevated or non-elevated risk for depression. Each participant was counted more than once—one for each follow-up visit they completed. Percentages and raw counts (*n*) are displayed above each bar. Statistical comparison was conducted using Chi-square test of independence and effect size was measured by Cramér's *V*.

4. Discussion

This study examined the differences in sleep health, somatic symptoms, physical health as well as race, age, and menopausal status between the group of midlife women with elevated risk for depression and the group without. Supporting the first hypothesis, which tested whether women with an elevated risk for depression would experience lower sleep satisfaction and reduced sleep efficiency, the findings displayed a consistent relationship between depressive risk and various dimensions of sleep disturbances across 11 visits. Women suffering from more depressive symptoms reported significantly higher levels of sleep restlessness and poorer sleep quality. This association suggested that subjective dissatisfaction with sleep could be a core factor that linked to increased susceptibility to depression, confirming previous research that used actigraphy to measure sleep (Bowman et al., 2021). Although the effect sizes were moderate at best, Fisher's p demonstrated consistency and statistical robustness across visits, further emphasizing the validity of these associations. Additionally, it is worth noting that while the between-group differences for typical night's sleep did not reach statistical significance for individual visits, Fisher's method that used to conduct aggregate analysis revealed a significant overall effect. This implied that subtle changes in sleep experiences might accumulate over time and still contribute to mental burdens that are associated with increased risk for depression.

Another sleep health indicator, sleep efficiency—trouble falling asleep, frequent nighttime awakenings, and unusual early morning awakenings—was also significantly worse among participants with higher risk for depression. These results reiterated conclusions from recent literature where polysomnography found prolonged sleep latency and frequent awakenings among patients with depression (Riemann et al., 2020). The persistence of these effects across various visits also highlighted previous speculations that disrupted sleep continuity is not only a predictor and symptom of depression but also a potential biomarker to identify those at risk (Strawbridge et al., 2017).

Regarding vasomotor symptoms, although traditional t-tests failed to detect group differences in vasomotor symptoms at the significant level, the steadily small Fisher's p-values unveiled that participants who were more vulnerable to depression reported experiencing more hot flashes, cold sweats, and night sweats throughout visits. This association, despite small effect sizes, was supported with statistical robustness when aggregated. Supporting the study's second hypothesis, the findings validated the conclusion from a 2018 systematic review that a bidirectional linkage exists between vasomotor symptoms and depression (Natari et al., 2018). These pronounced vasomotor symptoms could potentially contribute to the compromised sleep health observed in the high-risk group. While the onset of sleep is coupled with the falling of core body temperature due to the release of serotonin, higher rectal and oral temperature throughout the sleep period were found among patients struggling with insomnia (Irwin, 2022). Thermoregulatory instability could disrupt sleep continuity, increase restlessness, and thus reduce

overall sleep quality—patterns consistent with self-reports from women scoring higher than the cutoff of CES-D. Previous studies have found that vasomotor symptoms were linked with a surging frequency of nighttime awakenings and poor sleep qualities (Vousoura et al., 2015). Polysomnographic study has also shown that nighttime hot flashes often occurred before waking episodes (Freedman & Roehrs, 2006).

The study also investigated the differences in the use of medication and self-perceived health status. Women who suffered from more depressive symptoms were more likely to report using nervous conditions medications, such as tranquilizers and antidepressants. This pattern echoed prior observations as it was logical for participants of higher risk for depression to need more pharmacological support to manage their mental health. On the contrary, neither *t*-tests nor Fisher's method demonstrated enough evidence of a differential use of sleep medications. This phenomenon could be explained by the habitual practice of using sedating antidepressant, like trazodone and mirtazapine, to treat menopause-related sleep disorders with comorbid depression (Caretto et al., 2019). Moreover, the fact that cognitive behavioral therapy and hormone replacement therapy had both been proven effective in treating menopausal sleep disturbances could also address the lack of a between-group difference for sleep medication (Schaedel et al., 2021). Additionally, participants who scored higher than the clinical cutoff reported poorer overall health throughout multiple visits. This association matched with earlier findings that portrayed a relationship between worsened perceived health and menopausal women as well as negative health perception and depression (Del Sueldo et al., 2018). These trends not only reinforced the broader impact of depressive symptoms on subjective well-being, hinting at a constellation of interrelated challenges that involved not only mental health but also physical factors.

The racial distribution of women at elevated risk for depression diverged significantly from those at non-elevated risk. One possible explanation for Chinese being over-represented in the non-elevated group is that the Western patterns of depression is different from those reported by the Chinese who tend to focus on somatic symptoms and interpret their discomforts as physical in origin. Additionally, in the early 1990s, when the baseline visit was taking place, the term "neurasthenia" was widely employed by medical practitioners in China to diagnose mental illness (Parker et al., 2001). Hence, the difference presented here could possibly mean a difference in understanding or use of terminology. Furthermore, the significant relationship found between race and depressive risks contradicted an earlier study where the incidence or severity of depressive symptoms did not differ between African American and Caucasian women (Brown et al., 2014). On the other hand, when assessed globally, the overall lifetime prevalence of major depressive disorder among Whites was 17.9% while that of African Americans was 10.4%—a pattern that matched with the current study (Williams et al., 2007). One potential explanation lay with the provider: practitioners tended to underdiag-

nose, misdiagnose, and only give the diagnosis of depression to those with more serious, chronic, and debilitating symptoms (Bailey et al., 2019).

Last but not least, the observed correlations between menopausal status, age, and depression provided additional insight into factors influencing women's health during midlife. Data from the menopausal status distribution showed that participants in the early perimenopausal stage were overrepresented in the high-risk group, consistent with current literature which demonstrated that the relationship remained even after adjusting for history of negative life events (Bromberger et al., 2011; Cohen et al., 2006). Perimenopause is often defined as the transitional period before actual menopause begins. Tarlatzis and Zepiridis (2003) stated that sterility usually started at 41 and menopause began a decade after the substantial drop of fertility. Accordingly, the age distribution found that women of age 42 - 50 were more likely to belong in the elevated risk group, replicating the prior conclusion. Aside from sleep disturbances and vasomotor symptoms, a range of menopause-specific complaints such as vaginal dryness, breast pain, joint pain, and change in cognitive function all overlap with mood fluctuations, leading to an increased risk for depression (Willi & Ehlert, 2019). Nevertheless, it is worth noting that while the association between age and depressive risks as well as that of race and depression risks are statistically significant in a large sample like the SWAN study, these demographic factors are week individual predictors of depressive risks.

One of the key strengths of this study is its use of a large, racially and ethnically diverse, longitudinal dataset that enhanced the study's generalizability. With information encompassing 11 assessment points that spanned more than a decade, the current study aims to capture patterns of women's health, both psychological and physical, as they navigated through menopausal transition. Additionally, by analyzing both continuous and dichotomized depression symptoms and employing multidimensional measures of sleep health instead of individual components, the study offers a more comprehensive view of how various variables interact with each other.

Several limitations of this study should be noted as well. First, as a secondary analysis of observational data, the findings could not be used to establish causality. While the results were statistically significant, additional variables that were not accounted for (e.g., stress, weight, education, pain) could confound these associations. Next, despite CES-D being a widely used instrument, it measures depressive symptoms rather than provides a clinical diagnosis. Given that the cutoff might lead to misclassification, it is recommended that future researchers, when possible, use clinical diagnoses to divide participants into groups. In addition, participants attrition over time may also introduce bias, especially if the reasons behind dropping out were related to depressive symptoms. Finally, although the raw data included a diverse sample and bilingual question administration, the cultural differences were still insufficiently captured in the questionnaires, which could impact health perception and, consequently, the self-reporting.

In conclusion, more depressive symptoms were associated with increased sleep discontinuity, increased vasomotor symptoms, and poorer physical health. The findings converge with a growing body of literature that a bidirectional relationship exists between disrupted mental health and sleep experiences. Future scientists interested in investigating the life quality of midlife women should try to manipulate sleep or depression to determine the causality as well as account for other domains to better understand how biopsyosocial factors interact to impact participants' health.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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