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Determination of cardiometabolic risk in pre- and post-menopausal women

Ilksen Orhan¹ , Hatice Serap Koçak² and Emine Kaplan^{3*}

Abstract

Objective The study was designed to determine and compare the cardiometabolic risk in premenopausal and postmenopausal women.

Methods Data were collected using cross-sectional and correlational study. In this study, the sociodemographic characteristics, anthropometric measurements, and biochemical parameters of menopausal women were examined.

Results The average age of menopausal women is higher compared to premenopausal women. Menopausal duration, number of children, daily cigarette consumption, body weight, body mass index (BMI), waist circumference, hip circumference, waist-to-hip ratio, systolic and diastolic blood pressure, fasting blood glucose, hemoglobin, AST (aspartate aminotransferase), and Framingham risk score are higher in menopausal women compared to premenopausal women. Conversely, height, HDL (high-density lipoprotein) level, LDL (low-density lipoprotein) level, TSH (thyroid-stimulating hormone), ALT (alanine aminotransferase), HbA1c (glycated hemoglobin), serum albumin, and visceral adiposity index (VAI) values are lower in menopausal women compared to premenopausal women.

Conclusion These findings indicate changes in the metabolic profiles of menopausal women. This study could serve as an important resource for assessing the health status of menopausal women and for implementing appropriate measures.

Clinical trial number not applicable.

Keywords Cross-sectional study, Cardiometabolic risk, Peri-Menopausal, Post-Menopausal, Women

Introduction

In this study, the sociodemographic characteristics, anthropometric measurements, and biochemical parameters of menopausal women were examined. The average age of menopausal women is higher than that of premenopausal women. Menopausal duration, number of children, daily cigarette consumption, body weight, body mass index (BMI), waist circumference, hip circumference, waist-to-hip ratio, systolic and diastolic blood pressure, fasting blood glucose, hemoglobin, AST (aspartate aminotransferase), and Framingham risk score are higher in menopausal women compared to premenopausal women. Conversely, height, HDL (high-density lipoprotein) level, LDL (low-density lipoprotein) level,

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TSH (thyroid-stimulating hormone), ALT (alanine aminotransferase), HbA1c (glycated hemoglobin), serum albumin, and visceral adiposity index (VAI) values are lower in menopausal women than in premenopausal women. These findings indicate changes in the metabolic profiles of menopausal women. This study could serve as an important resource for assessing the health status of menopausal women and implementing appropriate measures.

Introduction and aim

Menopause is defined as the permanent cessation of menstruation. Menopause is diagnosed after twelve months of amenorrhea. The period before menopause is referred to as the premenopausal period, and the years following the last menstrual period are referred to as postmenopause [1]. It is known that menopause increases the risk of cardiometabolic diseases and mortality, such as obesity, metabolic syndrome (MetS), type 2 diabetes mellitus (Type 2 DM), and cardiovascular diseases (CVD) [2–5]. Parameters such as body mass index (BMI), waist circumference (WC), blood pressure, glycemia, and serum lipid profile have been found to be associated with menopausal status, with postmenopausal women having higher levels of serum total cholesterol (TC), low-density lipoprotein (LDL), triglycerides (TG), systolic blood pressure (SBP), diastolic blood pressure (DBP), and fasting blood glucose [6, 7]. Abdominal obesity and the decline in menopausal estrogen affect insulin and lipid mechanisms [3].

Increased BMI has been observed to elevate the mortality risk in postmenopausal women [2, 8]. Obesity and abdominal obesity are significant risk factors for diseases such as DM, coronary heart disease (CHD), and certain cancers. Cardiovascular disease (CVD) risk factors, incidence, and mortality increase from the menopausal period compared to women of reproductive age [2].

Although CVD is often considered the “disease of men,” it is actually the “disaster of women.” Despite regional variations, evidence shows a significant increase in age-adjusted CVD deaths over the past 60 years [9]. Two-thirds of female deaths (64%) occur due to underlying undiagnosed CVD, with a worse prognosis than men despite occurring ten years later in women [9]. Evidence suggests that approximately one billion women experience menopause [1]. With these insights, the study was designed to determine and compare the cardiometabolic risk in menopausal and postmenopausal women.

Materials and methods

Sample, location, and time of the study

The sample of this cross-sectional and correlational study consisted of women aged 35–65 who visited the Internal Medicine and Obstetrics and Gynecology Polyclinic of

State Hospital between 02.30.2022 and 09.30.2022. The sample size was calculated using the formula if the number of individuals in the population is known. The sample size was determined to be approximately 140 women (70 postmenopausal, 70 premenopausal) with a confidence level of 95% and a margin of error of 5%. During the data collection phase, a total of 150 women (77 menopausal, 73 non-menopausal) were reached.

The study included women who volunteered to participate, aged 35–65, both menopausal and non-menopausal, and who were literate.

Exclusion criteria were chronic heart disease, immunosuppressive drug use, cancer, hormone replacement therapy, pregnancy, and lactation.

Data collection

Data were collected through face-to-face interviews conducted by the researcher. The tools used for data collection are described below.

Socio-demographic information Demographic characteristics such as age, marital status, education level, occupation, physical activity levels, and duration of menopause were queried.

Anthropometric Measurements Weight measurements (kg) were taken with individuals wearing thin clothing and no shoes. Height (cm) measurements were taken with patients barefoot and standing with their feet together and their head in the Frankfurt horizontal plane using a stadiometer in the clinic. Waist circumference (WC) measurements were taken by finding the midpoint between the lowest rib bone and the iliac crest. Hip circumference (HC) was measured by standing on the individual's side and measuring at the highest point of the hip. The waist-to-hip ratio was calculated by dividing waist circumference measurement by hip circumference measurement. For women, a waist circumference ≥ 80 cm was classified as a risk, and ≥ 88 cm was classified as high risk. The ideal value for waist-to-hip ratio for women is considered to be < 0.85 [10, 11]. BMI was calculated by dividing body weight (kg) by height (m) squared and classified according to WHO's BMI classification as follows: < 18.5 underweight, 18.5–24.99 normal, 25–29.99 overweight, and ≥ 30 obese [12]. The Visceral Adiposity Index for women was calculated using the formula $(WC/[36.58 + (1.89 \times BMI)]) \times (TG/0.81) \times (1.52/HDL)$ [13]. Body weight and height were measured using standard methods and recorded to the nearest 0.1 kg and 0.1 cm, respectively.

Blood pressure measurement Thirty minutes before the measurement, individuals were queried about their consumption of tea, coffee, and tobacco, and those who did not consume them were measured. After five min-

utes of rest, individuals were seated with their backs against a chair, and clothing on the arm to be measured was removed [14]. During the measurement, they were instructed not to speak. The cuff was placed around the arm at heart level, and the arm was supported. The cuff was wrapped around the arm, with the lower end of the cuff positioned 2.5–3 cm above the elbow crease, and the stethoscope was not pressed against the cuff. The cuff was inflated to 20–30 mmHg above the level where the radial pulse disappeared to prevent occlusive sounds. The valve was opened, and the pressure was reduced at a rate of 2–4 mmHg per second. The values at which the first sound and the last sound were heard were recorded as systolic and diastolic blood pressure, respectively [15].

Biochemical parameters Blood samples of the participating women were collected after at least 8 h of overnight fasting for the determination of fasting blood glucose, total cholesterol, triglycerides, HDL cholesterol, LDL cholesterol, thyroid-stimulating hormone (TSH), and glycated hemoglobin (HbA1c). Accurate values were recorded. Some blood values were converted to international system units for VAI calculation [16].

Framingham risk scoring It calculates the risk of myocardial infarction, coronary death, or the onset of CHD within 10 years. The evaluation includes major risk factors such as gender, age, systolic blood pressure, total cholesterol, HDL, smoking habit, and diabetes mellitus. The scoring reflects the risk in individuals without clinical findings, thus applicable only for primary prevention. It is categorized into three levels: high, medium, and low. Patients with a 10-year risk of adverse events > 20% are considered high risk, those with 10–20% are considered medium risk, and those with < 10% are considered low risk [17].

Statistical analysis

The data were analyzed using the SPSS program. The normal distribution was assessed using the Kolmogorov-Smirnov test. Chi-square analysis was employed to assess the sociodemographic characteristics and menopausal status of women. Independent two-sample t-tests were used to compare women's anthropometric measurements and biochemical values with their menopausal status. Correlation analysis was performed to compare women's menopausal status with their age, anthropometric measurements and blood values. The interpretation of the correlation coefficient was as follows: 0.8–1.0 indicates a very strong relationship, 0.6–0.8 indicates a strong relationship, 0.4–0.6 indicates a moderate relationship, 0.2–0.4 indicates a weak relationship, and 0.0–0.2 indicates a very weak or no relationship. A significance level of 0.05 was utilized.

Ethical considerations

This study was conducted in accordance with the Declaration of Helsinki. Prior to the research, approval was obtained from the non-Interventional Research Ethics Board of an Eastern university (2023/34625). Written permission was obtained from the institution where the research was conducted. Informed consent was obtained from the participants in the study. Clinical trial number: not applicable.

Results

Some sociodemographic characteristics of the women included in the study are presented in Table 1. It was found that 96.1% of women in menopause were married, 56.2% of women not in menopause were university graduates, 90.9% of menopausal women were not employed, 72.6% of non-menopausal women had income matching their expenses, 77.9% of menopausal women used medication continuously, 61.6% of non-menopausal women had a family history of heart disease, 85.7% of menopausal women did not smoke, 97.4% of menopausal women did not consume alcohol, 71.4% of non-menopausal women did not engage in regular exercise, 57.1% of menopausal women had metabolic syndrome, 41.6% of menopausal women had diabetes, 71.4% of menopausal women had another chronic disease, and 42.9% of menopausal women were obese (Table 1).

The duration of menopause in women who have entered menopause is 9.45 ± 0.63 . It was found that compared to women who have not entered menopause, women who have entered menopause have statistically significantly higher values in terms of age, number of children, body weight, BMI, waist circumference, hip circumference, systolic blood pressure, diastolic blood pressure, fasting blood glucose, AST, and Framingham score average, as well as waist-to-hip ratio ($p < 0.05$). It was also determined that non-menopausal women had higher daily cigarette consumption and hemoglobin levels ($p < 0.05$). There was no statistically significant relationship between the height, HDL, LDL, TSH, ALT, AST, HbA1c, serum albumin levels, and Visceral Adiposity Index (VAI) scores of women who have entered menopause, although the VAI score was higher ($p > 0.05$) (Table 2).

It was determined that there was a significant positive relationship between the Framingham score average of women in menopause and hemoglobin, TSH, HbA1c and VAI, and a positive significant relationship between VAI and the average of total cholesterol, triglyceride, LDL and Framingham score. It was found that there was a significant positive correlation between the Framingham score average of women who were not in menopause and age, BMI, waist-to-hip ratio, total cholesterol, triglyceride and LDL, and a significant relationship between VAI and

Table 1 Distribution of some sociodemographic characteristics of women in menopausal and non-menopausal groups

Sociodemographic Characteristics	Menopausal (n=77)		Non-Menopausal (n=73)		Total (n=150)	
	n	%	n	%	n	%
Marital Status						
Married	74	96.1	58	79.5	132	88.0
Single	3	3.9	15	20.5	18	12.0
Education Level						
Literate	31	40.3	5	6.8	36	24.0
Primary School	32	41.6	16	21.9	48	32.0
High School	9	11.7	11	15.1	20	13.3
University	5	6.5	41	56.2	46	30.7
Employment Status						
Not Working	70	90.9	37	50.7	107	71.3
Working	7	9.1	36	49.3	43	28.7
Income-Expense Balance						
Less than Expense	37	48.1	14	19.2	51	34.0
Equal to Expense	36	46.8	53	72.6	89	59.3
More than Expense	4	5.2	6	8.2	10	6.7
Regular Medication Use						
Uses Medication	60	77.9	32	43.8	92	61.3
Does Not Use Medication	17	22.1	41	56.2	58	38.7
Family History of Cardiovascular Disease						
Disease Present	38	49.4	45	61.6	83	55.3
Disease Absent	39	50.6	28	38.4	67	44.7
Smoking Status						
Non-Smoker	11	14.3	34	46.6	45	30.0
Smoker	66	85.7	39	53.4	105	70.0
Alcohol Use Status						
Non-Alcohol User	75	97.4	68	93.2	143	95.3
Alcohol User	2	2.6	5	6.8	7	4.7
Regular Exercise Status						
Exercises	22	28.6	33	45.2	55	36.7
Does Not Exercise	55	71.4	40	54.8	95	63.3
Presence of Metabolic Syndrome						
Syndrome Present	44	57.1	21	28.8	65	43.3
Syndrome Absent	33	42.9	52	71.2	85	56.7
Presence of Diabetes						
Diabetes Present	32	41.6	13	17.8	45	30.0
Diabetes Absent	45	58.4	60	82.2	105	70.0
Presence of Other Chronic Disease						
Present	55	71.4	31	42.5	86	57.3
Absent	22	28.6	42	57.5	64	42.7
Body Mass Index Class						
Underweight	0	0.00	2	2.7	2	1.3
Normal	13	16.9	25	34.2	38	25.3
Overweight	31	40.3	28	38.4	59	39.3
Obese	33	42.9	18	24.7	51	34.0
Total	77	100.0	73	100.0	150	100.0

fasting blood glucose, total cholesterol, triglyceride, HDL and LDL. There was a positive significant relationship between the Framingham score average of all participants and age, body weight, BMI, waist circumference, hip circumference, waist-to-hip ratio, systolic and diastolic blood pressure, fasting blood glucose, total cholesterol,

triglyceride, LDL, TSH and VAI. determined. A significant relationship was found between women's VAI and age, waist-to-hip ratio, total cholesterol, triglyceride, HDL, AST and Framingham score average ($p < 0.05$) (see Table 3).

Table 2 Distribution of women's characteristics, anthropometric measurements, and biochemical parameters

Characteristics	Menopausal		Non-menopausal		Statistical Test
	n	X ± SD	n	X ± SD	
Age	77	57.78 ± 5.44	73	41.14 ± 5.45	t:18.702 p:0.000
Duration of Menopause (Years)*	77	9.45 ± 0.63			
Number of Children	77	3.18 ± 1.62	73	2.00 ± 1.38	t:4.777 p:0.000
Daily Cigarette Consumption (pieces/day)	77	2.14 ± 0.67	73	7.30 ± 1.09	t:-4.051 p:0.000
Height (cm)	77	161.05 ± 5.42	73	161.75 ± 5.09	t:-0.815 p:0.416
Body Weight (kg)	77	77.23 ± 10.77	73	70.99 ± 11.19	t:3.477 p:0.001
Body Mass Index (BMI)	77	29.88 ± 4.72	73	27.13 ± 4.10	t:3.809 p:0.000
Waist Circumference (cm)	77	103.67 ± 15.00	73	91.73 ± 12.54	t:5.272 p:0.000
Hip Circumference (cm)	77	113.10 ± 12.30	73	105.10 ± 11.43	t:4.116 p:0.000
Waist-to-hip ratio	77	0.91 ± 0.08	73	0.87 ± 0.09	t:2.896 p:0.004
Systolic Blood Pressure (mmHg)	77	125.84 ± 13.21	73	115.20 ± 11.67	t:5.214 p:0.000
Diastolic Blood Pressure (mmHg)	77	76.62 ± 8.97	73	72.19 ± 8.37	t:3.122 p:0.002
Fasting Blood Glucose	77	117.54 ± 47.20	73	101.34 ± 36.91	t:2.333 p:0.021
Hemoglobin	77	11.85 ± 2.01	73	12.71 ± 1.57	t:-2.907 p:0.004
Total Cholesterol	77	196.29 ± 63.64	73	181.47 ± 50.40	t:1.575 p:0.117
Triglycerides	77	143.80 ± 66.68	73	127.86 ± 62.72	t:1.506 p:0.134
HDL	77	50.42 ± 19.47	73	49.60 ± 13.02	t:0.302 p:0.763
LDL	77	125.00 ± 45.18	73	119.28 ± 38.62	t:0.831 p:0.407
TSH	77	1.90 ± 1.47	73	2.23 ± 1.08	t:-1.567 p:0.119
ALT	77	21.24 ± 15.04	73	20.34 ± 12.34	t:0.399 p:0.690
AST	77	25.15 ± 17.47	73	19.68 ± 5.87	t:2.541 p:0.012
HbA1c	77	3.99 ± 3.54	73	3.51 ± 3.03	t:0.898 p:0.371
Serum Albumin	77	4.00 ± 0.69	73	3.97 ± 1.24	t:0.182 p:0.856
Mean Framingham Score	77	14.50 ± 3.74	73	7.57 ± 5.91	t:8.626 p:0.000
Visceral Adiposity Index (VAI)	77	4.46 ± 0.13	73	4.11 ± 0.12	t:1.860 p:0.065

SD= Standard Deviation

*Only data from menopausal women were evaluated

Discussion

BMI, waist circumference, hip circumference, waist-to-hip ratio, systolic and diastolic blood pressure, fasting blood sugar, hemoglobin, AST and Framingham

risk score were higher in women in menopause. Similarly, HDL and LDL values, HbA1c and VAI values were higher in women in menopause compared to women in premenopause.

Table 3 Correlation analysis results

	Menopausal						Non-menopausal						Total					
	Mean Framingham Score			Visceral Adiposity Index (VAI)			Mean Framingham Score			Visceral Adiposity Index (VAI)			Mean Framingham Score			Visceral Adiposity Index (VAI)		
	r	p		r	p		r	p		r	p		r	p		r	p	
Age	-0.197	0.086		0.481**	0.000		0.566**	0.000		0.107	0.368		0.716**	0.000		0.217**	0.008	
Body Weight (kg)	-0.091	0.432		0.155	0.178		0.292*	0.012		-0.019	0.879		0.342**	0.000		0.150	0.067	
Body Mass Index (BMI)	-0.035	0.763		0.060	0.605		0.383**	0.001		-0.065	0.585		0.387**	0.000		0.055	0.506	
Waist Circumference (cm)	-0.019	0.866		0.194	0.092		0.333**	0.004		0.199	0.091		0.423**	0.000		0.311	0.000	
Hip Circumference (cm)	-0.014	0.905		0.217	0.058		0.100	0.399		0.084	0.480		0.297**	0.000		0.202	0.013	
Waist-to-hip ratio	0.054	0.643		0.063	0.585		0.342**	0.003		0.152	0.199		0.315**	0.000		0.225*	0.006	
Systolic Blood Pressure (mmHg)	0.199	0.083		0.147	0.202		0.167	0.157		0.026	0.828		0.342**	0.000		-0.130	0.112	
Diastolic Blood Pressure (mmHg)	0.199	0.082		0.118	0.306		0.013	0.910		-0.056	0.641		0.187*	0.022		-0.145	0.077	
Fasting Blood Glucose	0.130	0.259		0.209	0.068		0.203	0.084		0.278*	0.017		0.264**	0.001		0.188*	0.021	
Hemoglobin	0.461**	0.000		0.003	0.978		0.118	0.322		-0.068	0.569		-0.086	0.296		-0.046	0.574	
Total Cholesterol	0.055	0.632		0.411**	0.000		0.580	0.000		0.305**	0.009		0.458**	0.000		0.297**	0.000	
Triglycerides	-0.115	0.317		0.322**	0.004		0.311**	0.007		0.920**	0.000		0.318**	0.000		0.882**	0.000	
HDL	0.030	0.795		-0.077	0.505		-0.014	0.905		-0.569**	0.000		-0.020	0.811		-0.466**	0.000	
LDL	0.108	0.341		0.239*	0.036		0.467**	0.000		0.266*	0.023		0.325**	0.000		0.120	0.143	
TSH	0.267*	0.019		-0.174	0.131		-0.197	0.096		-0.006	0.960		-0.214**	0.009		-0.080	0.328	
ALT	-0.165	0.151		0.079	0.494		-0.164	0.165		0.109	0.360		-0.079	0.339		0.016	0.844	
AST	-0.119	0.303		-0.140	0.226		-0.164	0.165		0.209	0.076		0.026	0.749		0.218*	0.007	
HbA1c	0.238**	0.037		0.160	0.166		0.100	0.400		0.080	0.503		0.141	0.086		0.011	0.897	
Serum albumin	-0.108	0.350		-0.193	0.952		0.052	0.661		0.106	0.374		0.016	0.847		-0.013	0.870	
Mean Framingham Score				0.321**	0.004		0.219	0.063		0.219	0.063		0.290**	0.000		0.290**	0.000	
Visceral Adiposity Index (VAI)																		

** Correlation is significant at the 0.01 level (2-tailed)

** Correlation is significant at the 0.05 level (2-tailed)

With increasing age, menopause becomes an inevitable reality in women's lives. The global population is aging every day, and women tend to outlive men [5]. Due to the increase of life expectancy from birth, the number of women undergoing menopause is increasing globally, with approximately one billion women reported to be experiencing menopause [1]. Improvements in living standards and a faster pace of life have led to an increase in obesity, with abdominal obesity also on the rise. Obesity is characterized by the abnormal or excessive accumulation of fat tissue, with the World Health Organization (WHO) defining obesity as having a Body Mass Index (BMI) of 30 kg/m² or higher [12]. The obesity rate has doubled since 1980, with nearly one-third of the global population now overweight or obese [18]. Studies have shown that obesity is a risk factor for many chronic diseases including diabetes, hypercholesterolemia, asthma, cancer, cardiovascular diseases (CVD), and hypertension (HT) [19].

In this study, it was found that women in menopause had higher weights, BMI, waist circumference, hip circumference, and waist-to-hip ratio. According to the European Cardiovascular Statistics published in 2017, obesity among women is 24.6% across Europe, while in our country, it is at 35.8%, ranking highest in Europe [9]. Postmenopausal changes in hormonal structure, lifestyle, diet, and physical activity are associated with obesity [4, 5]. A study has shown an increase in abdominal obesity in women within five years after menopause, which may be related to the loss of the protective role of estrogen and a relative increase in circulating androgens [5]. During this period, increases in endothelial dysfunction and oxidative stress, coupled with higher obesity rates and lower physical activity levels compared to men, may have contributed to weight gain and increased waist circumference [9]. The European dyslipidemia guideline states that the risk increases when the waist circumference in women exceeds 80 cm [20]. A study conducted in our country found that women who had entered menopause had higher waist-to-hip ratios [10]. Current findings indicate that one in three women over the age of 30 in our country has abdominal obesity, and this rate is increasing [20].

Hypertension, CVD, and related deaths are among the leading causes of morbidity and mortality [9]. Similarly, in this study, it was found that women in menopause had higher systolic and diastolic blood pressures, and as women's age increased, both systolic and diastolic blood pressures also increased. HT is one of the leading causes of CVD and related deaths in both sexes in our country. Although hypertension is less common in young women compared to men, this trend reverses after menopause, with the frequency increasing in women over 65 years of age and doubling compared to the premenopausal

period [9, 20]. Premenopausal estrogen has a vasodilatory effect that contributes to blood pressure control. The cessation of estrogen effects after menopause leads to an increase in blood pressure [20]. In women, HT not only increases over time but also causes more target organ damage and complications than in men [9, 20]. In our country, HT affects 6 million men and 8 million women [20]. Approximately 75% of postmenopausal women are affected by hypertension [20]. Obesity and abdominal obesity increase the risk of hypertension in women. All women in our study group had waist circumferences above acceptable values, which may have contributed to their elevated fasting blood glucose levels.

Glucose metabolism is regulated by insulin secretion and action, which are affected by various factors such as genetic background, obesity, calorie intake, exercise, hormones, medications or chemicals, pancreatic diseases, and infections. The prevalence of abnormal glucose metabolism increases around the age of 50 and beyond in women [21]. In this study, it was found that women in menopause had higher fasting blood sugar levels, and fasting blood sugar increased further with age. Studies have shown that fasting blood sugar increases after menopause in different populations [10, 21]. Otsuki et al. found that the risk of increased fasting plasma glucose concentration after menopause was 2.64 times higher [21]. Wu et al. showed that menopause is an independent risk factor for impaired glucose tolerance [22]. In this study, the fasting blood sugar of menopausal women was 117.54 ± 47.20 mg/dL. This value is considered as impaired fasting glucose (IFG) in the literature. Elevated fasting blood sugar increases the risk of diabetes. Diabetes affects 13.7% of our population and affects approximately 7.5 million people [23]. The onset age of diabetes in our country is 52.8 years, while the average age of menopause is in the range of 48–49 years [24]. It is known that within less than 5 years after menopause, the risk of abdominal obesity and hyperglycemia increases [5]. The high age of menopausal women in our study group, the fact that more than half of the participants were overweight or obese, and the high waist circumference of the participants may have contributed to the elevated fasting blood glucose levels in women.

Obesity, abdominal obesity, aging, and menopausal status increase the risk of dyslipidemia through different mechanisms. It is known that the risk of hypertriglyceridemia increases in women 10–14 years after menopause [5]. Before menopause, estrogen increases HDL and decreases LDL, with positive effects on the renin-angiotensin system [9]. In this study, the menopausal period of women was 9.45 ± 0.63 years, and it was found that total cholesterol and triglyceride levels increased with age. Total cholesterol, LDL, and HDL are higher in early and late postmenopausal periods [4]. Dyslipidemia

is most commonly associated with obesity. Abdominal obesity poses a greater risk compared to elevated BMI due to fat accumulation in the subcutaneous area. Each centimeter increase in waist circumference has negative effects on lipid profile. In individuals with metabolic status impaired by abdominal obesity, sudden death is more common than in the normal population [9]. According to data from the TEKHARF study conducted in our country, triglyceride levels were reported to increase the most parallel to abdominal obesity [20]. Women in our study group had high levels of abdominal obesity, supporting the findings of the study.

Visceral fat constitutes 5–8% of total body fat mass in premenopausal women, increasing to 15–20% in postmenopausal women. Visceral fat acts as an endocrine organ secreting inflammatory markers involved in the development of metabolic syndrome and CVD [4]. This condition is often associated with excess weight. Visceral Adiposity Index (VAI) is a new anthropometric indicator that indirectly reflects the risk of cardiometabolic complications associated with obesity [5]. In this study, a significant relationship was found between VAI and age, waist-to-hip ratio, total cholesterol, triglyceride, HDL, AST and Framingham score average. VAI has been developed as a routine, comprehensive anthropometric measurement method for determining cardiovascular risks [13]. VAI is valuable in determining CVD risks and is associated with metabolic pathologies [13, 25–27]. Akman's study found that postmenopausal women had higher VAI values compared to premenopausal women [10]. A study conducted in our country found that patients with coronary artery disease had high VAI values [27]. High TG and low HDL levels are known to be associated with CVD risk [28]. The use of BMI, waist circumference, triglyceride and HDL values in calculating VAI may have been the reason for this result. The high prevalence of obesity and abdominal obesity in our study group and the increase in obesity with age may be a consequence of this.

CVDs are the leading cause of morbidity and mortality among adults worldwide. CVDs can largely be prevented by correcting modifiable risk factors. The Framingham risk score is calculated based on a combination of risk factors over the long term [29]. The Framingham risk score calculates the risk of myocardial infarction or coronary death within 10 years [30]. In our study, we found correlations between Framingham score average and age, body weight, BMI, waist circumference, hip circumference, waist-to-hip ratio, systolic and diastolic blood pressure, fasting blood sugar, total cholesterol, triglyceride, LDL, TSH and VAI were determined. This is an expected result, because the Framingham score calculates the risk of developing myocardial infarction, coronary death or CHD within 10 years with data such as gender, age,

systolic blood pressure, total cholesterol, HDL, smoking habit and diabetes. Our study group did not have very healthy indicators in terms of these characteristics. According to Framingham, being overweight by more than 20% of normal weight increases the likelihood of hypertension by 8 times [31].

Conclusion

In this study, it was determined that women in menopause had higher Framingham score and VAI values. In this study, it was found that obesity and abdominal obesity increase with age in women, affecting blood pressure and lipid profiles negatively. Identifying women at risk for cardiometabolic diseases and focusing on prevention is the best approach. Healthcare professionals should identify modifiable risks for CVDs. Primary prevention should include risks such as HT, DM, tobacco use, and sedentary lifestyle. Lifestyle changes such as healthy eating, quitting smoking, and adequate physical activity can be recommended.

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Author contributions

The authors declare that their contribution to the work is equal.

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Data availability

The datasets utilized in this research are accessible from the corresponding author upon a reasonable request.

Declarations

Ethics approval and consent to participate

All procedures performed were in accordance with the ethical standards of the national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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