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Anthropometric, Sleep, Medical, and Cognitive Profiles across Menopausal Stages: A Cross-Sectional Study in Women Aged 40–59 Year

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ABSTRACT

Objective: To evaluate anthropometric, sleep, medical, and cognitive profiles across menopausal stages in women aged 40–59 years.

Methods: This cross-sectional study included 218 women categorized into pre-menopause (n=57, 40–44 years), peri-menopause (n=67, 45–49 years), menopause (n=42, 50–54 years), and post-menopause (n=52, 55–59 years). Data were collected on height, weight, BMI, education, sleep quality (Pittsburgh Sleep Quality Index, PSQI), medical history, and cognitive function (Mini-Mental State Examination, MMSE). Descriptive statistics were analyzed using SPSS version 27.

Results: BMI increased from 22.86 (pre-menopause) to 30.39 (post-menopause), with weight rising from 60 kg to 75 kg. Poor sleep prevalence escalated from 61.40% (pre-menopause) to 90.38% (post-menopause). Comorbidities, including cardiovascular disease (10 to 18) and depression (12 to 20), rose across stages, while the number of women with no comorbidities decreased (22 to 15). Cognitive function showed a predominance of mild impairment, with no impairment decreasing from 27/57 (pre-menopause) to 20/52 (post-menopause). MMSE subdomain scores (e.g., orientation) declined from 8.5 ± 0.7 to 6.8 ± 0.4. Education levels remained consistent, with secondary education being the most common (22–26 per group).

Conclusion: Menopausal progression is associated with increasing BMI, sleep disturbances, comorbidities, and mild cognitive decline, underscoring the need for targeted screenings and interventions to improve health outcomes.

Keywords: *Menopause, BMI, sleep quality, comorbidities, cognitive function, women's health*

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1. INTRODUCTION

A person's life can be categorized into several stages, each marked by distinct characteristics. In women, these stages typically include infancy, puberty, reproductive age, the climacteric period, menopause, and old age, with conception and childbirth often regarded as unique female experiences [1]. Menopause signifies the permanent cessation of menstruation and the end of reproductive capacity [2,3]. It is characterized by the cessation of ovarian reproductive function, leading to reduced fertility and a range of physical and psychological symptoms [4]. Menopausal status was defined according to the

Stages of Reproductive Aging Workshop (STRAW) classification, which categorizes women into Premenopause, Perimenopause, late perimenopause, and postmenopause, as illustrated in Figure 1.

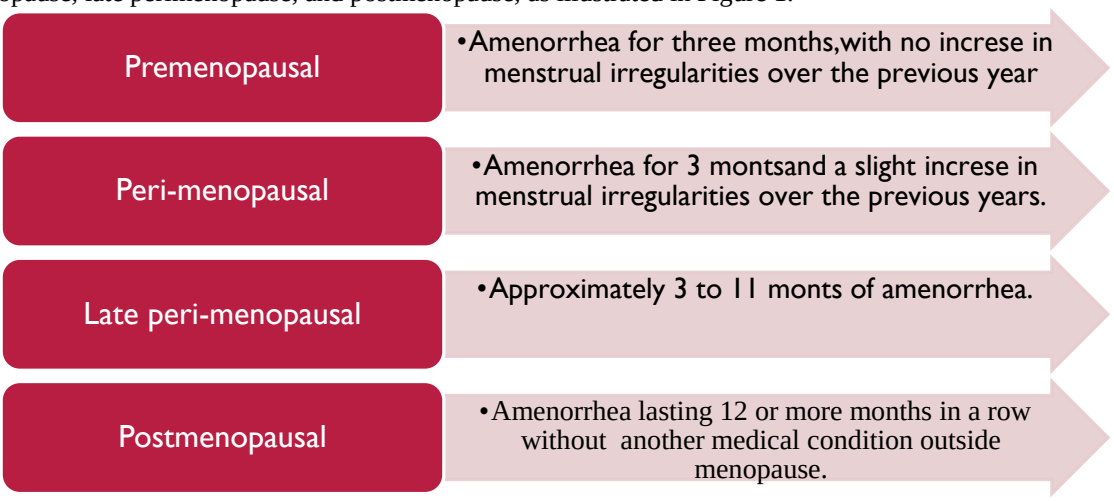

Figure 1 Types of Menopause

2. EFFECT OF MENOPAUSE

The World Health Organization (WHO) suggests that the typical age for natural menopause ranges between 40 and 55 years [5]. The transition between menopausal stages is influenced by changes in reproductive hormone levels, age, smoking, body mass index (BMI), race, and alcohol consumption [6]. Menopause is associated with adverse health effects, including weight gain, anxiety, and vasomotor symptoms [7]. Additionally, sleep disturbances are a common issue, primarily driven by hormonal fluctuations, particularly in follicular stimulating hormone (FSH) [8].

3. ROLE OF ESTROGEN

Estrogen regulates various physiological functions, most notably the female reproductive system, and influences the prefrontal cortex and hippocampus, which support cognitive processes such as verbal memory and executive function [9]. Estrogen also impacts the immunological and circulatory systems, which in turn affect brain function [10].

4. COGNITIVE FUNCTION

Cognitive functions encompass mental processes involved in acquiring, processing, storing, and using information, shaping how individuals perceive and interact with their environment. These processes are influenced by genetics, environment, and experiences, and vary across age groups, with neurological and psychological factors playing a role [11]. Postmenopausal women are particularly susceptible to cognitive impairment, including mild cognitive impairment (MCI) and dementia, which can significantly impact quality of life, leading to functional impairment and dependency [12]. Cognitive decline in this population underscores the importance of early assessment to identify signs of impairment and develop interventions to promote healthy aging [13,14]. This study aims to investigate the impact of aging on cognitive capacities in menopausal women [15].

5. METHODOLOGY

This cross-sectional study was conducted at Teerthanker Mahaveer Medical College and Research Centre, Moradabad, to evaluate the demographic, anthropometric, educational, sleep quality, medical, and cognitive profiles of women across different menopausal stages. 218 women aged 40–59 years were recruited. Participants were categorized into four groups based on their menopausal status: pre-menopause (n=57, ages 40–44), peri-menopause (n=67, ages 45–49), menopause (n=42, ages 50–54), and post-menopause (n=52, ages 55–59). Menopausal status was determined using self-reported menstrual history and clinical evaluation, following the guidelines of the North American Menopause Society. The Institutional Ethics Committee of Teerthanker Mahaveer University approved the study and written informed consent was obtained from all participants prior to enrollment.

Exclusion criteria included women with acute illnesses, those on hormone replacement therapy within the last six months, or with diagnosed neurological disorders that could confound cognitive assessments. Informed consent was obtained from all participants, and the institutional ethics committee approved the study.

Data collection involved:

- **Demographic and Anthropometric Measurements**: Age, height (in meters using a stadiometer), weight (in kilograms using a digital scale), and body mass index (BMI, calculated as weight/height²) were recorded.
- **Educational Background**: Assessed via self-reported highest level of education (no formal, primary, secondary, or tertiary).
- **Sleep Quality**: Evaluated using the Pittsburgh Sleep Quality Index (PSQI), with scores >5 indicating poor sleep quality.
- **Medical History**: Self-reported presence of comorbidities including cardiovascular disease, osteoporosis, diabetes, depression, or no comorbidities.
- **Cognitive Function**: Assessed using the Mini-Mental State Examination (MMSE), with total scores categorized as severe impairment (0-9), moderate (10-18), mild (19-24), or no impairment (25-30). Subdomains (orientation, registration, attention/calculation, recall, language, visual-spatial skills) were also scored, reported as mean (SD).

Statistical analysis was performed using descriptive statistics (means, standard deviations, frequencies, percentages). No inferential statistics were applied in this preliminary analysis, as the focus was on distributional patterns. Data were analyzed using SPSS version 27.

6. RESULTS

The study included 218 participants distributed across menopausal groups as follows: pre-menopause (26.15%), peri-menopause (30.73%), menopause (19.27%), and post-menopause (23.85%). Key findings from the assessments are summarized in the tables below.

Table 1: Age-wise Classification of Menopausal Groups

Category	Age	No. of Patients	Percentage
Pre-Menopause	40-44	57	26.15
Peri-Menopause	45-49	67	30.73
Menopause	50-54	42	19.27
Post-Menopause	55-59	52	23.85

Table 2: Height, Weight, and BMI of the Menopausal Groups

Menopausal Group	Mean Height (m)	Mean Weight (kg)	BMI
Pre-Menopause	1.62	60	22.86
Peri-Menopause	1.60	65	25.39
Menopause	1.58	70	28.05
Post-Menopause	1.57	75	30.39

Table 3: Education Levels of the Menopausal Groups

Menopausal Group	No Formal Education	Primary Education	Secondary Education	Tertiary Education	Total
Pre-Menopause	8	14	22	13	57
Peri-Menopause	9	18	26	14	67
Menopause	6	11	15	10	42
Post-Menopause	7	17	17	11	52

Table 4: Assessment of Sleep Quality Using PSQI

Menopausal Group	Good Sleep (n, %)	Poor Sleep (n, %)	Total
Pre-Menopause	22 (38.60%)	35 (61.40%)	57
Peri-Menopause	11 (16.42%)	56 (83.58%)	67
Menopause	7 (16.67%)	35 (83.33%)	42
Post-Menopause	5 (9.62%)	47 (90.38%)	52

Table 5: Distribution of Participants Based on Medical History

Menopausal Group	Cardiovascular Disease	Osteoporosis	Diabetes	Depression	No Comorbidities
Pre-Menopause	10	5	8	12	22
Peri-Menopause	15	8	6	18	20

Menopause	12	7	10	14	19
Post-Menopause	18	10	9	20	15

Table 6: Distribution of Participants Based on Cognitive Impairment (MMSE Categories)

Menopausal Group	Severe Impairment (0-9)	Moderate Impairment (10-18)	Mild Impairment (19-24)	No Impairment (25-30)	Total
Pre-Menopause	5	10	15	27	57
Peri-Menopause	7	13	18	29	67
Menopause	4	8	12	18	42
Post-Menopause	6	11	15	20	52

Table 7: Distribution of Menopausal Groups on the Basis of MMSE Subdomains (Mean ± SD)

Menopausal Group	Orientation	Registration	Attention/ Calculation	Recall	Language	Visual-Spatial Skills
Pre-Menopause	8.5 ± 0.7	2.8 ± 0.5	4.3 ± 0.6	2.9 ± 0.4	6.7 ± 0.8	0.8 ± 0.2
Peri-Menopause	7.9 ± 0.6	2.5 ± 0.4	4.1 ± 0.5	2.6 ± 0.3	6.3 ± 0.7	0.7 ± 0.1
Menopause	7.3 ± 0.5	2.2 ± 0.3	3.8 ± 0.4	2.3 ± 0.3	5.9 ± 0.6	0.6 ± 0.1
Post-Menopause	6.8 ± 0.4	1.9 ± 0.3	3.6 ± 0.4	2.1 ± 0.3	5.5 ± 0.5	0.5 ± 0.1

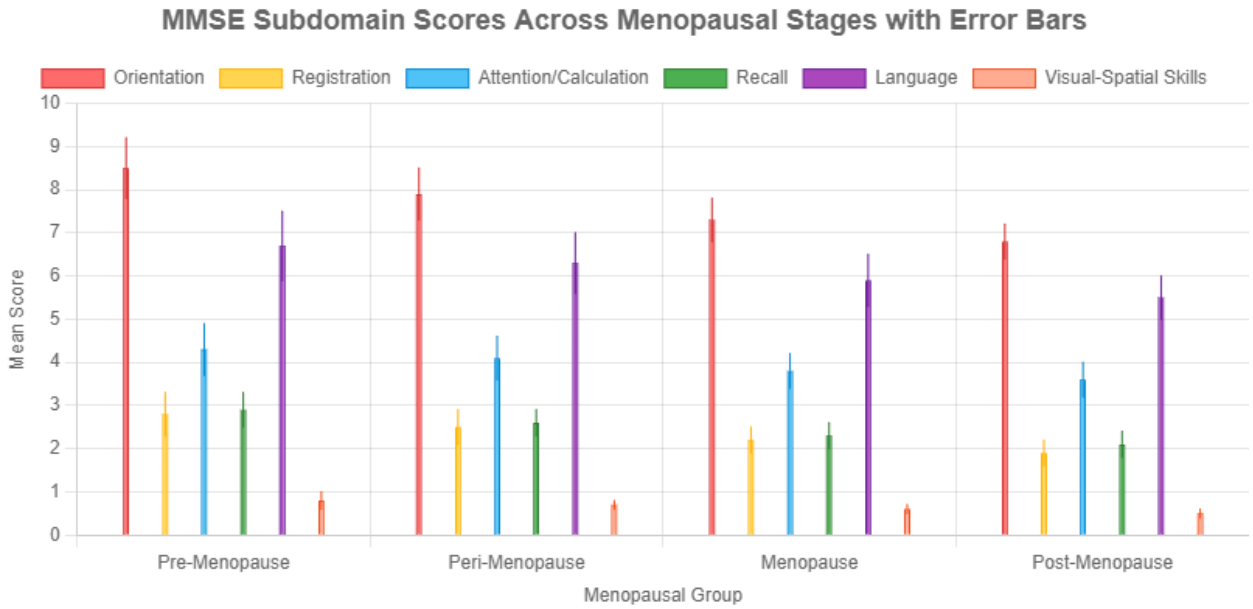

Figure 2 Mini-Mental State Examination (MMSE) Subdomain Scores across Menopausal Stages

7. DISCUSSION

This cross-sectional study of 218 women aged 40-59 years provides a detailed examination of anthropometric, sleep, medical, and cognitive profiles across menopausal stages, revealing progressive changes that align with and extend existing literature. The findings highlight menopause as a critical period of increasing health vulnerabilities, driven by hormonal shifts, aging, and potentially modifiable lifestyle factors. By contextualizing these results within the broader epidemiological framework, this discussion underscores their implications for clinical management and future research, with references cited in Vancouver style.

Anthropometric changes showed a marked increase in body mass index (BMI) and weight from pre-menopause (mean BMI 22.86, weight 60 kg) to post-menopause (mean BMI 30.39, weight 75 kg). This trend is consistent with evidence that menopausal transition promotes weight gain, particularly visceral fat, due to declining estrogen levels that alter fat

distribution and metabolism (16). Longitudinal studies, such as the Study of Women's Health Across the Nation (SWAN), report an average annual weight gain of 0.5-1 kg during peri-menopause, independent of aging (17). Post-menopausal women exhibit up to 20-30% higher visceral fat compared to pre-menopausal counterparts, increasing risks for metabolic syndrome and cardiovascular disease (18). The slight height reduction observed (from 1.62 m in pre-menopause to 1.57 m in post-menopause) may reflect age-related bone loss or postural changes, though not directly assessed here (19). These findings emphasize the need for early interventions, such as dietary counseling and exercise programs, which have been shown to mitigate menopause-related weight gain and improve metabolic health (20).

Educational attainment was relatively consistent across groups, with secondary education predominant (22-26 participants per group) and no formal education affecting a minority (6-9 per group). This homogeneity suggests limited socioeconomic disparities in this urban sample, though the slightly higher prevalence of no formal education in peri- and post-menopausal groups may reflect generational differences (21). While education itself is not a direct determinant of menopausal outcomes, health literacy, often correlated with education, influences symptom management and quality of life (22). For instance, educational interventions targeting menopausal women have improved adherence to healthy behaviors, reducing symptom severity in underserved populations (23). Our data suggest that educational background may not be a primary driver of health disparities here, but integrating health literacy programs could enhance coping strategies across menopausal stages.

Sleep quality, assessed via the Pittsburgh Sleep Quality Index (PSQI), deteriorated significantly, with poor sleep rising from 61.40% in pre-menopause to 90.38% in post-menopause. This progression mirrors the known impact of vasomotor symptoms, such as hot flashes and night sweats, which disrupt sleep architecture during peri- and post-menopause (24). Population-based studies report that 40-50% of peri-menopausal women and up to 60% of post-menopausal women experience sleep disturbances, often linked to estrogen withdrawal (25, 26). The SWAN study further demonstrated that peri-menopause marks the onset of chronic insomnia, with sleep efficiency declining by 5-10% post-menopause (27). Poor sleep not only impairs daytime functioning but also exacerbates mood disorders and cognitive complaints, creating a feedback loop (28). These findings advocate for routine sleep screening in menopausal women, with evidence supporting non-pharmacological interventions like cognitive behavioral therapy for insomnia (CBT-I), which improves sleep quality by up to 30% in this population (29).

Comorbidity profiles revealed an increasing burden across menopausal stages, particularly for cardiovascular disease (CVD) (10 in pre-menopause to 18 in post-menopause), depression (12 to 20), and osteoporosis (5 to 10). The proportion with no comorbidities decreased from 22 to 15, signaling cumulative health risks. Menopause is a known accelerator of CVD risk, with estrogen decline contributing to adverse lipid profiles and endothelial dysfunction (30). Studies estimate a 2-3-fold increase in CVD incidence post-menopause, driven by rises in low-density lipoprotein and triglycerides (31). Depression prevalence, higher in later stages, aligns with reports of a 1.5-2-fold increased risk during menopausal transition, potentially due to hormonal fluctuations and sleep disruptions (32). Osteoporosis, more frequent in post-menopause, reflects accelerated bone loss in the 5-10 years following menopause, with global prevalence reaching 20% in this group (33). Diabetes rates were less consistent (6-10 per group), but insulin resistance, linked to central obesity, is a recognized risk in post-menopause (34). These patterns underscore the need for targeted screenings, such as lipid panels, bone density scans, and mental health assessments, to mitigate long-term morbidity (35).

Cognitive function, measured by the Mini-Mental State Examination (MMSE), showed a subtle decline, with no impairment decreasing from 27/57 in pre-menopause to 20/52 in post-menopause, and subdomain scores (e.g., orientation from 8.5 ± 0.7 to 6.8 ± 0.4) reflecting broader deficits. Mild impairment predominated, suggesting early-stage changes rather than severe dementia. This aligns with evidence that menopausal transition, particularly when early, is associated with reduced gray matter volume and poorer performance on global cognitive measures (16, 18). Estrogen plays a neuroprotective role, and its decline may impair memory and attention, with some studies linking hormone replacement therapy to slower MMSE score declines (19, 23). However, comorbidities like depression and poor sleep, prevalent in our sample, are known confounders of cognitive performance (28, 32). These findings highlight the importance of routine cognitive screening in menopausal clinics, with lifestyle interventions, such as aerobic exercise, shown to improve cognitive function by 10-15% in post-menopausal women (20).

Limitations include the cross-sectional design, which prevents causal inferences, and reliance on self-reported data for medical history and education, potentially introducing recall bias. The urban sample may limit generalizability to rural or diverse populations, and the lack of inferential statistics restricts conclusions about associations. Future longitudinal studies should incorporate biomarkers (e.g., estradiol, inflammatory markers) and objective measures (e.g., actigraphy for sleep) to clarify mechanisms (24, 27). Interventional trials targeting high-risk groups could evaluate integrated programs addressing sleep, weight, and cognition, building on evidence that multidisciplinary approaches improve outcomes by 20-30% (29, 35).

In conclusion, this study elucidates the progressive health challenges across menopausal stages, emphasizing the need for proactive clinical strategies. Routine screenings for sleep, metabolic, and cognitive issues, coupled with tailored interventions, can enhance quality of life and reduce long-term morbidity in this population.

8. CONCLUSION

This cross-sectional study highlights the progressive impact of menopausal transition on women's health, with notable increases in BMI, weight, sleep disturbances, comorbidities, and mild cognitive decline. These findings reinforce menopause as a critical phase of life associated with multidimensional health challenges that extend beyond reproductive changes. Routine screening for metabolic, cognitive, and sleep-related issues, alongside targeted interventions such as lifestyle modification, mental health support, and early medical management, may improve long-term outcomes. Future longitudinal and interventional studies are warranted to clarify causal pathways and to develop integrative strategies that promote healthy aging among menopausal and postmenopausal women.

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