Maturitas 190 (2024) 108130

Contents lists available at ScienceDirect

Maturitas

journal homepage: www.elsevier.com/locate/maturitas

Review article

The role of menopausal symptoms on future health and longevity: A systematic scoping review of longitudinal evidence

Robin Andrews [a,*,1], Arron Lacey [b,1], Kate Bache [c,1], Emma J. Kidd [a,1]

[a] Cardiff University Welsh School of Pharmacy and Pharmaceutical Sciences, Redwood Building, King Edward VII Ave, Cardiff, Wales CF10 3NB, United Kingdom
[b] Swansea University Institute of Life Science, Swansea University Medical School, Institute of Life Science 2, Sketty, Swansea, Wales SA2 8QA, United Kingdom
[c] Health & Her Unit D, Tramshed Tech, Pendyris St, Cardiff, Wales CF11 6BH, United Kingdom

ARTICLE INFO

Keywords:
Menopause
Menopausal symptoms
Cognitive decline
Cardiovascular disease
Longevity
Vitality
Psychological wellbeing

ABSTRACT

Women live longer than men but spend more years in poor health. Menopausal symptoms are not generally associated with adverse health outcomes. However, increasingly, evidence suggests they can significantly impact future health and longevity. Understanding the long-term effects of menopausal symptoms will enable clinicians to identify risk factors and intervene with modifications to support healthy aging.

This review examined the scope of research investigating the association between menopausal symptoms and future health outcomes. We searched for longitudinal cohort studies. Date and geographical restrictions were not applied. Articles were screened and data extracted using standardised methods.

Included studies examined the role of menopausal symptoms on future health developments using a sample who had experienced menopause and were deemed healthy at baseline, with clear reporting of their menopausal status at symptom assessment.

We identified 53 eligible studies with data from over 450,000 women enrolled in 28 longitudinal cohorts.

Cardiovascular disease, psychiatric disorders, diabetes, and reduced bone mineral density were positively associated with menopausal symptoms. Breast cancer was associated with an asymptomatic menopause. Psychological menopausal symptoms and cognitive decline improved after menopause, except among women from low socioeconomic backgrounds.

These findings demonstrate that menopausal symptoms are important indicators for future health risks. Future work should investigate the impact of underexplored menopausal symptoms on future health, such as sleeping problems and urogenital issues, and evaluate whether treating menopausal symptoms could lead to improvements in future health outcomes. Should future research continue to support these findings, clinical guidelines should be updated to support clinical decision-making in menopause care.

1. Introduction

While women live longer than men, they spend more years in poor health [1]. One factor distinguishing women from men is that women experience menopause, characterised by large alterations in reproductive hormones during midlife and leading to greater risk of cardiovascular disease, osteoporosis, and cognitive decline [2]. There are over 30 symptoms associated with menopause [3] and it was previously thought that these had little impact on long-term health. However, emerging evidence suggests that menopausal symptoms can have significant impacts on health. For example, severe vasomotor symptoms have been associated with increased white matter hyperintensities [4], heightened risk of cardiovascular diseases [5] and suicidal ideation [6].

Vasomotor symptoms (VMS), such as hot flushes and night sweats, are the most recognised characteristics of menopause, and most treatments focus on relieving VMS [7]. However, on average women experience 7 to 10 distinct co-occurring symptoms [8], falling within psychological (low mood, anxiety), cognitive (brain fog, memory loss), pain (joint pain, headaches) and sleep-specific (sleep disturbances, insomnia) domains [9]. Ethnicity can also impact the experience of

* Corresponding author.
E-mail addresses: AndrewsR16@cardiff.ac.uk (R. Andrews), a.s.lacey@swansea.ac.uk (A. Lacey), kate@healthandher.com (K. Bache), kiddej@cardiff.ac.uk (E.J. Kidd).

[1] Previous dissemination: Andrews R, Lacey A, Bache K, Kidd EJ. Review of the impact of menopause symptoms on longevity. Poster session presented at the Alzheimer's Association International Conference (AAIC) 2023 July 16–20; Amsterdam, Netherlands; e078224.

https://doi.org/10.1016/j.maturitas.2024.108130
Received 24 April 2024; Received in revised form 20 August 2024; Accepted 25 September 2024
Available online 30 September 2024

menopause, with women from African backgrounds reporting more severe VMS compared to other ethnicities [10], whereas women of Chinese and Japanese descent reported much lower rates of VMS [11] but higher rates of cognitive symptoms during the menopause transition or peri-menopausal period (the years leading up to menopause) [12].

Given that menopausal symptoms are multifaceted and can impact women in numerous ways, it is crucial to examine the long-term effects of all symptoms associated with menopause. Improving understanding in this area would enable clinicians to identify risk factors during midlife, allowing them to modify these risk factors against individual profiles to prolong future health and longevity.

1.1. Objectives

This systematic scoping review was conducted to assess the scope of research exploring the longitudinal impact of menopausal symptoms on future health outcomes. This review is the first study within project PROPHECY (Predicting the Role of Oestrogen-related Pathologies on Health Erosion to Conserve healthy Years). A key aim of PROPHECY is to examine the bidirectional impact of menopausal symptoms on future wellbeing. The PROPHECY project was developed to assess longitudinal databanks such as the UK Biobank [13], the Secure Anonymised Information Linkage (SAIL) databank [14], and Whitehall II [15] to assess the influence of menopause-related factors on future health outcomes. The goal of this review was to evaluate limitations in knowledge relating to menopausal symptom types and key outcomes to generate targeted hypotheses for assessment in PROPHECY. The key objectives were to determine:

1. The extent that menopausal symptoms have been explored in relation to future health and longevity.
2. Which health conditions have been assessed in relation to menopausal symptoms.

2. Methods

This review was developed in accordance with the PRISMA extension for scoping reviews [16] and the guidance for developing systematic scoping reviews developed by the Joanna Briggs Institute (JBI) [17]. Further details can be found in the PROSPERO protocol registration, number CRD42023402441, available from: https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=402441. We endeavoured to conduct a systematic scoping review because this approach combines the comprehensive mapping of scoping reviews with the rigor and reproducibility of systematic reviews. This method was suitable for our research objectives because it can accommodate diverse study designs and types of evidence, especially in complex or heterogeneous fields such as menopausal symptomology.

2.1. Search strategy

Between March and August 2023, EMBASE, MEDLINE, CINAHL, OVID Emcare, JBI Library of Systematic Reviews, the Cochrane Library, Scopus and Web of Science were searched. Publication date, geographical region and sample size restrictions were not applied. Only studies published in, or adequately translated to, English were included. Systematic reviews were not included but reference lists of eligible reviews were assessed to identify additional reports.

2.2. Selection criteria

Included studies evaluated the long-term effects of menopausal symptoms. Menopausal symptoms are broad, therefore search terms focused on the top 15 most reported menopausal symptoms indexed by the British Menopause Society [18]. To target outcomes encompassing future health and longevity, search terms included phrases relating to lifespan, psychiatric factors, and phrases relating to the main causes of death in women over 45 years [19] including cardiovascular disease (CVD), self-harm, dementia, organ failure and cancer (Supplementary Table S1).

Titles and abstracts were screened according to three criteria:

1. The sample has experienced menopause and menopausal status at symptom assessment is clear.
2. The sample was deemed healthy at baseline (aside from experiencing menopausal symptoms) or were deemed healthy when they were experiencing menopausal symptoms if assessments were historical.
3. The study explored the association between menopausal symptoms on future health or longevity (i.e., the design was longitudinal or retrospective and examined the role of menopausal symptoms on future health developments).

2.3. Data collection & analysis

Reports which met the criteria were screened independently by two authors. A Kappa statistic ($\kappa = 0.762$, $\rho < 0.001$) indicated acceptable inter-reviewer consistency [20]. Any disagreements were discussed to reach a consensus on inclusion. The process of study selection and exclusion are shown in a PRISMA flowchart (Fig. 1).

Relevant data was extracted including authorship, country, design, cohort, length of follow-up, sample size, menopausal status, menopausal symptom(s), health outcomes and key findings (Supplementary Table S2). Studies were assessed using the JBI Critical Appraisal Checklist, all studies were deemed of suitable quality for assessment as part of a scoping review [21].

We conducted a narrative synthesis describing health outcomes in relation to specific menopausal symptoms. This process involved thematically mapping specific health conditions with specific menopausal symptoms to identify prevalent patterns. Due to differences in menopausal symptoms, populations, follow-up times, and symptom measures, we did not conduct a meta-analysis due to the high level of heterogeneity across studies.

3. Results

3.1. Study characteristics

53 studies met our eligibility criteria, a condensed summary of the associations between menopausal symptoms and future health outcomes is shown in Table 3. These studies included data from 457, 274 women from 28 cohorts. At baseline participants were a weighted mean age of 54.95 years, 19 % of studies included perimenopausal women at baseline, 26 % included only postmenopausal women at baseline, 55 % included both peri- and postmenopausal women at baseline. The Study of Women's Health Across a Nation (SWAN) was the most evaluated cohort, analysed in 26 % of studies. Most studies (n = 37, 70 %) included USA data, with 7 from Northern Europe, 6 from Australia, 5 from Taiwan, 1 from Italy and 1 from Puerto Rico. There were no studies from Africa, Eastern Europe, the Middle East, Southeast or Southwest Asia. Vasomotor symptoms were the most frequently evaluated in 41 % of studies while the least explored symptoms were sleeping problems (n = 2) and palpitations (n = 1) (Fig. 2a). The most explored outcomes were CVD risks, assessed in 30 % of studies (Fig. 2b).

3.2. Cardiovascular disease (CVD) risks

3.2.1. VMS and CVD

Nine studies exploring the association between menopausal symptoms and cardiovascular risk factors focussed specifically on VMS [22–30]. Most studies found a clear association between CVD risks and VMS, suggesting that a history of menopausal VMS is linked to higher future cardiovascular disease risks [22,23,25,28,29]. However, a

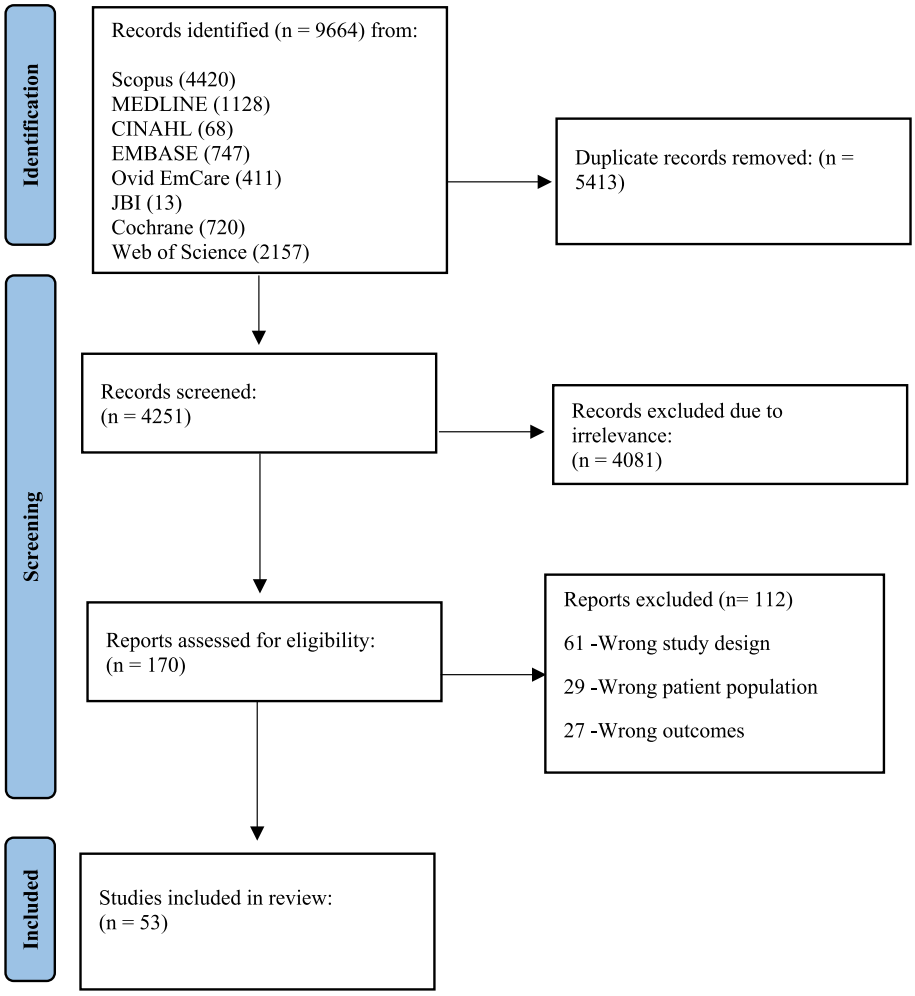

Fig. 1. PRISMA flow diagram of study selection process.

Women's Health Initiative (WHI) study of 20,050 postmenopausal women (median follow-up of 7 years) reported no association between VMS severity and cardiovascular outcomes, but positive associations with total menopausal symptoms and severity regarding CVD and stroke risks [24]. Variations in VMS types, with night sweats having a greater impact than hot flushes, were noted in studies from the US [27], Australia [25], Sweden and the Netherlands [26]. A pooled analysis of individual-level data from 23,365 women in 6 prospective studies indicated that women reporting severity for both hot flushes and night sweats had a higher CVD risk than those with hot flushes alone or night sweats alone [30]. VMS was associated with increased rates of hypertension and higher BMI, however the effects of VMS on CVD risks endured after controlling for these factors [30]. The timing of VMS onset also influenced risks, with both early and late onset associated with increased CVD risks and all-cause mortality [23,30].

3.2.2. *Cumulative effect of menopausal symptoms on CVD*

Four studies focused on the cumulative impact of menopausal symptoms on cardiovascular outcomes [31–34]. Three studies using data from over 28,000 women in The National Health Insurance Research Database in Taiwan found menopausal symptoms were an independent CVD risk factor, after comparing symptomatic and asymptomatic women and following them up after 14 years [31–33]. Another WHI study by Nudy et al. [34] examined the cumulative effects of individual symptoms on CVD and all-cause mortality among 80,278 women across 8 years, revealing significant associations with total number of symptoms and severity of specific symptoms relating to VMS, cognition, musculoskeletal pain, and psychological and sleep symptoms.

3.2.3. *Psychological symptoms and CVD*

Evidence from the Study of Women's health Across a Nation (SWAN) explored whether depressive symptoms were independently associated with coronary arterial calcification (CAC) progression in 346 women who were assessed for 2.3 years. Findings suggested that increased depression scores were associated with CAC progression, and risks were found to be similar to high BMI and systolic blood pressure [35].

3.2.4. *Weight gain during menopause and CVD*

The Adventist Health Study reported a protective effect of weight gain in lean postmenopausal women, showing a significant decrease in CVD mortality risk among those who gained weight during the menopause transition [36]. This study used a sample of 4064 women and followed them up for 17 years.

3.2.5. *Palpitations and CVD*

Distinct patterns of palpitations were observed in another SWAN study of 3276 women who were followed for 16 years. A substantial portion of women experienced palpitations during perimenopause and early post-menopause, however these symptoms were not found to be associated with subclinical CVD [37].

Table 3
Future outcomes in relation to menopausal symptoms.

Future outcomes by MS	Study IDs	N studies (%)	Key finding
CVD			
Menopausal symptoms	Huang et al. [31], Huang et al. [32], Yu et al. [33], Nudy et al. [34]	4 (7)	Symptomatic menopause was associated with greater CVD versus asymptomatic menopause.
VMS	Ferri et al. [22], Szmuilowicz et al. [23], Nudy et al. [24], Dam et al. [25], Gast et al. [26], Svartberg et al. [27], Thurston et al. [28], Thurston et al. [29], Zhu et al. [30]	9 (17)	VMS were heavily associated with CVD risks. Women with persistent and severe VMS were at greater risk. Night sweats were more likely to lead to greater risks than hot flushes.
Psychological symptoms	Janssen et al. [35]	1 (2)	Depressive symptoms during menopause were associated with a 25 % increased risk of CAC progression.
Weight gain	Singh et al. [36]	1 (2)	Among lean women who gained weight during menopause, there was a more than three-fold decrease in CVD mortality risk.
Palpitations	Carpenter et al. [37]	1 (2)	Palpitations were not associated with subclinical CVD.
Cognitive decline			
Cognitive symptoms	Greendale et al. [38], Kilpi et al. [39], Than et al. [40], Karlamangla et al. [41], Maki et al. [42], Epperson et al. [43], Devi [44]	7 (13)	Cognitive symptoms emerged during early perimenopause and returned to premenopausal levels after menopause for most women, although they did not resolve for low-income women.
Psychological symptoms	Greendale et al. [49]	1 (2)	Anxiety and depression symptoms impacted future cognition.
VMS	Peterson et al. [45], Katainen et al. [46]	2 (4)	Little evidence that VMS influenced future cognition.
Sleeping problems	Weber et al. [47], Shieu et al. [48]	2 (4)	Sleep symptoms during menopause worsened future cognitive health.
Weight gain	Soreca et al. [50]	1 (2)	Perimenopausal weight gain was associated with reduced GMV 20 years later.
Psychological wellbeing			
Menopausal symptoms	Hu et al. [60], Chen et al. [61], Kravitz et al. [62], Seib et al. [63], Strauss et al. [64]	5 (9)	Symptomatic menopause was associated with increased risks of developing depressive symptoms and psychiatric illnesses.
VMS	Bromberger et al. [67], Bromberger et al. [68]	2 (4)	Women with VMS were more vulnerable to developing depressive symptoms post-menopause, especially those with lower socioeconomic status.
Psychological symptoms	Campbell et al. [65], Freeman et al. [66]	2 (4)	Depression symptoms which first emerged during menopause tended to abate in post-menopause among women with no prior history of depression.
Breast cancer			
Menopausal symptoms	Fei et al. [54], Huang et al. [55]	2 (4)	Having a symptomatic menopause was associated with a reduced risk of breast cancer.
VMS	Caan et al. [56], Hart et al. [57], Chlebowski et al. [58], Van Den Berg et al. [59]	4 (7)	VMS may be associated with reduced risks of breast cancer unless they persisted well into post-menopause.
Weight gain	Alsaker et al. [51], Harvie et al. [52], Radimer et al. [53]	3 (5)	Weight gain during perimenopause and menopause increased risks of breast cancer, whereas weight loss during menopause decreased breast cancer risks.
Diabetes			
Menopausal symptoms	Reeves et al. [72]	1 (2)	Having multiple concurrent moderate to high intensity menopausal symptoms was associated with early onset of diabetes and metabolic syndrome.
VMS	Thurston et al. [69], Gray et al. [70], Herber-Gast & Mishra [71]	3 (5)	VMS were an independent risk factor for diabetes, heightened insulin resistance, and blood glucose levels.
Chronic kidney disease			
VMS	Cheung et al. [74]	1 (2)	Women with CKD were more likely to have had menopause before age 45, but were less likely to have experienced VMS compared to women without CKD
Bone mineral density			
VMS	Crandall et al. [73]	1 (2)	Even in the earliest menopause transition stages, women with VMS had lower BMD than women without VMS

Abbreviations: MS = Menopausal symptoms, VMS = vasomotor symptoms, CVD=Cardiovascular symptoms, GMV = Grey Matter Volume, CAC = Coronary Artery Calcification, BMD = Bone Mineral Density.

3.3. Future cognition

3.3.1. Cognitive symptoms in relation to future cognition

Seven studies found that cognition was impacted by the menopause transition [38–44], particularly during perimenopause [38,40]. Cognitive detriments were mainly evident in areas relating to verbal learning, verbal memory [38,39,41] and processing speed [38–41]. Outcomes varied, with some studies suggesting cognitive issues resolve after menopause [38,44], while others reported persistent detriments [42,43]. Notably, studies which reported persistent detriments used data from the Women's Interagency HIV Study (WIHS) [42] and the Penn Ovarian Aging study [43] and included longer follow-up times

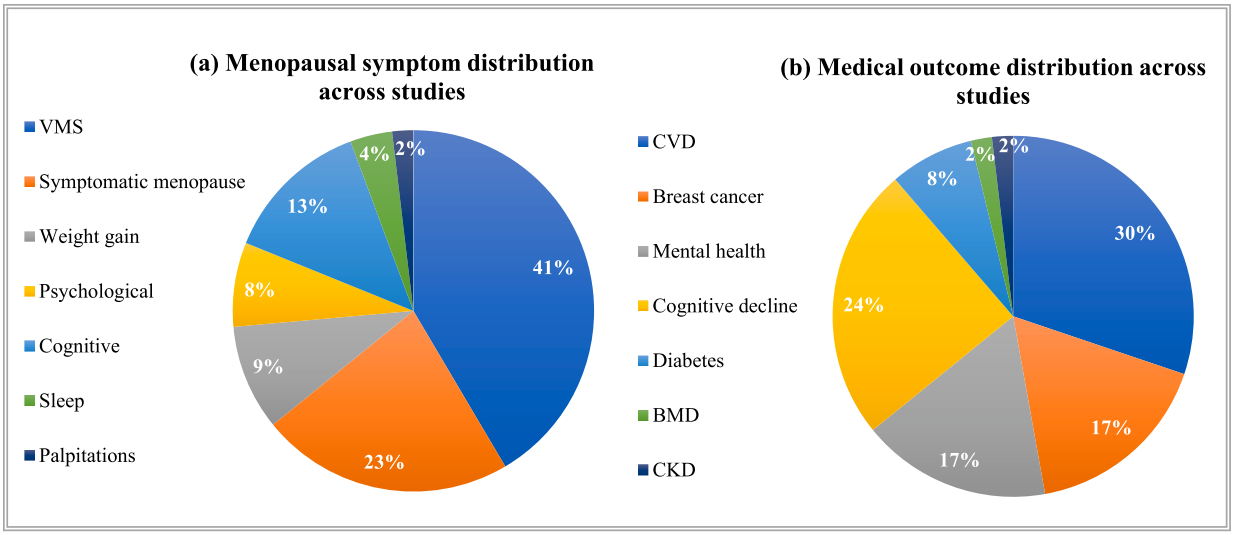

Fig. 2. Pie charts showing (a) menopausal symptom distribution across studies, and (b) medical outcome distribution across studies. VMS vasomotor symptoms, CVD cardiovascular disease, BMD bone mineral density, CKD chronic kidney disease.

(between 8 and 14 years, respectively), more diverse samples, and women of low-income backgrounds.

3.3.2. *VMS and cognition*

Two studies suggested no relationship between VMS and future cognition [45,46]. In the Wisconsin Longitudinal Study (n = 874), experiencing VMS during menopause was not related to cognition 11 years later (at age 65) in covariate adjusted models (e.g. intelligence quotient, socioeconomic status, income) [45]. A second study of 57 women followed from perimenopause to postmenopause for 19 years found that cognitive and sleep symptoms improved as VMS resolved in later life [46].

3.3.3. *Sleep and future cognition*

Two studies explored cumulative sleep effects on future cognition [47,48]. The Rochester Investigation of Cognition Across Menopause (RICAM) followed 85 women for 9 years and found that significant declines in verbal learning and memory were associated with disturbed sleep during the menopause transition [47]. The Health and Retirement Study (HRS) followed 5880 women for 10 years and demonstrated that earlier age at menopause was linked to greater declines in future cognitive performance, mediated by menopause-related insomnia symptoms [48].

3.3.4. *Psychological symptoms and future cognition*

Results from SWAN found that depression and anxiety symptoms during menopause were negatively associated with future cognitive performance among 1903 women who were followed up for 6 years [49]. This study also found no association between VMS and future cognition [49].

3.3.5. *Weight gain and future cognition*

An examination of menopausal weight gain among 48 women in the Pittsburgh Healthy Women Study (HWS) suggested that an increase in BMI during peri-menopause predicted a greater reduction in grey matter volume 20 years later [50].

3.4. *Breast cancer*

3.4.1. *Weight gain during menopause and breast cancer*

Studies indicated increased breast cancer risk with weight gain before menopausal age and decreased risk with weight loss during the menopause transition [51–53]. In the Iowa Women's Health Study, which followed 33,660 women for 15 years, demonstrated that weight loss from age 30 to menopause reduced breast cancer risks [52].

3.4.2. *Symptomatic menopause and breast cancer*

In two large (n > 1400) case-control studies, findings indicated that experiencing menopausal symptoms was associated with a substantially reduced risk of breast cancer, including young-onset breast cancer [54,55].

3.4.3. *VMS and breast cancer*

Studies showed inconsistent results, with some indicating reduced breast cancer risk in women with VMS and others suggesting increased risk with persistent VMS [56–59]. Discrepancies may be attributed to varying study and symptom durations, for example a WHI study found that experiencing persistent VMS (enduring for 10 years or more) was associated with increased risks of breast cancer [58]. This study [58] followed women for 18 years which was at least 10 years longer than studies which found reduced risks [56,57] or no associations [59].

3.5. *Future psychological wellbeing*

3.5.1. *Symptomatic menopause and future psychological wellbeing*

Experiencing a symptomatic menopause was associated with heightened depression scores and increased risks of psychiatric illnesses in the future [60–64]. Notably, a SWAN study [62] of 1551 women followed for 15 years reported that childhood trauma and low social support prior to menopause were also predictive of postmenopausal depression.

3.5.2. *Depression symptoms and future psychological wellbeing*

Two studies suggested depressive symptoms are most likely to emerge in perimenopause and decrease during post-menopause [65,66]. However, in the Penn Ovarian Aging Study (POAS), 203 women were followed for 14 years and findings indicated that women with a history of depression had increased risks of depressive symptoms both before and after menopause in comparison to women with no history of depression [66].

3.5.3. *VMS and future psychological wellbeing*

Two SWAN studies used data from over 3202 women who were followed up between 5 [67] and 8 [68] years. These studies demonstrated that high depressive symptoms after menopause were predicted by frequent VMS, low social support, and stressful life events during the

menopause transition [67,68].

3.6. Diabetes risks

3.6.1. VMS and diabetes risks

Three studies demonstrated associations between VMS, particularly night sweats, and increased risks of developing diabetes and insulin resistance [69–71]. Hot flushes were associated with higher rates of insulin resistance and glucose levels [69]. Among these studies included a WHI study of 150,007 women who were followed for 13 years [70] and found women with night sweats had up to 22 % increased risks of developing diabetes.

3.6.2. Symptomatic menopause and diabetes risk

A SWAN study of 3097 women followed for 20 years demonstrated that multiple concurrent moderate to high intensity physical and psychological symptoms were associated with early onset of diabetes and metabolic syndrome in later life [72].

3.7. Bone mineral density (BMD)

Another SWAN study of 2213 women followed for 5 years found that even in the earliest menopause transition stages, women with a history of VMS had lower BMD than women without VMS [73].

3.8. Chronic kidney disease (CKD)

A WHI study of 17,891 women suggested that women with CKD were more likely to have had menopause before age 45 but less likely to experience VMS during menopause. After 10 years follow-up persistent VMS and CKD were independently associated with increased risk for mortality, but CKD did not modify the association of late VMS with mortality, coronary heart disease or stroke [74].

4. Discussion

4.1. Main findings

This review assessed the scope of longitudinal research examining the effects of menopausal symptoms on future health and longevity. Studies consistently demonstrated adverse effects on physical and psychological well-being during the menopause transition, with vasomotor symptoms (VMS) associated with cardiovascular, psychiatric and diabetes risks. While cognitive effects generally reverted to premenopausal levels, exceptions persisted, especially among low-income women. Notably, menopausal symptoms, excluding weight gain, exhibited a protective effect against breast cancer risks. Sleeping problems and palpitations were infrequently studied, and no studies explored the effects of period irregularities, urogenital symptoms, or headaches on future health outcomes.

4.2. Interpretation

Women with menopausal symptoms face greater risks of CVD, reduced BMD, and diabetes, especially among those reporting severe VMS. Hypertension predicts poorer cardiovascular health and symptoms include VMS, sleep problems, headaches, low energy, and palpitations [75], all of which can emerge during menopause. Consequentially, women who experience certain symptoms during midlife may be experiencing symptoms of hypertension. However, a pooled analysis demonstrated that controlling for hypertension does not diminish night sweats' independent association with heightened CVD risks [30].

An alternative mechanism by which menopausal symptoms may equate to poorer cardiometabolic profiles could be related to oestrogen. Women who do not report menopausal symptoms have been shown to have significantly higher endogenous oestradiol levels, and oestradiol levels have been found to have a positive association with menopausal symptom severity [76]. Vasomotor, sleep, and urogenital symptoms during menopause are characteristic of low oestrogen levels [76–78], and oestrogen has been shown to have a protective influence on bones [76], the heart [76], and glucose metabolism [79]. This would explain why low BMD, CVD and diabetes were found to be significantly associated with menopausal symptoms, particularly VMS.

Moreover, several studies suggested that menopausal symptoms were associated with reduced risks of postmenopausal breast cancer. >70 % of breast cancers are oestrogen –receptor-positive [80] and oestrogens are influential in the progression of breast carcinomas. Markedly, no studies examined the impact of urogenital symptoms during the menopause transition on future health risks and, as these symptoms are driven by low oestrogen levels, it is possible they would also be related to oestrogen-related pathologies. It is important to note, however, that not all studies have found significant relationships between menopausal symptoms and oestradiol levels, suggesting a need to identify other mechanisms by which they emerge and relate to future health risks [76].

Cognitive symptoms which first emerged during menopause were shown to abate for most women after the menopause transition [38,44]. However, in low-income women, cognition continued to decline in the years after the menopause transition [42,43]. As low income has multiple risk factors for cognitive decline including low education, mental illness, high trauma exposure, substance misuse and exposure to infectious diseases, this could suggest that lower income women may be more vulnerable to longer-lasting cognitive effects of menopause [42]. However, it is unclear whether any enduring cognitive changes were related to the development of dementia as this was not assessed in any studies.

As with cognitive symptoms, depression symptoms were also found to abate in the years after menopause among women with no prior history of depression [60,61]. However, women who experienced a highly symptomatic menopause were found to be at greater risk of developing psychiatric illnesses in the years following menopause [60–63,67,68], and this was particularly true for women who reported stress, trauma, and low social support prior to their final menstrual period [62,63]. As with women who continue experiencing cognitive decline after menopause, these findings suggest that certain groups are particularly vulnerable to psychiatric illnesses after menopause. Psychiatric illnesses are also a risk factor for cognitive disease [81]. Therefore, psychological symptoms during menopause may explain the association between further cognitive decline during post-menopause among low-income women, as stress, trauma, and low social support has been associated with poverty [82,83].

5. Strengths, limitations & future directions

A key strength of our review is that it provides a holistic and comprehensive assessment of the long-term effects of menopausal symptoms, to identify gaps in knowledge for researchers aiming to examine this rapidly developing area. Attention was given to variances in research by country of origin, which could be useful to researchers interested in examining geographic disparities in menopause-specific research.

Our goal was to identify the effects of symptoms which emerged as a result of menopause. However, some menopausal symptoms are also recognised characteristics of aging [84] and are prevalent in several conditions which are common during midlife [76]. Therefore, it is likely we missed studies which were eligible for inclusion, as the role of menopause in the development of symptoms could not be verified in them.

Moreover, it is not currently possible for researchers to confirm accurately whether symptoms are related to menopause or are the result of undiagnosed health conditions. Therefore, it could be argued that the cohorts examined in our studies may have been reporting on early signs of aging or poor health, rather than menopausal symptoms per se.

However, the quality of these studies was assessed, and all were deemed of high quality, with reasonable controls for the effects of medical covariates.

Another limitation was that none of the studies involved men as a control group. Certain symptoms are prevalent among both sexes during midlife, such as sleeping problems and psychological symptoms [85]. It is not clear whether similar findings would have occurred in male cohorts. Therefore, future research should aim to distinguish the independent effects of menopausal symptoms from the natural consequences of aging by using male controls.

Most of the studies in our review evaluated data from high income countries, with over 70 % coming from the USA. This is an important limitation as menopausal symptoms vary greatly across countries and ethnic backgrounds [12]. This limitation is mitigated to some extent by the use of the SWAN cohort in many studies, which includes women of various ethnic backgrounds as it was developed to identify ethnic differences in menopause [84]. However, all participants are USA inhabitants, so the extent to which geographic factors influence menopausal symptoms is unclear. Furthermore, a majority studies focussed on vasomotor symptoms. Given that these symptoms are less prevalent among certain ethnic groups, this suggests these findings are less generalisable to women who do not experience these symptoms. Thus, our conclusions on the consequences of menopausal symptoms on future health need to be validated in more diverse populations. Therefore, future research should endeavour to analyse and compare longitudinal data which represents the symptom experiences of women from a wide variety of countries and ethnicities to identify how geolocation and race impact associations between menopausal symptoms and long-term health outcomes.

Sleep-related symptoms are highly prevalent among perimenopausal and postmenopausal women and, in some cases, are shown to be the most common symptom of menopause [86]. However, only two studies assessed sleeping problems [47,48]. Other common symptoms which were not evaluated included period irregularities, low energy, urogenital symptoms, joint pain, and headaches. These symptoms are all highly prevalent among non-white populations and have been shown to significantly impact quality of life [12]. Therefore, research should examine the role of under-explored menopausal symptoms in the development of future health outcomes.

It remains unclear whether women with cognitive symptoms which do not improve after menopause are at greater risk of developing dementia. Given that the best treatment for cognitive disease is prevention and early detection, it is especially pertinent to assess the cognitive risks related to menopause and to understand whether severe cognitive symptoms during the menopause transition can be used to identify at-risk groups.

Given the associations between menopausal symptoms and future health outcomes, it is important that future work identifies whether ameliorating menopausal symptoms during the menopause transition can reduce risks to future health and wellbeing. For example, could interventions which reduce vasomotor symptoms also reduce risks of developing cardiovascular diseases in later life? Ultimately, understanding whether treatment reduces adverse outcomes could empower women to undertake preventative actions during the menopause transition to enhance their future health.

Finally, while papers consistently reported links between menopausal symptoms and the development of medical conditions in the future, there is significant heterogeneity between these studies in terms of designs, symptom measures, and the populations explored. This meant that conducting a statistical analysis of this data was not possible. Thus, these associations should be interpreted with caution.

6. Conclusions

These findings demonstrate that menopausal symptoms are associated with cardiovascular disease, psychiatric disorders, diabetes, and reduced bone mineral density. However, given the wide heterogeneity between studies, future work is needed to definitively confirm these outcomes. Psychological and cognitive symptoms during menopause generally abate post-menopause, except among women from low socioeconomic backgrounds, or who have low social support and high exposure to trauma and stress. Identifying at-risk groups through menopausal symptom evaluation is crucial for improving long-term health. Future research must involve diverse populations, male controls and explore understudied symptoms, with a focus on cognitive disease outcomes. Furthermore, it is essential to assess whether treating menopausal symptoms as they arise could influence future health outcomes. Ultimately these findings suggest that menopausal symptoms are important indicators for future health risks. Should future research continue to support these findings, clinical guidelines should be updated to support clinical decision-making in menopause care.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.maturitas.2024.108130.

Contributors

Robin Andrews conceived the study and conducted the searches, extracted data, conducted quality assessments, and wrote the first draft of the manuscript.

Arron Lacey conceived the study and reviewed and revised the manuscript.

Kate Bache conceived the study and reviewed and revised the manuscript.

Emma J Kidd conceived the study and conducted searches, advised on data extraction, and reviewed and revised the manuscript.

All authors saw and approved the final version and no other person made a substantial contribution to the paper.

Funding

Peer-reviewed project grant funded by The Waterloo Foundation, grant reference 1890/5027; the funder is not involved in any aspect of the work. Additional funding for the same project provided by Health & Her with Kate Bache involved in the conception of the ideas and the writing of the manuscript.

Ethical approval

This is a scoping review and did not involve human or animal participants, therefore ethical approval is not applicable.

Provenance and peer review

This article was not commissioned and was externally peer reviewed.

Declaration of competing interest

RA is employed by Health & Her. AL is a consultant for Health & Her. KB is the co-founder and CEO of Health & Her.

Acknowledgments

We would like to thank our faculty librarian Zoe Young at Cardiff University (Welsh School of Pharmacy and Pharmaceutical Sciences) for advising on the development of our search terms and strategy. We would also like to thank Priya Mistry, Lily Barwood, and Caitlin Spargo for conducting preliminary searches as part of their undergraduate dissertation. Finally, we would like to thank the researchers and participants involved in the included studies for the important insights gleaned from this research, we hope to contribute further insights on this topic.

References

[1] Nusselder WJ, Cambois EM, Wapperom D, Meslé F, Looman CWN, Yokota RTC, et al. Women's excess unhealthy life years: disentangling the unhealthy life years gap. Eur J Public Health [Internet]. 2019 Oct [cited 2023 Sep 11];29(5):914–9. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6761840/.

[2] Rees M, Abernethy K, Bachmann G, Bretz S, Ceausu I, Durmusoglu F, et al. The essential menopause curriculum for healthcare professionals: a European Menopause and Andropause Society (EMAS) position statement. Maturitas [Internet]. 2022 Apr 1 [cited 2023 Sep 11];158:70–7. Available from: https://www.sciencedirect.com/science/article/pii/S0378512221003443.

[3] D. Holloway, The menopause: symptoms, treatments and implications for women's health and well-being, Primary Health Care 33 (4) (Aug 1 2023), https://doi.org/10.7748/phc.2022.e1759 (Internet, cited 2023 Sep 11).

[4] Thurston RC, Wu M, Chang YF, Aizenstein HJ, Derby CA, Barinas-Mitchell EA, et al. Menopausal vasomotor symptoms and white matter hyperintensities in midlife women. Neurol. Int. 2023 Jan 10 [cited 2023 Sep 11];100(2):e133–41. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9841446/.

[5] Thurston RC. Symptom reporting, cardiovascular disease, and mortality as women age: it is more than menopause. Menopause [Internet]. 2022;29(12):1355–6. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85143107978&doi=10.1097%2fGME.0000000000002121&partnerID=40&md5=348b2242df47204d6713c2fc9834ccb2.

[6] S.Y. An, Y. Kim, R. Kwon, G.Y. Lim, H.R. Choi, S. Namgoung, et al., Depressive symptoms and suicidality by menopausal stages among middle-aged Korean women, Epidemiology and Psychiatric Sciences [Internet]. (2022) 31. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85136578260&doi=10.1017%2fS2045796022000439&partnerID=40&md5=e06b2a458a88bfe705f84fe9a5e7e875.

[7] Santoro N, Roeca C, Peters BA, Neal-Perry G. The menopause transition: signs, symptoms, and management options. The Journal of Clinical Endocrinology & Metabolism [Internet]. 2021 Jan 1 [cited 2023 Feb 6];106(1):1–15. Available from: doi:https://doi.org/10.1210/clinem/dgaa764.

[8] Mariette-JB., Are women suffering in silence? New BMS survey puts spotlight on significant impact of menopause, British Menopause Society. (2016). Available from: https://thebms.org.uk/2016/05/women-suffering-silence-new-bms-survey-puts-spotlight-significant-impact-menopause/ (Internet, cited 2023 Sep 11).

[9] S.D. Harlow, C. Karvonen-Gutierrez, M.R. Elliott, I. Bondarenko, N.E. Avis, J. T. Bromberger, et al., It is not just menopause: symptom clustering in the Study of Women's Health Across the Nation, Women's Midlife Health. 3 (1) (2017) 1–13.

[10] S.D. Harlow, S.A.M. Burnett-Bowie, G.A. Greendale, N.E. Avis, A.N. Reeves, T. R. Richards, et al., Disparities in reproductive aging and midlife health between black and white women: the Study of Women's Health Across the Nation (SWAN), Women's Midlife Health [Internet]. 8 (1) (Feb 8 2022) 3, https://doi.org/10.1186/s40695-022-00073-y (cited 2022 Oct 31).

[11] Avis NE, Crawford SL, Greendale G, Bromberger JT, Everson-Rose SA, Gold EB, et al. Duration of menopausal vasomotor symptoms over the menopause transition. JAMA Intern Med [Internet]. 2015 Apr 1 [cited 2024 Jun 18];175(4):531–9. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4433164/.

[12] S. Prasad, Menopause in ethnic minority women, Post Reprod Health (Jul 4 2023) 20533691231186562, https://doi.org/10.1177/20533691231186562 (Internet, cited 2023 Sep 11).

[13] Collins R. What makes UK Biobank special? The Lancet [Internet]. 2012 Mar 31 [cited 2024 Jun 18];379(9822):1173–4. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(12)60404-8/abstract.

[14] Jones KH, Ford DV, Jones C, Dsilva R, Thompson S, Brooks CJ, et al. A case study of the Secure Anonymous Information Linkage (SAIL) Gateway: a privacy-protecting remote access system for health-related research and evaluation. Journal of Biomedical Informatics [Internet]. 2014 Aug 1 [cited 2024 Jun 18];50:196–204. Available from: https://www.sciencedirect.com/science/article/pii/S1532046414000045.

[15] Marmot M, Brunner E. Cohort Profile: The Whitehall II study. International Journal of Epidemiology [Internet]. 2005 Apr 1 [cited 2024 Jun 18];34(2):251–6. Available from: doi:https://doi.org/10.1093/ije/dyh372.

[16] A.C. Tricco, E. Lillie, W. Zarin, K.K. O'Brien, H. Colquhoun, D. Levac, et al., PRISMA Extension for Scoping Reviews (PRISMA-ScR): checklist and explanation, Ann. Intern. Med. 169 (7) (Oct 2 2018) 467–473.

[17] Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. JBI Evidence Implementation [Internet]. 2015 Sep [cited 2023 Aug 29];13(3):141. Available from: https://journals.lww.com/ijebh/fulltext/2015/09000/guidance_for_conducting_systematic_scoping_reviews.5.aspx.

[18] The British Menopause Society, Data on Women's Experience of Menopause in Great Britain Survey, 2016.

[19] Global health estimates: leading causes of death [Internet]. [cited 2023 Sep 8]. Available from: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death.

[20] J.R. Landis, G.G. Koch, The measurement of observer agreement for categorical data, Biometrics (1977) 159–174.

[21] JBI Critical Appraisal Tools | JBI [Internet]. [cited 2023 Sep 11]. Available from: https://jbi.global/critical-appraisal-tools.

[22] L.A. Ferri, N. Morici, G. Bassanelli, N. Franco, L. Misuraca, L. Lenatti, et al., History of vasomotor symptoms, extent of coronary artery disease, and clinical outcomes after acute coronary syndrome in postmenopausal women, Menopause 25 (6) (2018) 635–640.

[23] E.D. Szmuilowicz, J.E. Manson, J.E. Rossouw, B.V. Howard, K.L. Margolis, N. C. Greep, et al., Vasomotor symptoms and cardiovascular events in postmenopausal women, Menopause (New York, NY). 18 (6) (2011) 603.

[24] M. Nudy, X. Jiang, A.K. Aragaki, J.E. Manson, A.H. Shadyab, A.J. Foy, et al., The severity of vasomotor symptoms and number of menopausal symptoms in postmenopausal women and select clinical health outcomes in the Women's Health Initiative Calcium and Vitamin D randomized clinical trial, Menopause 27 (11) (2020) 1265–1273.

[25] V. Dam, A.J. Dobson, N.C. Onland-Moret, Y.T. van der Schouw, G.D. Mishra, Vasomotor menopausal symptoms and cardiovascular disease risk in midlife: a longitudinal study, Maturitas 133 (2020) 32–41.

[26] G.C.M. Gast, V.J. Pop, G.N. Samsioe, D.E. Grobbee, P.M. Nilsson, J.J. Keyzer, et al., Vasomotor menopausal symptoms are associated with increased risk of coronary heart disease, Menopause 18 (2) (2011) 146–151.

[27] J. Svartberg, D. von Mühlen, D. Kritz-Silverstein, E. Barrett-Connor, Vasomotor symptoms and mortality: the Rancho Bernardo Study, Menopause 16 (5) (2009) 888–891.

[28] R.C. Thurston, Y. Chang, E. Barinas-Mitchell, J.R. Jennings, D.P. Landsittel, N. Santoro, et al., Menopausal hot flashes and carotid intima media thickness among midlife women, Stroke 47 (12) (2016) 2910–2915. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84995505888&doi=10.1161%2fSTROKEAHA.116.014674&partnerID=40&md5=b6aee02eb620d82f991c68e7a2876c5c (Internet).

[29] R.C. Thurston, H.E. Aslanidou Vlachos, C.A. Derby, E.A. Jackson, M.M. Brooks, K. A. Matthews, et al., Menopausal vasomotor symptoms and risk of incident cardiovascular disease events in swan, J. Am. Heart Assoc. 10 (3) (2021) 1–17. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85100828878&doi=10.1161%2fJAHA.120.017416&partnerID=40&md5=acec2d8882c61b511a853208f0e0b182 (Internet).

[30] D. Zhu, H.F. Chung, A.J. Dobson, N. Pandeya, D.J. Anderson, D. Kuh, et al., Vasomotor menopausal symptoms and risk of cardiovascular disease: a pooled analysis of six prospective studies, Am. J. Obstet. Gynecol. 223 (6) (2020) 898.e1–898.e16.

[31] C.H. Huang, C.L. Li, C.T. Kor, C.C. Chang, Menopausal symptoms and risk of coronary heart disease in middle-aged women: a nationwide population-based cohort study, PLoS One 13 (10) (2018) e0206036.

[32] C.H. Huang, C.T. Kor, I.B. Lian, C.C. Chang, Menopausal symptoms and risk of heart failure: a retrospective analysis from Taiwan National Health Insurance Database, ESC Heart Failure. 8 (4) (2021) 3295–3307.

[33] C.H. Yu, C.T. Kor, S.C. Weng, C.C. Chang, C.P. Chen, C.L. Wu, Symptomatic menopausal transition and risk of subsequent stroke, PeerJ 7 (2019) e7964.

[34] M. Nudy, A.K. Aragaki, X. Jiang, J.E. Manson, M.A. Allison, A.H. Shadyab, et al., The severity of individual menopausal symptoms, cardiovascular disease, and all-cause mortality in the Women's Health Initiative Observational Cohort, Menopause 29 (12) (2022) 1365–1374. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85143180766&doi=10.1097%2fGME.0000000000002089&partnerID=40&md5=cc6fbc82b47da256204ce1e494939d2a (Internet).

[35] I. Janssen, L.H. Powell, K.A. Matthews, J.F. Cursio, S.M. Hollenberg, K. Sutton-Tyrrell, et al., Depressive symptoms are related to progression of coronary calcium in midlife women: the Study of Women's Health Across the Nation (SWAN) Heart Study, Am. Heart J. 161 (6) (2011) 1186–1191.e1.

[36] P.N. Singh, E. Haddad, S.F. Knutsen, G.E. Fraser, The effect of menopause on the relation between weight gain and mortality among women, Menopause 8 (5) (2001) 314–320.

[37] J.S. Carpenter, Y.I. Cortés, J.E. Tisdale, Y. Sheng, E.A. Jackson, E. Barinas-Mitchell, et al., Palpitations across the menopause transition in SWAN: trajectories, characteristics, and associations with subclinical cardiovascular disease, Menopause 30 (1) (2023) 18–27.

[38] Greendale GA, Huang MH, Wight RG, Seeman T, Luetters C, Avis NE, et al. Effects of the menopause transition and hormone use on cognitive performance in midlife women. Neurol. Int. 2009 May 26 [cited 2023 Sep 11];72(21):1850–7. Available from: https://n.neurology.org/content/72/21/1850.

[39] Kilpi F, Soares ALG, Fraser A, Nelson SM, Sattar N, Fallon SJ, et al. Changes in six domains of cognitive function with reproductive and chronological ageing and sex hormones: a longitudinal study in 2411 UK mid-life women. BMC Womens Health [Internet]. 2020 Aug 14 [cited 2023 Sep 11];20:177. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7427852/.

[40] S. Than, C. Moran, R. Beare, A. Vincent, E. Lane, T.A. Collyer, et al., Cognitive trajectories during the menopausal transition, Frontiers in Dementia 2 (2023), https://doi.org/10.3389/frdem.2023.1098693 (Internet, cited 2023 Sep 11).

[41] A.S. Karlamangla, M.E. Lachman, W. Han, M. Huang, G.A. Greendale, Evidence for cognitive aging in midlife women: study of women's health across the nation, PLoS One 12 (1) (2017) e0169008.

[42] Maki PM, Springer G, Anastos K, Gustafson DR, Weber K, Vance D, et al. Cognitive changes during the menopausal transition: a longitudinal study in women with and without HIV. Menopause [Internet]. 2021 Jan 11 [cited 2023 Sep 11];28(4):360–8. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8576848/.

[43] C.N. Epperson, M.D. Sammel, E.W. Freeman, Menopause effects on verbal memory: findings from a longitudinal community cohort, J. Clin. Endocrinol. Metab. 98 (9) (Sep 2013) 3829–3838.

[44] G. Devi, Menopause-related cognitive impairment, Obstet. Gynecol. 132 (6) (2018) 1325–1327.

[45] A. Peterson, R.T. Gottesman, E.C. Miler, S.E. Tom, The association of vasomotor symptoms during the menopausal transition and cognition in later life, Menopause (New York, NY). 29 (7) (2022) 832.

[46] R. Katainen, J.R. Engblom, P. Polo-Kantola, Climacteric-related symptoms in menopause transition and beyond: a prospective 19-year follow-up study on previously hysterectomized women, Menopause 25 (8) (2018) 890–896.
[47] Weber MT, Rubin LH, Schroeder R, Steffenella T, Maki PM. Cognitive profiles in perimenopause: hormonal and menopausal symptom correlates. Climacteric [Internet]. 2021 Jul 4 [cited 2023 Sep 11];24(4):401–7. Available from: doi: https://doi.org/10.1080/13697137.2021.1892626.
[48] M.M. Shieu, T.J. Braley, J. Becker, G.L. Dunietz, The interplay among natural menopause, insomnia, and cognitive health: a population-based study, Nature and Science of Sleep 15 (2023) 39–48. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85148575288&doi=10.2147%2fNSS.S398019&partnerID=40&md5=5a43416d28e845e71512c1b5b8a11602 (Internet).
[49] G.A. Greendale, R.G. Wight, M.H. Huang, N. Avis, E.B. Gold, H. Joffe, et al., Menopause-associated symptoms and cognitive performance: results from the study of women's health across the nation, Am. J. Epidemiol. 171 (11) (2010) 1214–1224.
[50] I. Soreca, C. Rosano, J.R. Jennings, L.K. Sheu, L.H. Kuller, K.A. Matthews, et al., Gain in adiposity across 15 years is associated with reduced gray matter volume in healthy women, Psychosom. Med. 71 (5) (2009) 485.
[51] M.D.K. Alsaker, I. Janszky, S. Opdahl, L.J. Vatten, P.R. Romundstad, Weight change in adulthood and risk of postmenopausal breast cancer: the HUNT study of Norway, Br. J. Cancer 109 (5) (2013) 1310–1317.
[52] M. Harvie, A. Howell, R.A. Vierkant, N. Kumar, J.R. Cerhan, L.E. Kelemen, et al., Association of gain and loss of weight before and after menopause with risk of postmenopausal breast cancer in the Iowa women's health study, Cancer Epidemiol. Biomarkers Prev. 14 (3) (2005) 656–661.
[53] K.L. Radimer, R. Ballard-Barbash, J.S. Miller, M.P. Fay, A. Schatzkin, R. Troiano, et al., Weight change and the risk of late-onset breast cancer in the original Framingham cohort, Nutr. Cancer 49 (1) (2004) 7–13.
[54] C. Fei, L.A. DeRoo, D.P. Sandler, C.R. Weinberg, Menopausal symptoms and the risk of young-onset breast cancer, Eur. J. Cancer 49 (4) (2013) 798–804.
[55] Y. Huang, K.E. Malone, K.L. Cushing-Haugen, J.R. Daling, C.I. Li, Relationship between menopausal symptoms and risk of postmenopausal breast cancer relationship between menopausal symptoms, Cancer Epidemiol. Biomarkers Prev. 20 (2) (2011) 379–388.
[56] B.J. Caan, A. Aragaki, C.A. Thomson, M.L. Stefanick, R. Chlebowski, F.A. Hubbell, et al., Vasomotor symptoms, adoption of a low-fat dietary pattern, and risk of invasive breast cancer: a secondary analysis of the Women's Health Initiative randomized controlled dietary modification trial, J. Clin. Oncol. 27 (27) (2009) 4500.
[57] V. Hart, S.R. Sturgeon, N. Reich, L.L. Sievert, S.L. Crawford, E.B. Gold, et al., Menopausal vasomotor symptoms and incident breast cancer risk in the Study of Women's Health Across the Nation, Cancer Causes Control 27 (2016) 1333–1340.
[58] R.T. Chlebowski, J.E. Mortimer, C.J. Crandall, K. Pan, J.E. Manson, R. Nelson, et al., Persistent vasomotor symptoms and breast cancer in the Women's Health Initiative, Menopause 26 (6) (2019) 578–587.
[59] M.J. Van Den Berg, G.D. Mishra, Y.T. Van Der Schouw, G.C.M. Herber-Gast, Vasomotor menopausal symptoms are not associated with incidence of breast cancer in a population-based cohort of mid-aged women, Eur. J. Cancer 50 (4) (2014) 824–830.
[60] L.Y. Hu, C.C. Shen, J.H. Hung, P.M. Chen, C.H. Wen, Y.Y. Chiang, et al., Risk of psychiatric disorders following symptomatic menopausal transition: a nationwide population-based retrospective cohort study, Medicine 95 (6) (2016).
[61] M.H. Chen, T.P. Su, C.T. Li, W.H. Chang, T.J. Chen, Y.M. Bai, Symptomatic menopausal transition increases the risk of new-onset depressive disorder in later life: a nationwide prospective cohort study in Taiwan, PLoS One 8 (3) (2013) e59899.
[62] H.M. Kravitz, A.B. Colvin, N.E. Avis, H. Joffe, Y. Chen, J.T. Bromberger, Risk of high depressive symptoms after the final menstrual period: the Study of Women's Health Across the Nation (SWAN), Menopause 29 (7) (2022) 805–815.
[63] C. Seib, K. Lee, J. Humphreys, D. Anderson, Predictors of mental health in midlife and older Australian women: a multilevel investigation, Health Care Women Int. 37 (12) (2016) 1263–1276.
[64] J.R. Strauss, The reciprocal relationship between menopausal symptoms and depressive symptoms: a 9-year longitudinal study of American women in midlife, Maturitas 70 (3) (2011) 302–306.
[65] K.E. Campbell, L. Dennerstein, S. Finch, C.E. Szoeke, Impact of menopausal status on negative mood and depressive symptoms in a longitudinal sample spanning 20 years, Menopause 24 (5) (2017) 490–496.
[66] E.W. Freeman, M.D. Sammel, D.W. Boorman, R. Zhang, Longitudinal pattern of depressive symptoms around natural menopause, JAMA Psychiatry 71 (1) (2014) 36–43.
[67] J.T. Bromberger, K.A. Matthews, L.L. Schott, S. Brockwell, N.E. Avis, H.M. Kravitz, et al., Depressive symptoms during the menopausal transition: the Study of Women's Health Across the Nation (SWAN), J. Affect. Disord. 103 (1–3) (2007) 267–272.
[68] J.T. Bromberger, L.L. Schott, H.M. Kravitz, M. Sowers, N.E. Avis, E.B. Gold, et al., Longitudinal change in reproductive hormones and depressive symptoms across the menopausal transition: results from the Study of Women's Health Across the Nation (SWAN), Arch. Gen. Psychiatry 67 (6) (2010) 598–607.
[69] R.C. Thurston, S.R. El Khoudary, K. Sutton-Tyrrell, C.J. Crandall, B. Sternfeld, H. Joffe, et al., Vasomotor symptoms and insulin resistance in the study of women's health across the nation, J. Clin. Endocrinol. Metab. 97 (10) (2012) 3487–3494.
[70] K.E. Gray, J.G. Katon, E.S. LeBlanc, N.F. Woods, L.A. Bastian, G.E. Reiber, et al., Vasomotor symptom characteristics: are they risk factors for incident diabetes? Menopause (New York, NY). 25 (5) (2018) 520.
[71] G.C.M. Herber-Gast, G.D. Mishra, Early severe vasomotor menopausal symptoms are associated with diabetes, Menopause 21 (8) (2014) 855–860.
[72] A.N. Reeves, M.R. Elliott, M.M. Brooks, C.A. Karvonen-Gutierrez, I. Bondarenko, M.M. Hood, et al., Symptom clusters predict risk of metabolic-syndrome and diabetes in midlife: the Study of Women's Health Across the Nation, Ann. Epidemiol. 58 (2021) 48–55.
[73] C.J. Crandall, Y. Zheng, S.L. Crawford, R.C. Thurston, E.B. Gold, J.M. Johnston, et al., Presence of vasomotor symptoms is associated with lower bone mineral density: a longitudinal analysis, Menopause (New York, NY). 16 (2) (2009) 239.
[74] Cheung KL, Stefanick ML, Allison MA, LeBlanc ES, Vitolins MZ, Shara N, et al. Menopausal symptoms in women with chronic kidney disease. Menopause (New York, NY) [Internet]. 2015 Sep;22(9):1006–11. Available from: https://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=25628057&site=ehost-live&scope=site.
[75] Maas AHEM, Rosano G, Cifkova R, Chieffo A, van Dijken D, Hamoda H, et al. Cardiovascular health after menopause transition, pregnancy disorders, and other gynaecologic conditions: a consensus document from European cardiologists, gynaecologists, and endocrinologists. European Heart Journal [Internet]. 2021 Mar 7 [cited 2023 Sep 11];42(10):967–84. Available from: doi:https://doi.org/10.1093/eurheartj/ehaa1044.
[76] S.R. El Khoudary, G. Greendale, S.L. Crawford, N.E. Avis, M.M. Brooks, R. C. Thurston, et al., The menopause transition and women's health at midlife: a progress report from the Study of Women's Health Across the Nation (SWAN), Menopause (New York, NY). 26 (10) (2019) 1213.
[77] S.S. Faubion, C.J. Crandall, L. Davis, S.R. El Khoudary, H.N. Hodis, R.A. Lobo, et al., The 2022 hormone therapy position statement of the North American Menopause Society, Menopause 29 (7) (2022) 767–794.
[78] J. Marsden, M. Marsh, A. Rigg, Society BM, British Menopause Society consensus statement on the management of estrogen deficiency symptoms, arthralgia and menopause diagnosis in women treated for early breast cancer, Post Reproductive Health. 25 (1) (2019) 21–32.
[79] M. Alemany, Estrogens and the regulation of glucose metabolism, World J. Diabetes 12 (10) (2021) 1622.
[80] Leygue E, Murphy LC. A bi-faceted role of estrogen receptor β in breast cancer. Endocrine-Related Cancer [Internet]. 2013 Jun 1 [cited 2023 Sep 11];20(3): R127–39. Available from: https://erc.bioscientifica.com/view/journals/erc/20/3/R127.xml.
[81] Kępińska AP, MacCabe JH, Cadar D, Steptoe A, Murray RM, Ajnakina O. Schizophrenia polygenic risk predicts general cognitive deficit but not cognitive decline in healthy older adults. Transl Psychiatry [Internet]. 2020 Dec 8 [cited 2023 Sep 12];10(1):1–9. Available from: https://www.nature.com/articles/s41398-020-01114-8.
[82] H. Liao, S. Li, D. Han, M. Zhang, J. Zhao, Y. Wu, et al., Associations between social support and poverty among older adults, BMC Geriatr. 23 (1) (2023) 1–13.
[83] S. Weyers, N. Dragano, S. Möbus, E.M. Beck, A. Stang, S. Möhlenkamp, et al., Low socio-economic position is associated with poor social networks and social support: results from the Heinz Nixdorf Recall Study, Int. J. Equity Health 7 (2008) 1–7.
[84] National Institute on Aging, Research explores the impact of menopause on women's health and aging, Available from: https://www.nia.nih.gov/news/research-explores-impact-menopause-womens-health-and-aging, 2022 (Internet, cited 2023 Nov 20).
[85] H.E. Yeom, Gender differences in climacteric symptoms and associated factors in Korean men and women, Appl. Nurs. Res. 41 (2018) 21–28.
[86] N. Salari, R. Hasheminezhad, A. Hosseinian-Far, S. Rasoulpoor, M. Assefi, S. Nankali, et al., Global prevalence of sleep disorders during menopause: a meta-analysis, Sleep Breath. (2023) 1–15.