Correlation Between Body Mass Index and Total Cholesterol Levels in Health Workers at Garba Med General Hospital Bali: A Cross Sectional Study

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Abstract

Last ten years, around 36 million people suffering from cardiovascular disease (CVD) in Indonesia. One of the most important risk factors for CVD, especially in coronary heart disease (CHD) is hypercholesterolemia. An increase in BMI above normal included overweight and obesity, will have an impact on increasing the total cholesterol levels. A preliminary study was previously carried out at Garba Med General Hospital, and it was found that 16 (24,6%) of all health workers at Garba Med General Hospital were classified as overweight and obese. From this background, researcher is interested to determine about the relationship between body mass index (BMI) and total cholesterol levels in health workers at Garba Med General Hospital. This research is an analytical study with prospective cross-sectional design. As many as 41 health workers General Hospital. As many as 41 respondents has become samples in this research. The sampling technique was used purposive sampling with inclusion and exclusion criteria. Data collection in this study used primary data that collected by measurement weight and height to found out the body mass index and measurement of total cholesterol levels using the rapid test method with an easy touch GCU device. Bivariate analysis of this research using Pearson's Correlation and the result showed significant positive correlation between BMI and total cholesterol levels with p-*value* < 0.05 (0.027).

Keywords: Body Mass Index, Hypercholesterolemia, Obesity

1. Introduction

Last ten years, around 36 million people suffering from CVD in Indonesia. Indonesia Ministry of Health data shows that the incidence of non-communicable diseases such as CVD, diabetes melitus (DM), hypertension, stroke, and dyslipidemia is increasing from year to year. Cardiovascular Disease is the leading cause of death in the world, especially in devolved countries[1,2]. The highest incidence of CVD in the world is CHD.[2] As many as 28 million people in the world encounter sudden death due to heart attacks.[1] Data in 2016 showed, more than fifty thousand people in Indonesia experience about CHD.[3]

One of the most important risk factors for CVD, especially in CHD is hypercholesterolemia beside hypertension and smoking. Hypercholesterolemia is the only one risk factor that can occur atherosclerosis.[1,4] Hypercholesterolemia is a condition where it increases in total cholesterol levels in the blood.[4] Prevalence of hypercholesterolemia in Indonesia, based on National Basic Health Research survey in 2016, was 52,3%. It was increased compared 35.9% in 2013.[3,5] One of the most risk factors of hypercholesterolemia include high of BMI or obesity. An increase in BMI above normal (overweight and obesity) will have an impact on increasing the total cholesterol levels. Nowadays, there is a change in the lifestyle of the current population in the world, where the habit of consuming foods with high fat content, alcohol consumption and low physical activity can increase the risk of overweight and obesity. It will cause lipid metabolism disorders such as hypercholesterolemia and ultimately increase the risk of CHD and resulting in death.[5] An increase in total cholesterol levels is a condition

that does not show any signs or symptoms, however it leads to an increase in the risk of atherosclerotic disease, and subsequently premature death.[4]

Hypercholesterolemia can also occur due to lack of daily physical activity, especially in the working population, such as in health workers. Around 8-10 hours per day, most of the time of health workers is spent at work. It is also supported by the habit of consuming high-calorie food such as fast food, which can increase the risk of obesity and hypercholesterolemia.[5] A preliminary study was previously carried out at Garba Med General Hospital, and there was found that 16 (24,6%) of all health workers at Garba Med General Hospital were classified as overweight and obese. From this background, researcher is interested to determine about the correlation between BMI and total cholesterol levels in health workers at Garba Med General Hospital.

2. Materials and Methods

Study design

This research is an analytical study with prospective cross-sectional design. The purpose of this study was to analyses Correlation between BMI and total cholesterol levels in health workers at Garba Med General Hospital. The data collection and measurement are carried out at certain times. This research was conducted at Garba Med General Hospital in Badung, Bali, Indonesia from August to September 2023.

Samples

As many as 41 health workers in Garba Med General Hospital has become samples in this research. The sampling technique in this study was used purposive sampling with inclusion criteria in this sample were age >18 years old, and willing to sign a inform consent form to become a research sample. Exclusion criteria were age <18 years old, under consumption of anti-hypercholesterolemia medication and steroid drugs, pregnant woman, and history of diseases that can cause disorders of fat metabolism. Independent variable in this study is BMI and dependent variable is total cholesterol levels.

Data Collection

Data collection in this study used primary data collection that was carried out by researcher. Body mass index data was found by measurement of weight adjusted for height, calculated as weight in kilograms divided by the square of height in meters (kg/m2).[6] Body weight was measured using a body scale and height using a microtoise. Respondents will be categorized into 6 BMI categories, namely underweight: <18.5; normal: 18.5-24.9; overweight: 25.0-29.9; obesity grade I: 30.0-34.9; obesity grade II: 35.0-39.9; obesity grade III: ≥ 40.0.[7] Total cholesterol levels data was obtained by measuring using the rapid test method with an easy touch GCU device. Blood samples are taken through capillaries. Respondent will be categorized into 3 categories that were normal when total cholesterol levels <200 mg/dL, borderline when total cholesterol levels 200-239 mg/dL, high total cholesterol if the result ≥ 240 mg/dL.[8]

Definitions

Hypercholesterolemia is a pathological condition which has been reported in 38% of the world adult population. Hypercholesterolemia is characterized by elevated cholesterol is defined as total cholesterol value higher than 240 mg/dL.[8] High levels of blood cholesterol closely associated with the development of CHD, which will pile up and thicken the blood vessel walls causing calcification is the biggest risk factor for atherosclerosis. Atherosclerosis is a condition due to the inflammatory response in blood vessels because of the presence of plaque in the arteries. This condition is progressive and causes thickening and hardening of the arterial walls, resulting in arterial stiffness and fragility. Hypercholesterolemia is the predictor of various CVD, which is the leading cause of death in the world and is closely associated with the development CHD. Hypercholesterolemia is usually caused by a combination of environmental and genetic factors. In developed

countries, hypercholesterolemia is often due to both poor dietary habits and lifestyle and is linked to the metabolic syndrome.[9]

Body mass index (BMI) is a measure of weight adjusted for height, calculated as weight in kilograms divided by the square of height in meters (kg/m^2).[6] BMI is important in the determination of potential future health issues and has been widely used as a factor in the determination of various public health policies.[10] BMI is a simple, inexpensive, and non-invasive surrogate measure of body fat. In contrast to other methods, BMI relies solely on height and weight and with access to the proper equipment, individuals can have their BMI routinely measured and calculated with reasonable accuracy.[6] The clinical limitations of BMI should be considered. BMI is a surrogate measure of body fatness because it is a measure of excess weight rather than excess body fat. Body mass index does not distinguish between excess fat, muscle, or bone mass, nor does it provide any indication of the distribution of fat among individuals. BMI is interpreted by using standard weight status categories that are the same for all ages and for both men and women. The standard weight status categories associated with BMI ranges for adults can be seen in the table below.[6,7,10]

Table 1. Classification of BMI

BMI	Weight Category
<18.5	Underweight
18.5 – 24.4	Normal
25.0 – 29.9	Overweight
30.0 – 34.9	Obesity grade I
35.0 – 39.9	Obesity grade II
≥ 40.0	Obesity grade III

Statistical Analysis

Univariate analysis was used to determine each variable's frequency and distribution. The statistical bivariate analysis correlation between BMI and total cholesterol levels were assessed using Pearson's Correlation. According to the data, normality test using Kolmogorov Smirnov test, all distributions data were normal. The data analysed used the statistical package for social science (SPSS 27 version).

Ethical Clearance

Ethical approval was obtained for this study from Director of Garba Med General Hospital. Inform consent for respondents was taken both verbally and in written form after a through explanation of the study procedures. Confidentially of the study participants was carefully maintained through data de-identification.

3. Results

Table 2. Distribution of Characteristics Respondent

No	Variables	Total	Percentage (%)
1	**Gender**		
	Male	10	24.4%
	Female	31	75.6%
2	**Age**		
	21-25 years old	14	34.1%
	26-30 years old	25	60.9%
	31-35 years old	2	5.0%
3	**Job**		
	Doctor	4	9.8%

	Nurse	21	51.0%
	Midwife	4	9.8%
	Health analyst	4	9.8%
	Radiographer	2	4.9%
	Pharmacy clinical staff	4	9.8%
	Others	2	4.9%
3	**Smoking**		
	Yes	5	12.2%
	No	36	87.8%
4	**Alcohol Consumption**		
	Yes	6	14.6%
	No	35	85.4%

Table 1. showed the distribution of characteristics respondent based on gender, age, job, and habits of smoking and alcohol consumption. The majority respondents were female as many as 31 people (75.6%) and male respondents were 10 people (24.4%). Most of the respondents work as a nurse as many as 21 respondents (51.0%). The age of respondents was categorized by 3 groups. The largest age group is 26-30 years old with 25 people (60.9%), 21-25 years old group as many as 14 people (34.1%) and there was 2 people (5%) in 31-35 years old age group. The respondent's smoking habits we divide it into 2 categories, namely smoking and non-smoking. There were 5 people (12.2%) smoking, and 36 people (87.8%) were non-smoking. Alcohol consumption habits are also divided into 2 categories. As many as 6 people (14.6%) have the habit of consuming alcohol and 35 people (85.4%) does not have the habit of consuming alcohol.

Table 3. BMI Distribution of Respondent

No	BMI	Number	Percentage (%)
1	Underweight	1	2.5%
2	Normal	21	51.0%
3	Overweight	12	29.3%
4	Obesity grade I	5	12.2%
5	Obesity grade II	1	2.5%
6	Obesity grade III	1	2.5%

Table 2. showed BMI categories of respondent. Data showed from 41 respondent, there was 1 respondent (2.5%) included to the underweight category, 21 respondents (51.0%) included to the normal BMI, 12 (29.3%) included to the overweight category, 5 respondents (12.2%) included to the obesity grade 1, 1 respondent (2.5%) included to the obesity grade 2, and 1 respondent (2,5%) included to the obesity grade 3.

Table 4. Total cholesterol levels Distribution of Respondent

No	Total cholesterol levels	Number	Percentage (%)
1	Normal	29	70.7%
2	Borderline	11	26.8%
2	High	1	2.5%

Table 3. showed total cholesterol levels data of respondent. Data showed amongst 41 respondents, there was 28 (68.3%) respondents categorized into normal total cholesterol levels, 13 (29.3%) respondents categorized into borderline total cholesterol levels, and 1 (2,5%) respondent categorized into high total cholesterol levels.

Table 5. BMI Based on Gender Distribution

Gender	BMI					
	Underweight	Normal	Overweight	Obesity Grade 1	Obesity Grade 2	Obesity Grade 3
Male	0 (0%)	3 (7.2%)	5 (12.2%)	2 (5.0%)	0 (0%)	0 (0%)
Female	1 (2.5%)	18 (43.8%)	7 (17.1%)	3 (7.2%)	1 (2.5%)	1 (2.5%)

Table 4. showed BMI based on gender distribution. Most of the male respondents were categorized to overweight (5 (12.2%) of 10 male respondents), 3 respondents (7.2%) categorized to normal BMI and 2 respondents (5.0%) categorized to obesity grade I. Eighteen of 31 female respondents were categorized to normal BMI, 1 respondent (2.5%) categorized to underweight, 7 respondents (17.1%) categorized to overweight, 3 respondents (7.2%) categorized to obesity grade I, 1 respondent (2.5%) categorized to obesity grade II, and 1 respondent (2.5%) categorized to obesity grade III.

Table 6. Total cholesterol levels Based on Gender Distribution

Gender	Total cholesterol levels					
	Normal	Percentage	Borderline	Percentage	High	Percentage
Male	8	19.6%	1	2.5%	1	2.5%
Female	21	51.0%	10	24.4%	0	0%

Table 4. showed Total cholesterol levels based on gender distribution. Most of the male respondents have normal total cholesterol levels. There were 8 male respondents (19.6%) have normal total cholesterol levels. 1 respondent (2.5%) have borderline total cholesterol levels, and 1 respondent has high total cholesterol levels. Whereas 21 female respondents (51.0%) have normal total cholesterol levels and 10 respondents (24.4%) have borderline total cholesterol levels.

Table 7. Bivariate Analysis of The Correlation Between BMI and Total cholesterol levels in Health Workers at Garba Med General Hospital.

BMI	Total cholesterol levels						Total
	Normal	%	Borderline	%	High	%	
Underweight	1	2.5%	0	0%	0	0%	1
Normal	15		6		0	0%	21
Overweight	11	26.8%	1	2.5%	0	0%	12
Obesity grade I	2	4.9%	2	4.9%	1	2.5%	5
Obesity grade II	0	0%	1	2.5%	0	0%	1
Obesity grade III	0	0%	1	2.5%	0	0%	1
p-*value* 0.027							
Pearson Correlation 0.346							

The cross tabulation between BMI and can be seen in table 8. Most of respondent had a normal BMI and borderline category for total cholesterol levels. Correlation between BMI and total cholesterol levels using Pearson test with sig. (2-tailed) was 0.027 (p-*value* <0.05), which mean, there was significant relationship between BMI and total cholesterol levels in Health workers at Garba Med General Hospital. The Pearson correlation coefficient value was 0.346 which indicate low relationship.

4. Discussion

This research was conducted from August to September 2023. The data was collected by direct examination for BMI and total cholesterol levels to all of the respondents. Based on the result, most of respondents in this study were woman (31 of 41 respondents), with the majority age of respondents between 26-30 years. One respondent (2.5%) has high total cholesterol levels and include to obesity grade I. Most of respondents who include overweight BMI have normal total cholesterol levels, and only one respondent included to borderline total cholesterol levels.

This study findings showed that BMI and total cholesterol levels have significant positive associations with p-*value* <0.05 (0.027), however the coefficient value indicated low correlation. This is in accordance with previous research conducted by Prihantini and Kurnianto in 2022 that showed p-*value* 0.000, although Pearson correlation showed indicate high relationship.[5] There were differences with the previous research that conducted by Wongkar, et al in 2022. The result of that research showed there was no significant correlation between BMI and total cholesterol levels, with p-*value* 0.682 and the Pearson correlation 0.001 that indicated low relationship.[11]

The difference between two previous research were caused by various risk factors for high cholesterol level, such as unhealthy dietary habits, alcohol consumption, smoke, obesity, low physical activity, and family history of hypercholesterolemia.[12] According to the literature, one of the risk factors for hypercholesterolemia is overweight and obesity. Obesity can increase cardiovascular risk through risk factors such as increased cholesterol level. Abnormality of cholesterol are very commonly observed in patients with obese. About 60-70% people with obesity had hypercholesterolemia, however not all people with obesity had high total cholesterol levels. It also seen in this study, not all respondents who fall into the overweight category have high total cholesterol levels, and not all respondents with a normal BMI have normal total cholesterol levels. This is influenced by the variability of risk factors that cause hypercholesterolemia.[13]

In this study, high total cholesterol levels influenced by the characteristics of the respondents, which all respondents of this study are health workers with productive age who generally have a low level of daily physical activity. Health workers generally spend more time for working, so the opportunity to do other physical activities such as sports is very limited. In addition, there is a habit among workers who consume fast food during breaks, which is more practical to eat during working hours. It can also increase the risk of developing hypercholesterolemia because hypercholesterolemia occurs due to inappropriate food consumption, especially fast food that contains high of fat, it also one of the risk factors in resulting overweight and obesity. The results of Bintanah's research in 2010 showed that the majority (76.5%) respondents suffering from hypercholesterolemia had a history of high fat intake. The types of fat intake consumed include the most condensed coconut milk, fatty meats and coconut oil. People who have a high risk of cholesterol levels are those who consume foods that contain high saturated fats.[14] Alcohol consumption is also one of the risk factors that influence total cholesterol levels of respondents in this study. There were 6 respondents who have the habits of consuming alcohol. Previous research that conducted by Auley, 2020 about effects of obesity on cholesterol metabolism and its implications for healthy ageing, mentioned that chronic alcohol intake affects lipid metabolism broadly by provoking the increased synthesis of subsequent hypertriacylglycerolaemia, it can result in increased weight gain in certain individual and impact to obesity.[15]

Female respondents in this study had higher cholesterol level and classified as obese more than male respondents. According to the literature, prevalence of hypercholesterolemia is higher in women than in men. It because in women, fat is more found and also this occurs due to the role of estrogen hormones that can increase levels of High-Density Lipoprotein (HDL). Women tend to be more high risk of hypercholesterolemia especially after menopause. It also influenced by differences in levels of physical activity and energy intake in men and women.[9,16]

5. Conclusion

Based on the results of this research, it was found that there was a relationship between BMI and total cholesterol levels in health workers at Garba Med General Hospital however it was indicated low relationship. It was caused by variability of risk factors that cause hypercholesterolemia such as unhealthy dietary habits, alcohol consumptions, smoke, overweight and obesity, low physical activity and family history. For further research, authors recommend finding out factors are associated with the incidence of hypercholesterolemia in health workers with the specific measurement of cholesterol level, such measurement of HDL, Low Density Lipoprotein (LDL) and Triglycerides (TG).

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