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ORIGINAL ARTICLE

Early menopause and type 2 diabetes: A cross-sectional study at Royal Prima Hospital

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ABSTRACT

Type 2 diabetes mellitus (T2DM) is a metabolic disease affecting various organs and causing hormonal disorders. Estrogen deficiency can alter a woman's menstrual cycle and trigger menopause, which affects reproductive health, fat distribution, lipid profiles, and the nervous system. This study aimed to assess the relationship between T2DM and menopausal age in women in the menopausal phase. The research method used was observational with a cross-sectional design, using 120 medical records of menopausal women from the period 2020-2022 at the Royal Prima Hospital. To explore the relationship between menopausal age and T2DM, bivariate analysis was performed, including the Chi-square test or Fisher's Exact Test for categorical variables, as well as t-test or Mann-Whitney U test for numerical variables. The results showed that the age range of 51-60 years constituted the largest group of 120 T2DM patients (29.17%). The most common age of onset of menopause was between 46-50 years, and showed a significant influence on the risk of T2DM (sig value 0.026 and t value 2.257). Blood pressure, which varied from 81 mmHg to 283 mmHg, showed no significant association with T2DM. It can be concluded that age at the onset of menopause was significantly associated with the risk of T2DM, whereas blood pressure had no significant effect on T2DM in this study. These findings highlight the importance of health monitoring in women with early menopause to prevent the development of T2DM.

Keywords: type 2 diabetes mellitus, age at menopause, hormonal disorder

Introduction

Menopause is a critical phase in women's reproductive health that affects various aspects of physiology, including body composition, fat distribution, lipid profile, and nervous system degeneration.[1,2] The physiological changes associated with menopause are caused by estrogen deficiency, which has been shown to affect lipid metabolism, energy expenditure, insulin resistance, and body fat composition.[3] Menopause marks the end of a woman's reproductive years. It is a natural process that typically occurs between 45 and 55 years of age. Women may experience various symptoms during menopause, including hot flashes, night sweats, changes in urination and genitals, painful sex, and insomnia. The average age of menopause is approximately 51 years in developed countries, while in developing countries, it is between 43 and 49 years.[4] Early menopause is an adverse health risk factor that includes an increased risk of

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osteoporosis, cancer, diabetes, neurological disorders, mental health problems, and overall mortality. Conversely, menopause at a later age has been associated with a higher risk of reproductive cancers such as breast, endometrial, and ovarian cancers.[5–7]

A study reported that early menopause is associated with a higher risk of developing type 2 diabetes mellitus (T2DM) later in life. Women who go through menopause before the age of 40 years are almost twice as likely to develop T2DM compared to women who go through menopause between the ages of 45 and 54 years. However, this risk decreases as the age at menopause increases. Women who experience menopause after the age of 55 years have the same risk of developing T2DM as women who experience menopause between the ages of 45 and 54 years. In addition, each year of delayed menopause was associated with a 3% lower risk of T2DM. The age at which the woman went through menopause was also significantly correlated with the age at which she developed T2DM. Every year after a woman went through menopause, the average age at which she developed T2DM was on average 0.39 years later.[8] Diabetes occurs when the pancreas cannot produce enough insulin or when insulin is ineffective in breaking down glucose, causing systemic damage and chronic conditions. T2DM is caused by a disruption in the pancreatic β-cell receptor, which inhibits the effectiveness of insulin in regulating blood glucose levels.[9]

In Indonesia, approximately 4.8% of the population has diabetes, and more than half of the cases (58.8%) are undiagnosed. Projections suggest that approximately 21.3 million people in Indonesia will develop T2DM by 2030. The increasing prevalence of T2DM in Indonesia, triggered by factors such as population growth, aging, unhealthy lifestyles, poor diet, and high obesity, is a significant national health problem.[10] Understanding the risk factors for T2DM is important for effective prevention. Immutable risk factors include age and genetic predisposition, while modifiable risk factors include lifestyle changes, such as diet, sleep patterns, physical activity levels, and stress management.[11,12]

This study aimed to investigate the relationship between early menopause and T2DM. This study aimed to explore the impact of T2DM on reproductive health, with a particular emphasis on women. The main objective of this study was to generate new information that could be used to develop more effective prevention programs and clinical intervention approaches. This is important not only in the medical context but also in expanding our understanding of how long-term diseases affect women's reproductive health.

Method

This study used a quantitative approach with an observational analytical design and a cross-sectional method. The study was conducted at Royal Prima Hospital from March to April 2024. The study population consisted of female patients who had undergone menopause and were registered at Royal Prima Hospital. The sample will be selected using a non-probability sampling method, namely purposive sampling, based on the inclusion criteria: women aged 40-60 years with or without T2DM and a history of menopause and hypertension at Royal Prima Hospital from 2020 to 2022. Patients outside the age range or those who did not meet the diagnostic criteria were excluded. Based on the Slovin formula, the required sample size was approximately 120 from 170 populations that met the criteria.

Data were collected through a medical record review to record the age at menopause and T2DM status of the patients. The collected data will be coded and cleaned to ensure accuracy, such as by checking for missing entries and correcting inconsistencies. Data analysis involved descriptive statistical techniques to provide an overview of the distribution of menopausal age and the prevalence of T2DM. The association between age at menopause and T2DM will be explored through bivariate analysis using the chi-square test or Fisher's Exact Test for categorical variables, as well as the t-test or Mann-Whitney U Test for numerical variables, according to data distribution. All analyses were conducted using the SPSS statistical software, and the results are presented in tables and graphs for ease of interpretation.

Results

This study explored the relationship between age at onset of menopause, blood pressure, and T2DM at the Royal Prima Hospital. The main findings of this study showed a significant effect of age at onset of menopause on T2DM but no significant effect of blood pressure on T2DM. Data analysis showed that the prevalence of T2DM was highest in the age range of 51–60 years, with 35 patients (29.17%), while the lowest prevalence was found in the age range of 40–45 years, with 5 patients (4.17%). These data show that the risk of type 2 diabetes mellitus increases with age, particularly during menopause. This is in line with the theory that hormonal changes during menopause can affect glucose metabolism and increase the risk of

T2DM. Furthermore, blood pressure analysis showed that a blood pressure between 121 and 140 mmHg had the highest prevalence of T2DM (30.8%).

Table 1. The association between age and blood pressure with T2DM

Variable	n	%	T2DM (n(%))		P*
			Yes	No	
Age at menopause					
40 - 45	8	6.7	5 (4.17)	3 (2.50)	0.011
46 - 50	36	30.0	25 (20.83)	11 (9.17)	
51 - 60	55	45.8	35 (29.17)	20 (16.67)	
61 - 65	21	17.5	6 (5.00)	15 (12.50)	
Blood pressure					
81 – 100	18	15.0	11(9.16)	7(5.83)	0.028
101 – 120	17	14.1	6(4.97)	11(9.12)	
121 – 140	37	30.8	23(19.14)	14(11.65)	
141 – 170	31	26.0	17(14.25)	14(11.74)	
171 – 283	17	14.1	14(11.61)	3(2.48)	

**Fisher Exact*

Although there were variations in blood pressure levels among T2DM patients, the analysis did not show a significant effect of blood pressure on the incidence of T2DM. This may indicate that other factors, such as age at onset of menopause, have a more dominant role in influencing the incidence of T2DM than blood pressure alone.

Table 2. Regression analysis of factors associated with T2DM

	Unstandardized Coefficients		*Standardized Coefficients*	*T*	*Sig.*
	B	*Std. Error*	*Beta*		
T2DM	1.396	.259		5.387	.000
Age at menopause	.121	.054	.203	2.257	.026
Blood pressure	-.002	.001	-.149	-1.663	.099

The results of hypothesis testing showed that age at onset of menopause had a significant influence on T2DM, with a significance value (0.026) smaller than 0.05, and a calculated t value (2.257) greater than the t table. In contrast, blood pressure had no significant effect on T2DM, as the significance value (0.099) was greater than 0.05. This finding was reinforced by the results of Fisher's Exact test, which showed a significant association between the age at onset of menopause and T2DM ($p < 0.05$). However, the association between blood pressure and T2DM was not significant according to the same test (p value = 0.028). The limitations of this study include the limited sample size and measurement methods that may not fully reflect the variability of the wider population. Further studies with larger sample sizes and more varied measurements are needed to confirm these findings and explore other factors that may contribute to the incidence of T2DM in menopausal women.

Discussion

The results showed that the highest prevalence of T2DM was found in women aged 51–60 years, reflecting the general trend that the risk of diabetes increases with age. This finding supports the results of previous studies showing that the risk of T2DM increases in women who enter menopause at an older age. A meta-analysis found that each 5-year increase in menopausal age was associated with a 10% reduction in T2DM risk.[13] Similarly, a large cohort study reported that early menopause was linked to higher T2DM risk, with a 4% decrease in risk for each year of later menopause onset.[14] This association persisted after adjusting for potential mediators. Another study observed that premature menopause (<40 years) nearly doubled the odds of T2DM compared to normal menopause (45-54 years).[8] Postmenopausal status itself was identified as a significant risk factor for T2DM, particularly in women with normal BMI.[15] In contrast, the prevalence

of T2DM was low in the 40-45 years age group, suggesting that factors other than menopausal age also play a role in diabetes risk. An earlier age at menopause may affect hormonal and metabolic balance, contributing to an increased risk of diabetes. However, in the t-test, only early menopausal age showed a significant effect on T2DM, whereas blood pressure showed no significant effect. This may indicate that age at onset of menopause has a stronger impact than blood pressure in the context of diabetes risk.

The results of the blood pressure analysis showed that blood pressure in the range of 121–140 mmHg was the most common in T2DM patients, supporting the theory that hypertension is an important risk factor for diabetes. A large-scale study found that T2DM was independently associated with hypertension over a 10-year period, with odds ratios ranging from 2.19 to 2.49.[16] Similarly, a prospective study in Chinese adults revealed that both prehypertension and hypertension were linked to increased T2DM risk, with hypertension showing a stronger association (OR: 2.02).[17] While T2DM appears to be causal for hypertension development, the reverse relationship is less clear.[18] The coexistence of these conditions significantly elevates the risk of cardiovascular events and chronic kidney disease. Factors contributing to this association include obesity, insulin resistance, activation of the renin-angiotensin-aldosterone system, and chronic inflammation.[19] Understanding these interconnections is crucial for developing targeted prevention and treatment strategies for both conditions. This may reflect the importance of blood pressure monitoring as part of the health management of T2DM patients, especially in the clinical context.

This study had some limitations. The sample size from only one hospital may not reflect the wider population; therefore, the results need to be interpreted with caution. In addition, blood pressure data were obtained from medical records, which may not always reflect patients' recent health conditions. Further studies with larger sample sizes and longitudinal designs are required to provide additional insights and strengthen these findings.

Conclusion

This study revealed a strong association between menopausal age and the prevalence of type 2 Diabetes Mellitus (T2DM) in women. Early menopause, particularly before the age of 40, significantly increases the risk of developing T2DM. This finding suggests that hormonal factors play a crucial role in the pathogenesis of diabetes. Additionally, this study confirms that hypertension is a significant risk factor for T2DM, highlighting the importance of blood pressure management in preventing and treating the disease. However, it is essential to note that this study has limitations, including a relatively small sample size and the use of medical records for blood pressure data. Further research with larger sample sizes and longitudinal designs is needed to strengthen these findings and to explore the underlying mechanisms.

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