DOI Number: 10.5958/0976-5506.2018.01687.X

The Effects of Age and Body Mass Index on Blood Glucose, Blood Cholesterol, and Blood Pressure in Adult Women

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ABSTRACT

Introduction: The risk factors of cardiovascular disease include having a high body mass index, hyperglycemia, hypercholesterolemia and increased blood pressure. The purpose of this study was to analyse the effects of age and body mass index (BMI) on blood glucose, blood cholesterol and blood pressure in adult women.

Method: An analytical observation using a cross-sectional method was employed as the study design. The study recruited 60 women aged between 30 to 60 years old to participate, using a purposive sampling technique. The data was analysed using univariate analysis and path analysis.

Result: Age and BMI showed as having the strongest direct effect on the blood pressure. Age also had a direct effect on blood glucose level and blood cholesterol level. The effect of age on blood glucose and blood cholesterol was also mediated by BMI.

Conclusion: Being of an older age had a direct effect on increased blood glucose, blood cholesterol, and blood pressure, while a higher BMI had a direct effect on increased blood pressure. As women get older, maintaining a normal BMI is beneficial to preventing the increase of their blood glucose, blood cholesterol and blood pressure.

Keywords: *age, body mass index, blood glucose, blood cholesterol, blood pressure*

INTRODUCTION

Cardiovascular disease is a public health problems and the leading cause of death in both developed and developing countries.[1,2] Globally, the number of deaths due to cardiovascular disease is estimated to have increased from 16.7 million in 2002 to 23.3 million in 2030.[3] In Indonesia, coronary heart disease is the second leading cause of death after stroke, contributing to 12.9% of the overall mortality rate.[4]

Several risk factors have been identified as a contributing factor to cardiovascular disease including age, increased body mass index, hyperglycemia, hypercholesterolemia and increased blood pressure.[2, 5-8] The risk of cardiovascular disease in females is greater than in males, with the influence of conventional factors such as high blood pressure, high cholesterol, diabetes, excessive body weight, and factors related to psychosocial condition and socioeconomic status.[9] In addition, hormonal changes throughout a woman's stages of life that affect the cardiac conduction system and the structure and function of the blood vessels, and systemic inflammation could cause cardiovascular disease.[10, 11] The purpose of this study was to analyse the effect of age and body mass index (BMI) on blood glucose, blood cholesterol and blood pressure in adult women.

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METHOD

Study design, setting, and sample size: This study employed an analytical observational design method with a cross-sectional method. The study was conducted

in Malang district, East Java, Indonesia. Using a purposive sampling method, 60 women aged between 30 to 60 years old were recruited to participate in the study.

Variables and the instrument of the data collection: There were five variables in the study, including age, BMI, blood glucose, blood cholesterol, and blood pressure as described below.

a. **Age:** The data of age was obtained from the sociodemographic characteristics of the respondents stated during the data collection. Other sociodemographic data included marital status, employment status and co-morbidity.

b. **Body mass index (BMI):** The body mass index was obtained from the measurement of body weight (kg) and height (m). The formula to calculate the BMI is as follow: (weight (kg) / weight (m))^2. BMI was classified as underweight (BMI <20 kg/m^2, normal (BMI= 20-24.9 kg/m^2), overweight (BMI= 25-29.9 kg/m^2), and obesity (BMI≥30 kg/m^2).[7]

c. **Blood glucose:** The blood glucose was measured based on the capillary blood glucose level (mg/dl) using a glucose meter. For the purpose of this study, blood glucose was measured from a random glucose test. A blood glucose level of less than 200 mg/dl was categorised as normal and a level of 200 mg/dl or higher was classified as hyperglycemia.

d. **Blood cholesterol:** Blood cholesterol was measured from the total blood cholesterol level obtained from peripheral blood (mg/dl) using a finger-stick cholesterol test. The blood cholesterol level was considered to be normal at less than 200 mg/dl, and hypocholesteremic at 200 mg/dl or higher.

e. **Blood pressure:** The blood pressure level was measured using a sphygmomanometer. The results of the Systolic Blood Pressure (SBP) and Dyastolic Blood Pressure (DBP) measurements of each study participant were recorded on an observation sheet. Using the Joint National Committee's 8 guidelines, the blood pressure level was categorised as normal for the SBP < 120 mmHg and DBP < 80 mmHg, pre-hypertension for the SBP 120 – 139 mmHg and DBP 80 – 89 mmHg, hypertension stage 1 for the SBP 140 – 159 mmHg and DBP 90 – 99 mmHg, and hypertension stage 2 for the SBP ≥ 160 mmHg and DBP ≥ 100 mmHg.[12]

Ethical consideration and the data collection: Before the data collection, all of the study participants were provided with information about the study and the right to withdraw at any time. A written informed consent was submitted by participants to indicate agreement to participate in the study. After filling in the questionnaire with their age, marital status, and current employment status, participants were measured for their blood pressure level, blood glucose level and blood cholesterol level.

DATA ANALYSIS

The data was analysed using descriptive analysis to describe the sociodemographic characteristics and the clinical characteristics of the participants. The data was then analysed using path analysis.

RESULTS

Sociodemographic and clinical characteristics of the study participants: As shown in Table 1, more than half of the subjects (63.3%) were aged between 30 to 45 years old. The majority of the women were married (88.3%) and unemployed (68.3%). Based on their clinical status, the majority of them did not have diabetes mellitus as a co-morbidity as indicated by the high percentage of women (91.7%) with normal random blood glucose level. The majority of the subjects had a normal BMI (45%). Most of the study subjects had a normal blood cholesterol level (51.7%), and normal blood pressure (35%).

Table 1: Sociodemographic characteristics and clinical characteristics of the study participants

Characteristics		Total	
		N	%
Socio-demographic characteristics			
Age (years)	30–45	38	63.3
	≥ 46	22	36.7
Marital status	Married	53	88.3
	Single/Divorce/ Widowed	7	11.7
Employment status	Employed	19	31.7
	Unemployed	41	68.3
Clinical characteristic			
Diabetes mellitus as co-morbidity	Yes	5	8.3
	No	55	91.7

Conted…

Body mass index	Underweight	7	11.6
	Normal	27	45.0
	Overweight	15	25.0
	Obesity	11	18.4
Blood glucose	Normal	55	91.7
	Hyperglycemia	5	8.3
Blood cholesterol	Normal	31	51.7
	Hypercholesterolemia	29	48.3
Blood pressure	Normal	21	35.0
	Pre-hypertension	19	31.7
	Hypertension stage 1	14	23.3
	Hypertension stage 2	6	10.0

Path analysis: As shown in Figure 3, the diagram path presented the results of the path analysis on the effects of age and BMI on blood glucose, blood cholesterol and blood pressure among the women participating in the study. There were four paths with significant relationships. The first significant direct effect was in age (X1. Usia) → blood glucose (Y1.GD). The second significant direct effect was age (X1. Usia) → blood cholesterol (Y2.KD). The third significant direct effect was age (X1. Usia) → blood pressure (Y3.TD). The fourth significant direct effect was shown in BMI (X2. IMT) → blood pressure (Y3.TD).

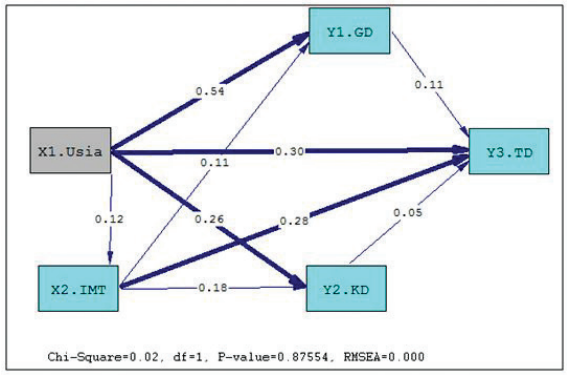

Figure 1: Results of the path analyses with their beta coefficient value

Table 2 presents the results of the path analysis displaying the effect values of age related to blood glucose, blood cholesterol and blood pressure. Each path described the direct or indirect effect of age on blood glucose, blood cholesterol and blood pressure. BMI was entered as the mediating variable.

Table 2: The path effect value of age on blood glucose, blood cholesterol, and blood pressure

No.	Path of variable	Effect value	Total effect
1.	Age → Blood Glucose	0.54	0.553
2.	Age → BMI → Blood Glucose	0.12 x 0.11 = 0.0132	
3.	Age → Blood cholesterol	0.26	0.282
4.	Age → BMI → Blood cholesterol	0.12 x 0.18 = 0.0216	
5.	Age → Blood Pressure	0.30	0.409
6.	Age → Blood Glucose → Blood pressure	0.54 x 0.11 = 0.0594	
7.	Age → Blood cholesterol → Blood Pressure	0.26 x 0.05 = 0.013	
8.	Age → BMI → Blood Cholesterol →Blood Pressure	0.12 x 0.18 x 0.05 = 0.0011	
9.	Age → BMI → Blood Glucose →Blood Pressure	0.12 x 0.11 x 0.11 = 0.0015	
10.	Age → BMI → Blood Pressure	0.28 = 0.034	

The first path showed a direct effect between age (X1) and blood glucose (Y1), while the second path had BMI as the mediator variable (X2). The effect value in the first path was 0.54. The value of this effect was unidirectional. As the women got older, their blood glucose levels tended to increase by 0.54 times. In the second path, the effect value was 0.013. The direction showed an order of effect that indicated that older age with the BMI increase as the mediation would increase the blood glucose level by 0.013 times. The total effect of the relationship between age and blood glucose was 0.553 times.

The third and fourth paths showed the effect between age (X1) and blood cholesterol (Y2). The third path presented a direct path, while the fourth path had a direction with BMI as the mediating variable (X2). The effect value of the third path was 0.26, while the

fourth path was 0.0216 after being mediated by BMI. The total effect of the relationship between women's age and blood cholesterol level was 0.282. This effect value indicated the unidirectional path which explained that growing older would lead women to have an increased blood cholesterol level by 0.282 times.

The paths from the fifth to the tenth were the pathway between age (X1) and the blood pressure variable (Y3). While the fifth path had a direct line between age and blood pressure level, the sixth path up to the tenth path were each mediated by BMI, blood glucose, and blood cholesterol respectively. The total of the effect value from the fifth to the tenth paths was 0.409. The unidirectional effect value means that the increased age of women would lead to the increasing blood pressure level by 0.409 times.

This finding indicates that the women's age had a strong significant effect on blood glucose, blood pressure, and blood cholesterol respectively. The women's BMI had a significant effect on blood pressure.

DISCUSSION

Age was shown to have a strong effect on blood glucose level, blood pressure level, and blood cholesterol level. The blood glucose level tends to rise along with an increase in age. The results of this study confirmed the findings of previous studies.[13, 14] Aging has a correlation to the changes in glucose metabolism in the blood system, including insulin resistance and cell dysfunction.[15, 16] The effectiveness of insulin could be decreasing due to an increase in abdominal fat mass, low physical activity, mitochondrial dysfunction, and hormonal changes.[17, 18]

The strong effect of age on the women's blood pressure level has been shown in the present study. This finding was consistent with previous studies that reported that increased blood pressure level was significantly associated with increasing age.[19-21] Aging causes changes in the structure of the arteries, so then the arteries become more rigid.[22] The increase in blood pressure may occur due to an unhealthy lifestyle, such as a high salt intake and high sugar consumption.[23] A high level of salt in diet can cause changes in vascular smooth muscle cells, which results in the accumulation of collagen in the walls of the arteries, thus increasing arterial stiffness.[24] For women, approaching the menopausal period cause a greater risk of increased blood pressure level than men. The mechanism of the blood pressure rise involves multiple factors such as decreased oestrogen levels, oxidative stress, endothelial dysfunction, and the influence of the renin angiotensin system and sympathetic activation.[25]

Another strong effect was also found between the women's age and blood cholesterol level in this study. The aging process results in changes in the cholesterol metabolism of the blood. These changes cause an increase in Low Density Lipoprotein (LDL) cholesterol. The balance between intake, synthesis, absorption, and excretion affects the cholesterol metabolism of the human body.[26]

Body Mass Index (BMI) affects blood pressure level. This finding supports the results of previous studies that illustrated the significant relationship between BMI and blood pressure.[19, 23] A high level of BMI affects blood pressure. Practicing a healthy lifestyle and controlling bodily weight should be encouraged in order to prevent an increase in blood pressure.[25, 27, 28]

CONCLUSION

Age has a significant effect on blood glucose, blood pressure, and blood cholesterol, while BMI has a significant effect on blood pressure. Aging puts women at a greater risk of having an increased level of blood glucose, blood pressure, and blood cholesterol. The risk escalates for older women with a high BMI. To maintain a normal level of blood sugar, blood cholesterol, and blood pressure, the risk factors should be controlled. While aging is inevitable, BMI level can be managed by practicing a healthy lifestyle such as reducing fat, salt, and sugar intake in their diet, promoting physical activity, and maintaining a normal body weight.

Ethical Clearance: Ethical approval was granted by the School of Public Health in Airlangga University, Surabaya.

Source of Funding: self funding.

Conflict of Interest: Authors declared that we have no conflict of interest.

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