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Effect of Menopause on the Increased Cardiovascular Risk Factors at Public Health Centers in Semarang Regency

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ABSTRACT

Background: Menopause potentially causes changes in metabolic disorders and atherosclerosis. This condition triggers cardiovascular disease (CVD) 16 times greater than breast cancer.

Objective: This study aimed to identify the prevalence of CVD risk factors in Prolanis participants at the Semarang Regency Health Center.

Methods: A cross-sectional study was conducted with 147 participants, who were selected from a group of 208 individuals who had undergone menopause and agreed to participate, and for whom complete data was available. Data on body mass index, blood pressure, random glucose levels, and cholesterol were collected from August to October 2025. Statistical analyses were then performed using one-way ANOVA and Pearson's correlation test.

Results: The results showed that menopause and the age at first menopause were significantly different, while the differences and correlations between menopause and blood pressure, blood glucose, and lipid levels were not significant.

Conclusion: The prevalence of metabolic syndrome (Met-S) in postmenopausal women increases with age. Menopause and Met-S had no significant differences and correlations, although women with Met-S showed a higher risk of CVD.

Keywords: Cardiovascular, menopause, metabolic syndrome, risk factors

ABSTRAK

Latar Belakang: Menopause berpotensi menimbulkan perubahan gangguan metabolik dan aterosklerosis. Kondisi ini memicu penyakit kardiovaskular (PKV) 16 kali lebih besar daripada kanker payudara.

Tujuan: Penelitian ini bertujuan untuk mengidentifikasi prevalensi faktor risiko PKV pada peserta Prolanis di Puskesmas Kabupaten Semarang.

Metode: Penelitian ini merupakan penelitian cross-sectional terhadap 147 peserta dari 208 peserta dengan data lengkap, yang telah menopause dan memutuskan untuk mengikuti. Data indeks massa tubuh, tekanan darah, kadar glukosa acak, dan kolesterol dikumpulkan pada bulan Agustus sampai Oktober 2025. Selanjutnya digunakan uji statistik one-way ANOVA dan korelasi Pearson.

Hasil: Hasil penelitian menunjukkan bahwa menopause dan usia pertama menopause berbeda secara signifikan, sedangkan perbedaan dan korelasi antara menopause dengan tekanan darah, glukosa darah, dan kadar lipid tidak signifikan.

Kesimpulan: Prevalensi sindrom metabolik (Met-S) pada wanita pascamenopause meningkat seiring bertambahnya usia. Menopause dan Met-S tidak memiliki perbedaan dan korelasi yang signifikan, meskipun wanita dengan Met-S menunjukkan risiko CVD yang lebih tinggi.

Kata kunci: Faktor resiko, kardiovaskuler, menopause, sindroma metabolik

INTRODUCTION

The prevalence of cardiovascular disease (CVD) has shifted from developed to developing countries, specifically in low- and middle-income nations such as Indonesia. The proportion of deaths attributed to CVD in developed countries decreased from 48% to 43%, while in developing countries, it rose from 18 to 25% over the same period[1].

In Indonesia, CVD mortality rate has shown a concerning trend from 2000 to 2019, increasing from 356.05 to 412.46 deaths per 100,000 men, and 357.52 to 354.07 deaths per 100,000 women. This period has also witnessed a rise in exposure to various risk factors, including obesity (up by 9%), smoking (1%), dyslipidemia (1.3%), hyperglycemia (2%), and hypertension (1.2%). Between 1990 and 2019, an additional 14,517 men and 17,917 women succumbed to CVD, primarily due to increased exposure to obesity[1].

All CVD are characterized by an increase in mortality rates, with the exceptions of rheumatic heart disease (RHD), and congenital heart disease (CHD), which decreased by 69% and 37% respectively. Stroke and ischemic heart disease remain the leading causes of death and morbidity in Indonesia, while stroke and peripheral artery disease (PAD) are the most common cardiovascular conditions[2]. Indonesia has the second-highest rate of CVD disability-adjusted life years (DALYs) among ASEAN countries, trailing only Laos in the first position. In Central Java, the burden of CVD DALYs is estimated at 11%. The impact of RHD and PAD is particularly significant among women[3].

Cardiovascular disease has emerged as the primary cause of mortality among women. It occurs 16 times more frequently than breast cancer and is becoming an increasingly significant risk factor for younger women. Women face specific sex-related cardiovascular risk factors due to hormonal influences, including contraception, pregnancy, endometriosis, polycystic ovary syndrome, gestational diabetes, preeclampsia, miscarriage, age at menarche, hysterectomy, and menopause[4].

The prevalence and effects of risk factors differ between men and women. In some age groups, women experience more CVD than men, which can be attributed to negative lifestyle changes such as increased smoking, stress, obesity, and sedentary behavior. Furthermore, cardiovascular risk factors such as hypertension, smoking, stress (mental tension), and diabetes tend to have a more severe impact on women arterial health compared to men[4].

Menopause has a greater impact on various metabolic biomarkers than aging[5]. It leads to changes in lipoprotein, fatty acid, and amino acid metabolism that occur independently of age, potentially contributing to the association between menopause and cardiometabolic diseases. The timing, whether early or late, plays a less critical role as risk factor for CVD than menopause[6].

Evidence from previous studies suggests that the timing of menopause may be linked to cardiovascular disease (CVD) risk, with a reciprocal relationship between the two. Data from the Framingham Heart Study demonstrated that elevated total cholesterol levels, higher systolic and diastolic blood pressure, and the presence of other CVD risk factors were independently associated with an earlier onset of menopause, regardless of smoking status[7].

Menopause is an important stage in a woman's life that can increase her risk of developing cardiovascular disease (CVD). This transition is associated with changes to cardiovascular risk profiles, metabolic health indicators and the progression of subclinical atherosclerosis[7]. Menopause-related hormonal alterations contribute to an increased cardiovascular risk through mechanisms such as the accumulation of visceral fat, hypertention, dyslipidaemia, disturbances in glucose metabolism, and non-alcoholic fatty liver disease. This study therefore aimed to assess the prevalence of these risk factors among participants in the Chronic Disease Management Programme (CDMP/Prolanis) at the Bringin, Leyangan, Lerep and Jimbaran public health centres in the Semarang district.

METHODS

This study was conducted at Bringin, Leyangan, Jimbaran, and Lerep Public Health Centres, Semarang District, Central Java Province, from November – December 2024, with a total number of 208 participants. Inclusion criteria were women, menopausal, CVD patients with or without metabolic syndrome (Met-S) comorbidities, complete data, and willingness to submit informed consent. By contrast, participants were excluded if they had a history of thyroid disorders, neoplastic

diseases or mental health conditions, or if they were using menopausal hormone therapy (MHT) in non-oral forms, such as patches or suppositories. After considering the exclusion criteria, only 145 participants were allowed to participate.

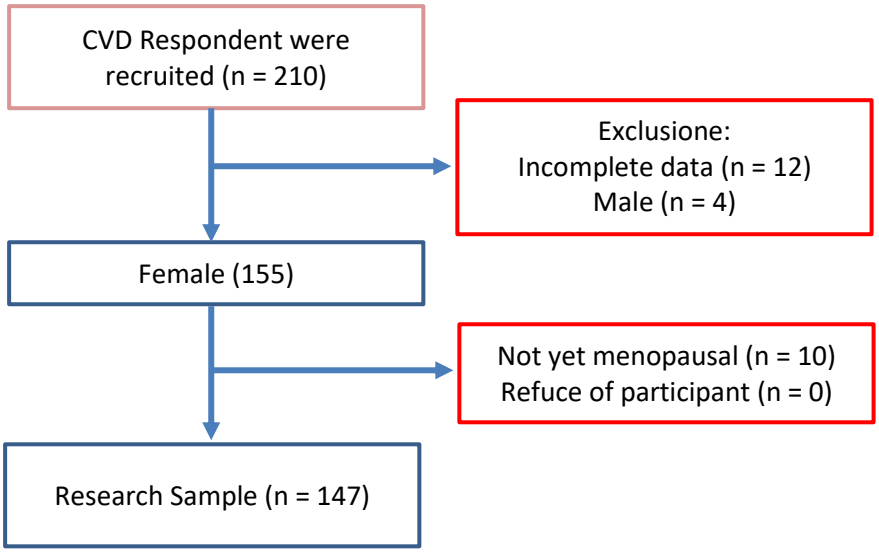


Figure 1. Research Sampling Flowchart

Study Design

This study employed a cross-sectional design with non-random convenience sampling. Data were collected via surveys and medical records from four primary health centres in Semarang district. Evaluations included anthropometric measurements, such as body mass index (BMI), blood pressure assessments and clinical laboratory analyses, including glucose levels, diabetes status (random blood sugar, RBS) and lipid profiles. Data checklists were also used.

Blood was collected from the ulnar vein using a Vacutainer system to assess key biochemical markers, including glucose, total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG). Participants were then divided into groups based on:

a. Menopausal status[8]:
   1. Perimenopause is the phase leading up to menopause, characterized by the initial endocrine, biological, and clinical symptoms of menopause.
      (a) Premature menopause - menopause that occurs before age 40.
      (b) Early menopause - menopause that occurs after age 40 but before age 45.
   2. Post menopause - the final menstrual period is defined as occurring at least 12 months prior to the time of assessment and usually occurs in a woman's late 40s or early 50s.

b. According to the 2020 ISH Global Practice Guidelines, hypertension is defined as having a SBP of at least 140 mmHg, a DBP of at least 90 mmHg, or being currently treated with antihypertensive drugs[9].

c. According to guidelines from the Centers for Disease Control and Prevention (CDC), body mass index (BMI) categories are defined as follows: underweight (BMI less than 18.5), normal weight (BMI 18.5 to 24.9), overweight (BMI 25.0 to 29.9), and obese (BMI 30 or higher). General obesity is characterized by a BMI of 30 kg/m² or greater, whereas abdominal obesity is identified by a waist circumference exceeding 80 cm[10].

d. Metabolic syndrome (MetS) was defined based on the most current criteria set by the International Diabetes Federation (IDF) and the updated guidelines from the National Cholesterol Education Programme's Adult Treatment Panel III (NCEP ATP III)[11]. Women were considered to have metabolic syndrome if they met at least three of the five specified risk factors. These include:
   1. Waist Circumference: A waist measurement of 80 cm or more.
   2. Triglycerides: Triglyceride levels above 150 mg/dL (or 1.7 mmol/L), or ongoing treatment for this lipid issue.
   3. HDL Cholesterol: HDL cholesterol levels

below 50 mg/dL (or 1.3 mmol/L), or ongoing treatment for this lipid issue.

4. Blood Pressure: Elevated blood pressure with systolic blood pressure (SBP) at 130 mmHg or higher, or diastolic blood pressure (DBP) at 85 mmHg or higher, or treatment for previously diagnosed high blood pressure.
5. Fasting Plasma Glucose: A fasting blood glucose level of 100 mg/dL (or 5.6 mmol/L) or higher, or a previous diagnosis of type 2 diabetes mellitus (T2DM). An oral glucose tolerance test (OGTT) is recommended if fasting glucose is above 100 mg/dL (5.6 mmol/L), though it is not mandatory for diagnosis.

e. Pre-metabolic syndrome (pre-MetS) was defined as the presence of at least two individual components without meeting all the criteria required for a MetS diagnosis[12].

f. Dyslipidaemia - diagnosed in accordance with the National Cholesterol Education Programme (NCEP) guidelines[13], if:

1. Total Cholesterol (TC): A level of 240 mg/dL or higher.
2. Triglycerides (TG): A level of 88 mg/dL or higher.
3. Low-Density Lipoprotein Cholesterol (LDL-C): A level of 160 mg/dL or higher.
4. High-Density Lipoprotein Cholesterol (HDL-C): A level of 40 mg/dL or lower, or the use of medications to regulate lipids.

Statistical Analysis

Quantitative data were presented as mean ± standard deviation (SD), while nominal and ordinal variables were described using descriptive statistical methods. For nominal and ordinal categories, the number (n) and percentage (%) were reported. To assess differences between the frequencies of categorical variable categories, appropriate statistical tests were used. For comparing selected quantitative variables across different menopause categories, the one-way ANOVA and the Kruskal Wallis tests were used. Additionally, correlation tests were conducted to explore the relationship between menopause and various risk factors.

RESULTS AND DISCUSSION

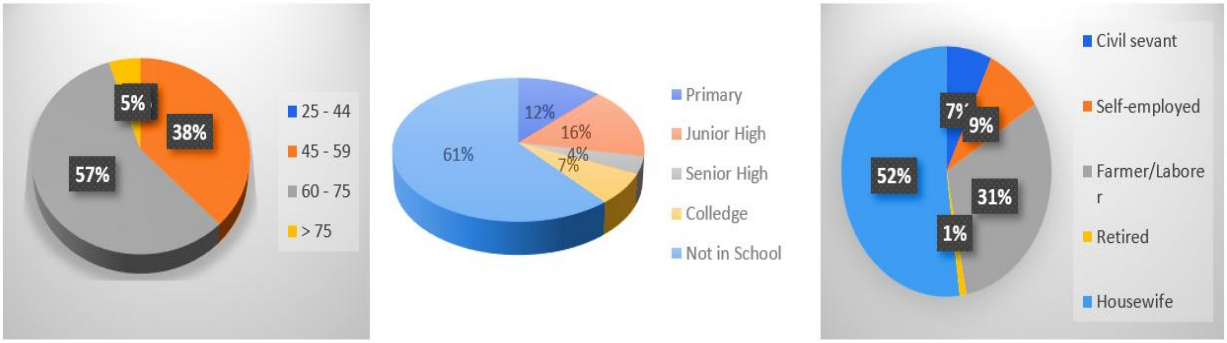


Figure 2. Demographics of Participants in Four Public Health Centres in Semarang District

Regarding age, about 57% of the participants were aged 60-75 years, 52% were housewives or unemployed, and 61% did not attend school.

Table 1. Age of First Menopause

Menopause Category	Age (years)	n	%	*p value*	Correlation
Early Premature	< 40	0	0.00	0.001	0,857**
Premature	40 - 44	8	5.41		
Relatively Premature	45 - 49	39	26.35		
Reference	50 - 51	38	25.68		
Relatively Late	52 - 54	22	14.86		
Late	≥ 54	40	27.03		
TOTAL		147	100.00		

Table 1 shows that the highest age of first menopause was found in the late category (27.03%), followed by relatively premature (25.35%) and reference (25.68%). The correlation

between menopause with age of first menopause was statistically significant (p<0.05).

Whether menopause occurs prematurely or late appears to be a less significant risk factor for cardiovascular disease (CVD) than menopause itself[6]. Menopause has a greater impact on various metabolic biomarkers than natural ageing[5]. Postmenopausal women generally undergo alterations in lipoprotein, fatty acid and amino acid metabolism independently of age, which may explain the link between menopause and cardiometabolic disease[14]. In addition, cardiovascular disease risk in women can be affected by environmental and lifestyle factors, including dietary habits, physical activity levels, body mass index (BMI), alcohol intake, smoking behavior, as well as sociodemographic, psychological, and socio-cognitive factors.. These factors can also trigger the mechanisms underlying menopause-related CVD.

During the menopausal transition, variations in oestrogen levels have been associated with increased systemic inflammation. This may exacerbate immune and metabolic dysfunction, contributing to the development of multiple chronic diseases[15], This substantially increases the risk of premature death among postmenopausal women[16].

Estrogen deficiency resulting from early or premature menopause has been linked to tissue and organ dysfunction mediated by hormones. This dysfunction is strongly associated with long-term health risks, including an increased risk of death[17]. A meta-analysis of 16 studies involving 321,233 women revealed a statistically significant link between early menopause (before the age of 40) and an increased risk of death from any cause[18].

Women generally develop cardiovascular disease (CVD) 7 to 10 years later than men, primarily because estrogen offers protective effects against the progression of atherosclerosis[19]. Experiencing a first CVD event before age 35 is associated with a twofold increased risk of premature menopause, while events occurring after age 35 are linked to menopause around age 51[20]. The risk of CVD rises after menopause, particularly in women with early menopause (before age 45) or premature ovarian insufficiency (POI) diagnosed before age 40[21]. This heightened risk is mainly driven by biological mechanisms and specific clinical conditions that enhance cardiovascular vulnerability.

These results suggest that suboptimal cardiovascular health prior to menopause may affect the timing of natural menopause. The age at natural menopause is increasingly regarded as a marker of reproductive ageing, cardiometabolic ageing, and somatic decline, as well as her overall health status. A later onset of natural menopause has been associated with positive outcomes, such as a reduced risk of death from all causes, as well as negative consequences, including an increased risk of breast and ovarian cancers[22].

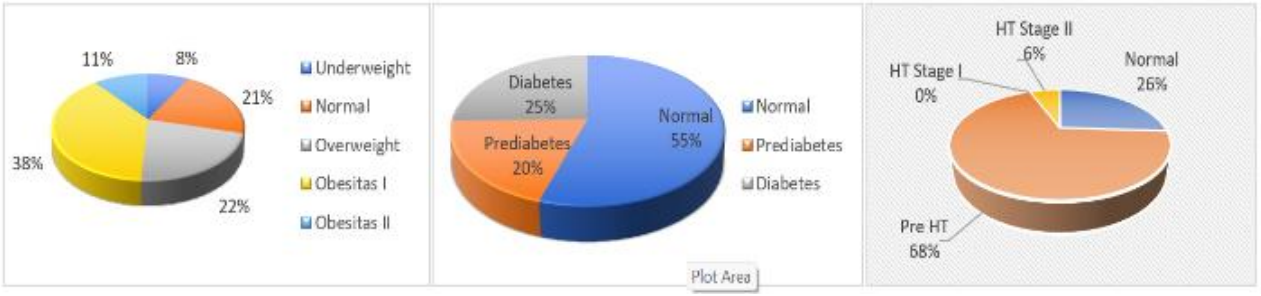
Premenopausal women who reported vasomotor or non-vasomotor menopausal symptoms were significantly more likely to have poor cardiovascular health than those who did not experience such symptoms[23]. Findings from the SWAN and MsHeart/MsBrain studies indicate that persistent and frequent vasomotor symptoms (VMS), such as hot flashes, are linked to an adverse cardiovascular risk profile, reduced function in peripheral and cerebrovascular systems, and a higher incidence of cardiovascular events[24]. Furthermore, Armeni et al. reported that the association between vasomotor symptoms and cardiovascular events differs by age, with elevated CVD risk observed predominantly in peri- and postmenopausal women younger than 60 years[25].

Research by Jamali et al. indicates that women who experience early or premature menopause face a significantly higher risk of experiencing non-fatal cardiovascular events before age 60, compared to those who reach menopause at ages 50 to 51. However, this increased risk is not evident after age 70[26]. The study demonstrates that an earlier age at menopause is closely associated with an increased risk of cardiovascular disease, with this association being particularly evident among women who experience natural menopause and have never receivedmenopausal hormone therapy (MHT).

Epidemiological studies indicate that the menopausal transition is linked to a higher occurrence of risk factors for cardiovascular disease (CVD). Despite this, the precise role of menopause in modulating cardiovascular disease risk in women remains incompletely understood[27]. Postmenopausal women are particularly

susceptible to CVD because the decline in oestrogen reduces its protective vasodilatory effects, which can lead to elevated blood pressure[28].

Rifkin et al. reported that a significant proportion of postmenopausal women are at an increased risk of cardiovascular disease[29]. Similarly, Choi et al. demonstrated that vasomotor and other menopausal symptoms are associated with a higher incidence of cardiovascular disease (CVD)[30]. Huang et al. further confirmed this relationship by showing that premature menopause confers a 1.5-fold increased risk of ischemic heart disease compared with menopause occurring after 45 years of age[27,31].



A. Body Mass Index B. Diabetes Status C. Hypertension Stage

Figure 3. Body Mass Index, Diabetes status and Hypertension Stage in Four Public Health Centres in Semarang District

Figure 3. shows that 38% of participants experienced obesity I, 22% were overweight, and 21% were normal. Participants were diagnosed with diabetes (25%), prediabetes (20%), and normal conditions (55%). In addition, 68% were diagnosed with prehypertension, hypertension stage 2 (6%), and normal (26%).

Obesity represents an established determinant of cardiovascular disease and occurs more frequently in women than in men[32]. Findings from the Framingham Heart Study indicated that obese women experienced a 64% increase in coronary artery disease (CAD) risk, compared with a 46% increase among obese men[33]. Other key contributors to CAD risk in women include type 2 diabetes mellitus (T2DM) and hypertension. Excess body weight, particularly abdominal obesity, is common among people with diabetes and is a major risk factor for cardiovascular disease. Furthermore, numerous studies have demonstrated a direct positive correlation between body mass index (BMI) and cardiometabolic conditions, including T2DM and atherosclerotic cardiovascular disease[34].

Table 2. Blood Pressure Profile

Menopause Categories	n	Average Blood Pressure (mmHg)			
		Systole	*p value*	Diastole	*p value*
Premature	8	132,38 ± 12,95		80,13 ± 5,46	
Relatively Premature	39	136,31 ± 14,30		80,03 ± 11,57	
References	38	132,82 ± 16,05	0,470	77,08 ± 10,33	0,201
Relatively Late	22	130,55 ± 13,63		83,68 ± 10,31	
Late	40	136,63 ± 14,90		78,95 ± 7,64	

Table 2 shows the highest SBP/DBP (136.63/83.68 mmHg) and the lowest (130.55/78.95 mmHg). One Way Anova test between menopause categories on SBP, (95%CI; p= 0.470) and DBP, (95%CI; p= 0.201) showed that there was no statistically significant difference.

Kim *et al.* showed the unadjusted and adjusted odds ratios (OR) of hypertension and subtypes compared to the premenopausal group[35]. The unadjusted OR for total hypertension was 3.10 (95%: 1.99–4.81) in perimenopausal and 3.52 (2.98–4.17) in postmenopausal women. Hypertension increased anthropometric variables and some biochemical parameters that trigger CVD. This may be associated with higher age in those who are

postmenopausal[36]. Other research has indicated that the age at which a woman experiences menopause influences her risk of developing cardiovascular disease (CVD), with the relationship appearing to be bidirectional. Findings from the Framingham Heart Study showed that elevated total cholesterol (TC), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were linked to an earlier menopause onset, independently of smoking status[37].

Hypertension is a major cardiovascular risk factor affecting 25% of women. Postmenopausal hormonal changes, in combination with elevated blood pressure, are associated with increased target organ damage and CVD, including coronary disease, chronic heart failure, arterial stiffness, and stroke[27]. Postmenopausal hypertension occurs because the protective effects of estrogen diminish and the sympathetic nervous system becomes overactive with age. Increasing evidence suggests that postmenopausal women with high blood pressure are at greater risk of cardiovascular events at lower blood pressure thresholds, and more susceptible to treatment-related side effects. Therefore, hypertension is a major risk factor for CVD in women[38].

The decline in estrogen coupled with an increase in testosterone after menopause shifts the estrogen-to-androgen ratio. This has been suggested as a key mechanism contributing to elevated blood pressure[22]. Continued androgen production in postmenopausal women may promote arterial stiffness and vascular inflammation, resulting in endothelial dysfunction and hypertension[39]. Furthermore, menopause appears to activate certain genes associated with hypertension development.

Decreased sex hormones, specifically estrogen, have been associated with vascular endothelial dysfunction[40], which may lead to increased blood pressure. These hormonal changes also contribute to the upregulation of the renin–angiotensin–aldosterone system (RAAS), leading to increased vasoconstriction and enhanced salt sensitivity[41,42]. However, a study by Buleishvili et al. involving normotensive postmenopausal women found no statistically significant correlations between blood oestrogen levels and nitric oxide (NO) or angiotensin II (ANG II) levels (95% CI; r = -0.4342, p = 0.2429; r = -0.2676, p = 0.4547). These findings suggest that other factors, such as oxidative stress, play a role in regulating arterial pressure in addition to oestrogen[43]. Furthermore, Sabbatini and Karigas emphasised the complexity of oestrogen-related mechanisms underlying sex differences in hypertension, particularly in postmenopausal women[44].

Study by Sabbatini & Karigas found that in postmenopausal women with hypertension, there was a decrease in free NO (by 10%) as well as an increase in endothelin-1 (by 14%) and Angiotensin II (ANG) (by 12%). A statistically significant correlation was found between the level of estrogen with the level of NO (r=-0.7935, p=0.0061), and ANG II (r=-0.7080, p=0.0328). On the other hand, a statistically insignificant dependence was found between the intensity of the nitrosyl hemoglobin electron paramagnetic resonance signal (NOHb EPR) and the level of estradiol (r=-0.29, p=0.12)[44].

Although hypertension is a complex, multifactorial condition, the renin–angiotensin–aldosterone system (RAAS) is recognised as a key regulator of baseline blood pressure and a major factor in the development of hypertension. Interventions targeting RAAS components, such as renin, angiotensin-converting enzyme (ACE), angiotensin II type 1 (AT1) receptors or aldosterone receptors, have been employed in both biomedical research and clinical trials to manage hypertension in humans[45,46].

Table 3. Random Blood Glucose Level

Menopause Categories	Average Random Blood Glucose Level (mg/dL)	*p value*	*correlation*
Premature	140,88 ± 41,99		
Relatively Premature	147,97 ± 111,565		
References	166,36 ± 89,40	0,457	0,243
Relatively Late	173,70 ± 94,01		
Late	157,18 ± 84,87		

Table 3 shows that the highest random blood glucose level of 173.70 mg/dL was experienced by participants with relatively late menopause and the

lowest was 140.88 mg/dL. Kruskal-Wallis test showed the relationship between menopause categories, blood glucose levels, (95%CI; p = 0.457), and the correlation test (95%CI; p = 0.243). There was no significant difference in random blood glucose levels between menopause categories.

Approximately 25% of the participants had diabetes status (Figure 3B). A meta-analysis conducted by Zakerinasab et al., which pooled data from 17 studies, revealed a significant correlation between the age at which menopause occurs and the likelihood of developing type 2 diabetes mellitus (T2DM). Women who experienced menopause after the age of 45 were found to have a markedly lower risk of developing T2DM, with an odds ratio (OR) of 0.13 (95% confidence interval (CI): 0.04–0.22). However, this protective effect was reduced for menopause after the ages of 50 and 55 (OR = 0.44, 95% CI: -1.12–2.00 and OR = 0.21, 95% CI: -1.39–1.82, respectively). The meta-analysis also highlighted the complex relationship between early menopause and subsequent T2DM risk[47].

Menopausal transition is accompanied by metabolic changes that predispose women to DM, specifically T2DM. This is because menopause results in an increased risk of upper body adipose tissue accumulation and an elevated incidence of insulin resistance. DM may also affect ovarian aging, potentially causing women with T1DM and early T2DM to experience menopause earlier than those without DM. Menopausal transition is a period of great impact on women lives when risk of CVD increases rapidly. Moreover, DM has a major impact on cardiovascular risk[39].

Women with diabetes mellitus (DM) are 1.81 times more likely to die from ischaemic heart disease and five times more likely to experience heart failure than women without DM[48]. Furthermore, women with hypertension have a higher risk of cardiovascular mortality than men and are less likely to receive treatment in accordance with blood pressure guidelines[49]. Postmenopausal status has also been significantly associated with elevated glycemic levels[50].

Clinically, glucose levels in women transitioning through menopause may remain stable or become dysregulated, which can lead to impaired glucose tolerance[51]. A meta-analysis conducted by Anagnostis et al. found that women who experienced premature menopause or premature ovarian insufficiency were at a significantly greater risk of developing type 2 diabetes mellitus (T2DM) compared with those who entered menopause after the age of 45[27]. Furthermore, Jamali et al. found that postmenopausal status was associated with a higher risk of cardiovascular disease in women with diabetes than premenopausal status, with elevated LDL cholesterol and fasting blood glucose levels identified as significant contributing factors[26].

Hyperglycaemia and decreased insulin sensitivity lead to an increased production and secretion of triglyceride-rich lipoproteins, including chylomicrons and very low-density lipoprotein 1 (VLDL1). Reduced peripheral lipoprotein lipase (LPL) activity and impaired hepatic uptake further elevate circulating remnant particles[52]. Residual VLDL1 is more susceptible to hydrolysis by high-density lipoprotein (HDL), resulting in higher levels of small, dense LDL (sd-LDL), which is highly atherogenic and prone to glycation[53].

Table 4. Lipid Profile

Menopause Categories	Lipid Profile (mg/dL)			
	Total Cholesterol	Triglycerides	LDL-C	HDL-C
Premature	195,25± 42,06	253,14± 127,50	114,57± 52,78	44,43± 8,36
Relatively Premature	190,87 ± 50,28	195,19 ± 96,47	102,33 ± 48,37	51,26 ± 11,67
References	203,61 ± 47,88	198,31 ± 101,37	102,83 ± 41,09	46,21 ± 9,79
Relatively Late	192,77 ± 53,75	121,60 ± 123,13	113,72 ± 51,19	52,00 ± 11,89
Late	194,23 ± 66,11	179,56 ± 70,61	123,16 ± 65,85	56,00 ± 17,42

Table 4 shows that menopause is associated with atherogenic changes in lipid profiles. Kruskal Wallis test between menopause category and TC level showed a p-value of 0.551 (95%CI) while the corresponding correlation test produced a p-value of 0.684. For TG level, the test resulted in a p-value of 0.331 and a correlation p-value of 0.181. Kruskal Wallis test between menopause category and LDL-C level, (p= 0.692) and correlation test (95%CI; p=

0.254). Similarly, for HDL-C level, the Kruskal-Wallis test showed a p-value of 0.216, and the correlation test produced a p-value of 0.059. These results showed that there was no significant difference between menopause category and lipid profile (p> 0.05) while the correlation between menopause and lipid profile was not significant (p> 0.05).

Menopausal status was not associated with differences in fat distribution, but age-related differences in lipids and lipoproteins appeared due to differences in menopausal status worsened in women with normal weight obesity (NWO)[54]. Postmenopause was associated with higher TC, LDL-C, non-HDL-C, HDL-C, and HDL_3-C. Premenopausal NWO women had higher LDL-C and VLDL-C comparable to obese women. Postmenopausal NWO women had higher TG and VLDL-C and lower HDL-C similar to obese women[54]. Additionally, postmenopausal women had higher TC, TG, and LDL-C levels, and lower HDL-C levels[55]. After menopause, risk of developing Met-S increases as a consequence of disrupted glucose regulation, progressive weight gain, and the accumulation of central abdominal fat[37]. Cardiovascular disease risk rises during the menopausal transition, with particularly higher vulnerability observed in women who enter menopause before 45 years of age or who are diagnosed with premature ovarian insufficiency (POI) prior to the age of 40[21]. This heightened risk is primarily attributed to distinct biological mechanisms and particular clinical characteristics that increase women's susceptibility to cardiovascular disease. Notably, the occurrence of an initial cardiovascular event before 35 years of age has been associated with an approximately twofold greater probability of early menopause, whereas cardiovascular events arising after 35 years are more commonly linked to menopause at about 51 years of age.. Furthermore, the increased risk of coronary heart disease (CHD) observed in smokers, particularly those who experience natural menopause at an earlier age, may be influenced by other smoking-related confounding factors[26].

Several biological mechanisms have been suggested to account for the effect of menopausal status on mortality[56], particularly the decrease in endogenous oestrogen during the menopausal transition and postmenopausal period[57]. Oestrogen plays a crucial role in regulating complex physiological processes, influencing ageing and modulating the risk of various diseases[58].

CONCLUSION

In conclusion, this study proved that there was no significant correlation or difference between menopausal status and risk factors such as blood pressure, blood sugar levels, and cholesterol. However, menopausal women were found to be susceptible to increased risk of CVD. National, community, health care system, and academic strategies are needed to comprehensively address cardiometabolic risk and improve the quality of life for menopausal women.

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