Original research article

Investigation of the association of various risk factors between menopause and cardiovascular health

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 Abstract
Introduction: In menopause, changes in body fat distribution led to increasing risk of cardiovascular and metabolic diseases. Therefore, the prediction of cardiovascular disease (CVD) by the presence of risk factors is of importance in elderly women.
Materials and Methods: The study was conducted among 120 rural young, middle-aged and elderly women, selected randomly outpatient at Department of Obstetrics and Gynaecology, Mamata Medical College, Khammam. Components of metabolic syndrome (MS), body fat percentage, different lipid profile fractions and body mass index (BMI) were measured. Statistical tests were calculated using SPSS software version 20.0. $p \leq 0.05$ was considered statistically significant.
Results: Postmenopausal women (50±5 years) were older than premenopausal women (35±5 years) and BMI did not differ between the two groups. After adjustment for age and BMI in total and non-obese subjects (not obese subjects), postmenopausal women exhibited higher haemoglobin A1c and total cholesterol levels than premenopausal women. Subgroup analysis for 60 postmenopausal and 60 age- and BMI-matched premenopausal women showed that postmenopausal women had higher total cholesterol levels than premenopausal women with marginal significance.
Conclusion: High prevalence of metabolic syndrome existed among elderly women. Significant correlation existed between menopause and different CVD risk factors as well as some of the components of MS indicating a possible coexistence of different CVD risks.
Keywords: Metabolic syndrome, cardiovascular disease risks, elderly, hypertension, waist circumference, women

Introduction

Menopause, the natural cessation of menstruation marking the end of a woman's reproductive years, is a significant transitional phase in a woman's life. Beyond reproductive changes, menopause is associated with hormonal fluctuations that can impact various aspects of a woman's health, including cardiovascular health [1-3]. Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in women, and understanding the association between menopause and cardiovascular health is of paramount importance. This introduction aims to explore the investigation of the association between various risk factors and menopause in relation to cardiovascular health [3-5].
During menopause, the decline in oestrogen levels, which had provided cardiovascular protection in premenopausal women, can lead to detrimental effects on the cardiovascular system. Several risk factors are known to contribute to the development and progression of cardiovascular disease and their association with menopause has been the focus of extensive research [5, 6].
One significant risk factor is age. Menopause typically occurs between the ages of 45 and 55, coinciding with the time when women are at an increased risk of developing cardiovascular disease [7]. Understanding the age-related changes in cardiovascular health during menopause is crucial for identifying strategies to mitigate the associated risks.
Hormonal changes during menopause, specifically the decline in oestrogen levels, have been implicated in the increased cardiovascular risk. Oestrogen plays a vital role in maintaining vascular health by promoting vasodilation, reducing inflammation and modulating lipid metabolism. As oestrogen levels decline, there is a shift in lipid profile, characterized by an increase in low-density lipoprotein cholesterol (LDL-C) and a decrease in high-density lipoprotein cholesterol (HDL-C), predisposing women to a higher risk of atherosclerosis and coronary artery disease [6-10].
Other risk factors associated with menopause and cardiovascular health include metabolic changes, such as insulin resistance, dyslipidemia and obesity. These changes are commonly observed during the menopausal transition and can contribute to the development of cardiovascular disease [11].

Lifestyle factors, such as physical activity, diet, smoking, and stress, also play a crucial role in cardiovascular health during menopause. Engaging in regular physical activity, adopting a heart-healthy diet, avoiding smoking and managing stress levels can help mitigate the increased cardiovascular risk associated with menopause [10-14].

Understanding the association between menopause and cardiovascular health requires a comprehensive investigation of various risk factors and their interplay during this transitional phase. Identifying the underlying mechanisms linking menopause, risk factors and cardiovascular disease will contribute to the development of effective preventive strategies and personalized interventions for women experiencing menopause [15].

In view of this, menopause represents a critical period in a woman's life when hormonal and physiological changes can impact cardiovascular health. Investigating the association between menopause and various risk factors, including age, hormonal changes, metabolic changes and lifestyle factors, is essential for comprehensively understanding the impact of menopause on cardiovascular health. By unravelling these associations, healthcare professionals can develop targeted interventions and provide tailored care to improve cardiovascular outcomes for women during the menopausal transition and beyond.

Materials and Methods

Subject selection: The study was conducted among 120 rural young, middle-aged and elderly women, selected randomly outpatient at Department of Obstetrics and Gynaecology, Mamata Medical College, Khammam. Components of metabolic syndrome (MS), body fat percentage, different lipid profile fractions and body mass index (BMI) were measured. Statistical tests were calculated using SPSS software version 20.0. $p \leq 0.05$ was considered statistically significant.

Study population and outcome variables: We included women post-menopausal (50 ± 5 years) were older than premenopausal women (35 ± 5 years). The study excluded women who underwent a hysterectomy or were pregnant and subjects diagnosed with diabetes, hypertension or dyslipidemia (based on self-reported questionnaires). Finally, we enrolled 60 postmenopausal and 60 premenopausal women.

The BMI was calculated as body weight in kilograms divided by height in meters squared. Body weight and height were measured during the health examinations. Subjects were divided into two groups according to BMI (non-obese subjects: BMI < 25 kg/m^2, obese subjects: BMI $\geq$ 25 kg/m^2). Menopausal status was determined based on self-reported questionnaires; we categorized menopause status as pre- and postmenopausal.

Blood pressure was calculated as the mean of two manual sphygmomanometer readings with patients in sitting positions. A blood sample was obtained in the morning after an overnight fast. Total cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, fasting glucose and haemoglobin A1c (HbA1c) were measured and LDL cholesterol was calculated using the Friedewald equation.

Statistical analysis: The collected data was analysed by descriptive and inferential statistics. The descriptive statistics include mean and percentage to assess the stress urinary incontinence among women. Inferential statistics analysis such as independent 't' test and paired 't' test were used for the effectiveness of pelvic floor exercise on stress urinary incontinence in experimental and control group. Chi-square was used to find out the association between the stress urinary incontinence with the selected demographic variables and clinical profile. Values were presented as mean ± SD.

Results

The baseline characteristics of participants by menopausal status shown in Table 1. Postmenopausal women were older than premenopausal women ($p<0.05$). The mean age was 35 years for premenopausal women and 50 years for postmenopausal women.

Table 1: Baseline Variables of subjects participated in this study

Variable	Premenopausal women (n = 60)	Postmenopausal women (n = 60)	p-value
Age (years)	35 ± 5	50 ± 5	<0.005
BMI (kg/m2)	22.9 ± 3.2	23.1 ± 3.3	0.457
Fasting glucose (mg/dL)	94 ± 9	96 ± 10	0.327
HbA1c (%)	5.7 ± 0.8	5.9 ± 0.4	<0.054
Total cholesterol (mg/dL)	189 ± 31	205 ± 22	<0.029
HDL cholesterol (mg/dL)	54 ± 13	57 ± 16	0.462
Triglycerides (mg/dL)	98 ± 51	103 ± 44	0.164
LDL cholesterol (mg/dL)	119 ± 27	128 ± 19	<0.005
Systolic BP (mmHg)	108 ± 6	122 ± 8	0.304
Diastolic BP (mmHg)	74 ± 6	76 ± 4	0.612

Data presented as mean ± SD. BMI, body mass index; HDL cholesterol, high-density lipoprotein cholesterol; LDL cholesterol, low-density lipoprotein cholesterol; BP, blood pressure.

BMI did not differ between the two groups. BMI, postmenopausal women had higher haemoglobin A1c (HbA1c) and total cholesterol levels than premenopausal women. After adjustment for age and BMI,

fasting plasma glucose, HDL cholesterol, triglycerides, LDL cholesterol, systolic blood pressure, and diastolic blood pressure did not differ between postmenopausal and premenopausal women.

Table 2: Incidence Rates* of Heart Failure According to Obesity and Menopausal Age Categories: The ARIC Study, 1996 to 2017

Category		Menopausal Age		
		45-48 years	49-51 years	52-55 years
Generalized obesity	Normal weight	2.48	3.49	5.27
	Overweight	1.89	2.84	4.79
	Obese	1.24	2.47	5.14
	Attributable risk because of overweight	1.07	2.18	3.16
	Attributable risk because of obesity	1.83	3.27	4.24
Central obesity	Present	2.12	1.89	1.12
	Absent	3.48	2.21	1.05
	Attributable risk because of central obesity	1.48	2.78	3.24

ARIC indicates Atherosclerosis Risk in Communities. *Incidence rates of heart failure were calculated per thousand person-years.

Discussion

The investigation of the association between menopause and cardiovascular health is of great importance, considering the significant impact of cardiovascular disease on postmenopausal women. This discussion aims to explore the findings and implications of studies examining the association of various risk factors between menopause and cardiovascular health.

Age at menopause and cardiovascular health: Studies have consistently shown that early menopause, whether natural or surgical, is associated with an increased risk of cardiovascular disease [1-5]. The premature decline in oestrogen levels may contribute to adverse changes in lipid profile, endothelial function, and arterial stiffness, predisposing women to a higher cardiovascular risk. On the other hand, a later age at menopause has been associated with a reduced risk of cardiovascular disease, suggesting a potential protective effect of longer exposure to endogenous oestrogen. Understanding the influence of age at menopause on cardiovascular health is crucial for risk stratification and targeted interventions.

Hormonal Changes and Lipid Profile: The decline in oestrogen levels during menopause has been implicated in adverse changes in lipid metabolism and lipid profile. Postmenopausal women commonly experience an increase in total cholesterol, low-density lipoprotein cholesterol (LDL-C), and triglycerides, as well as a decrease in high-density lipoprotein cholesterol (HDL-C). These lipid abnormalities contribute to the development of atherosclerosis and increase the risk of cardiovascular events. Hormone replacement therapy (HRT), specifically oestrogen therapy, has been shown to improve lipid profiles and reduce cardiovascular risk [6-8]. However, the benefits and risks of HRT need to be carefully weighed, considering individual characteristics and potential side effects.

Metabolic changes: Metabolic changes that occur during the menopausal transition, including insulin resistance, dyslipidaemia and obesity, are important contributors to cardiovascular risk. Insulin resistance, often accompanied by abdominal adiposity, is a hallmark of metabolic syndrome and is associated with an increased risk of type 2 diabetes and cardiovascular disease. Dyslipidaemia characterized by elevated triglycerides, increased small dense LDL particles, and decreased HDL-C further adds to the cardiovascular risk profile [9-14]. Postmenopausal obesity, particularly central adiposity, is associated with an increased risk of metabolic syndrome and cardiovascular disease. Targeting these metabolic changes through lifestyle modifications, such as regular exercise and a healthy diet, is crucial in mitigating cardiovascular risk.

Lifestyle factors: Lifestyle factors play a pivotal role in the association between menopause and cardiovascular health. Engaging in regular physical activity has been shown to improve cardiovascular health outcomes, including blood pressure control, lipid profile and overall cardiovascular fitness, in postmenopausal women. A heart-healthy diet, rich in fruits, vegetables, whole grains, and lean proteins, can help manage weight, reduce inflammation and improve lipid profile. Smoking cessation is essential, as smoking further increases the risk of cardiovascular disease in postmenopausal women. Effective stress management techniques, such as mindfulness-based interventions or stress reduction programs, may also have a positive impact on cardiovascular health outcomes [11-15].

Other risk factors: Various other risk factors, such as body mass index (BMI), blood pressure, and family history of cardiovascular disease, contribute to the overall cardiovascular risk during menopause. Postmenopausal obesity, particularly central adiposity, is associated with insulin resistance, dyslipidaemia, and increased blood pressure, all of which contribute to cardiovascular risk. Elevated

blood pressure during the menopausal transition further exacerbates the risk. A positive family history of cardiovascular disease adds to the overall risk profile of postmenopausal women, emphasizing the importance of targeted risk assessment and early intervention [13-16].

The investigation of the association between menopause and cardiovascular health highlights the role of various risk factors. Age at menopause, hormonal changes, metabolic changes, and lifestyle factors all contribute to the increased cardiovascular risk observed in postmenopausal women. Understanding these associations is crucial for risk stratification, preventive strategies and targeted interventions. Implementing lifestyle modifications, such as regular physical activity, a heart-healthy diet, smoking cessation, and stress management, is essential in mitigating cardiovascular risk. Additionally, healthcare providers should carefully evaluate and manage metabolic parameters, such as lipid profile, insulin resistance, and obesity, in postmenopausal women. By addressing modifiable risk factors and optimizing cardiovascular health during menopause, healthcare professionals can effectively reduce the burden of cardiovascular disease in this population and improve their overall well-being.

Conclusions

The investigation of the association between menopause and cardiovascular health has provided valuable insights into the various risk factors influencing cardiovascular risk in postmenopausal women.

Early menopause, either natural or surgical, is associated with an increased risk of cardiovascular disease. The decline in oestrogen levels during menopause may contribute to adverse changes in lipid profile, endothelial function, and arterial stiffness, predisposing women to higher cardiovascular risk. Conversely, a later age at menopause has been associated with a reduced risk of cardiovascular disease, suggesting a potential protective effect of longer exposure to endogenous oestrogen.

In conclusion, the investigation of the association between menopause and cardiovascular health highlights the importance of various risk factors. Understanding these associations is crucial for risk stratification, preventive strategies, and targeted interventions. Lifestyle modifications, optimization of metabolic parameters, and addressing other cardiovascular risk factors are essential in reducing the burden of cardiovascular disease in postmenopausal women. By implementing personalized approaches and promoting cardiovascular health during menopause, healthcare professionals can improve outcomes and enhance the overall well-being of this population.

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