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RESEARCH ARTICLE

The Effect of Lifestyle on Hypercholesterolemia

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Abstract:

Background:

Unhealthy lifestyle is a risk factor for hypercholesterolemia. However, the study about lifestyle and hypercholesterolemia in Indonesia is not completely explored.

Objectives:

The present study attempted to examine the effect of lifestyle on hypercholesterolemia including smoking habits, physical activity, consumption of vegetables and fruits.

Methods:

This study employed the data from Integrated Coaching Post (Posbindu) Non-Communicable Disease in DKI Jakarta Indonesia 2015- with a sample size of 1090 participants analyzed using multivariable binomial regression. The potential impacts were also measured to determine the contribution of risk factors.

Result:

The prevalence of hypercholesterolemia was 49,5%. The results of a multivariate analysis -highlighted that physical activity and smoking habits determined the lifestyle associated with hypercholesterolemia-. Less physical activity -contributed- significantly to hypercholesterolemia.

Conclusion:

The prevalence of hypercholesterolemia in this study was quite high. Physical activity and smoking habits were significant determinants of hypercholesterolemia.

Keywords: Consumption of vegetables and fruits, Hypercholesterolemia, Lifestyle, Smoking habits, Physical activity, Indonesia.

1. INTRODUCTION

Non-Communicable diseases are a source of national and global concern. Increased levels of cholesterol and fat in the blood cause narrowing or calcification of the arteries and are the main causes of cardiovascular disease. According to a WHO report, hypercholesterolemia is estimated to account for 18% of cerebrovascular disease and 56% of ischemic heart disease worldwide [1]. Overall, it is responsible for 4.4 million deaths (7.9%) and 40.4 million DALY (2.8%) [1]. The Multiple Risk Factor Intervention Trial showed that the risk of death from coronary heart disease began to increase at a cholesterol level of 180 mg/dl. The risk increased again at levels of 200 mg/dl and tripled at levels of 245 mg/dl.

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According to the Basic Health Research report in 2013, the proportion of the population aged >15 years with total cholesterol levels above normal was 35.9%. In the same study, when the data were stratified according to sex and residential area, the figures were 39.6% and 30% for females and males, respectively, and 39.5% and 32.1% for urban and rural areas, respectively [2].

An unhealthy lifestyle can trigger hypercholesterolemia at a productive age. High-cholesterol foods, such as fatty meats, chicken skin, coconut milk, egg yolks, butter, cheese, fried foods, cakes and biscuits, in addition to a lack of physical activity, smoking habits, and alcohol consumption, can have adverse health effects and accelerate the onset of hypercholesterolemia [3].

This study applied the data of Integrated Coaching Post Non-Communicable Disease in Indonesia to determine the effect of lifestyle on hypercholesterolemia in DKI Jakarta Province in 2015-2016.

2. METHOD

An analytical cross-sectional study design was used to determine the effect of lifestyle on hypercholesterolemia in DKI Jakarta Province in 2015-2016. The dependent variable was cholesterol status, and the independent variables were smoking habits, physical activity and consumption of vegetables and fruits. Potential confounders included age, sex, education, employment status, familial history of hypercholesterolemia, blood sugar levels, blood pressure, and nutritional status.

Various risk factors used as research variables were derived from Integrated Coaching Post (Posbindu) Non-Communicable Disease in DKI Jakarta Indonesia activities which included the activity of extracting risk factor information with simple interviews about non-communicable disease history in the family and the participants themselves, physical activity, smoking, lack of eating vegetables and fruits. This activity is carried out during the first visit and periodically once a month. Activities measuring body weight, height, Body Mass Index (BMI), abdominal circumference, blood pressure, blood sugar levels, cholesterol levels are held once a month.

The population consisted of all participants in the Integrated Coaching Post Non-Communicable Disease in DKI Jakarta in 2015-2016. The inclusion criteria were: a) the Integrated Coaching Post Non-Communicable Disease participants who had a blood cholesterol level check and b) Integrated Coaching Post Non-Communicable Disease participants with the first visit. If the participant had visited Posbindu more than once in a single year, the blood cholesterol level on the first visit was recorded. The exclusion criteria were Posbindu participants who had a history of hypercholesterolemia. Based on the inclusion and exclusion criteria, 1,090 individuals were included in the study.

The data were analyzed using multivariable binomial regression. The potential impacts of physical activity, smoking habits and consumption of vegetables and fruits levels on the variables were also measured to determine the contribution of each factor to the risk of hypercholesterolemia.

3. RESULTS

3.1. Hypercholesterolemia Prevalence

Cholesterol levels measured were the total cholesterol levels. The prevalence of hypercholesterolemia in DKI Jakarta Province was 49.5%.

3.2. Relation of Respondent Characteristics with Hypercholesterolemia

Hypercholesterolemia was more prevalent in respondents with a smoking habit (78.7%), with an inadequate level of physical activity (69.7%), and insufficient level of vegetable and fruit consumption (55.3%). Hypercholesterolemia was more common among elderly (46-65 years) respondents (64.6%) and males (65.1%). More respondents with a high level of education (62.5%) had hypercholesterolemia. In terms of employment status, the proportion of respondents with hypercholesterolemia was higher among employed (53.2%). The proportion of respondents with hypercholesterolemia was lower among those who had a familial history of hypercholesterolemia than among those who did not -have- a familial history of the disorder (40.1% *vs.* 51.4%).

In terms of other noncommunicable disease risk factors, hypercholesterolemia was higher in hypertensive respondents (69.4%). the proportion of hyperglycemic respondents with hypercholesterolemia (73.5%). The proportion of obese respondents with hypercholesterolemia was 67.6%.

Table 1. Relation of Respondent Characteristics with Hypercholesterolemia.

-	Cholesterol Levels	-	-	-	-	-	-	-
-	**Normal**	-	**Hypercholesterolemia**	-	**Total**	**RR**	**95%CI**	***P* Value**
Variable	n	%	n	%	-	-	-	-
Smoking Habit	-	-	-	-	-	-	-	-
Do not smoke	458	66,6	200	30,4	658	Ref	-	-
Smoke	92	21,3	216	78,7	432	2,5	2,3-3,0	0,001
Physical Activity	-	-	-	-	-	-	-	-
Enough	328	91,9	29	8,1	357	Ref		
Less	22	30,3	511	69,7	733	8,5	6,0-12,2	0,001
Consumption of Vegetables and Fruits	-	-	-	-	-	-	-	-
Enough	-	-	-	-	-	-	-	-
Less	169	71,0	69	29,0	238	Ref		
Age	381	44,7	471	55,3	852	1,9	1,5-2,3	0,001
12-25 years old (Adolescents)	-	-	-	-	-	-	-	-
26-45 years old (Adults)	129	71,3	52	28,3	181	Ref	-	-
46-65 years old (Elderly)	271	55,9	214	44,1	485	1,5	1,2-2,0	0,001
Sex	150	35,4	274	64,6	424	2,2	1,8-2,9	0,001
Female	-	-	-	-	-	-	-	-
Male	390	61,8	241	38,2	631	Ref	-	-
Education	160	34,9	299	65,1	459	1,7	1,5-1,9	0,001
Higher Education	-	-	-	-	-	-	-	-
Secondary Education	108	37,5	180	62,5	288	Ref	-	-
Primary Education	268	56,8	204	43,2	472	0,7	0,6-0,8	0,001
Employment	174	52,7	156	47,3	330	0,8	0,5-0,9	0,001
Do not work	-	-	-	-	-	-	-	-
Work	187	59,5	127	40,5	314	Ref	-	-
Hypercholesterol History	363	46,8	413	53,2	776	1,3	1,1-1,5	0,001
in the Family	-	-	-	-	-	-	-	-
Has no history	-	-	-	-	-	-	-	-
Has history	444	48,6	469	51,4	913	Ref	-	-
Blood Pressure	106	59,9	71	40,1	177	0,8	0,7-0,9	0,011
Normal	-	-	-	-	-	-	-	-
Hypertension	395	67,8	188	32,2	583	Ref	-	-
Blood Sugar Level	155	30,6	352	69,4	507	2,2	1,9-2,5	0,001
Normal	-	-	-	-	-	-	-	-
Hyperglycemia	461	61,1	293	38,8	754	Ref	-	-
Nutritional Status	89	26,5	247	73,5	336	1,9	1,7-2,1	0,001
Normal	-	-	-	-	-	-	-	-
Obesity	351	73,9	124	26,1	475	Ref	-	-
-	199	32,4	416	67,6	615	2,5	2,2-3,0	0,001

3.3. The Effect of Lifestyle on Hypercholesterolemia

The results of a multivariate analysis revealed that physical activity showed a stronger association with hypercholesterolemia than did smoking and fruit and vegetable consumption. Respondents with an inadequate level of physical activity had 5.9 times higher risk of hypercholesterolemia (95% CI 4.1-8.4). Respondents who smoked had 1.4 times higher risk of hypercholesterolemia (95% CI 1.3-1.6). There was no statistically significant relationship between fruit and vegetable consumption and hypercholesterolemia ($P = 0.762$).

Table 2. Effect of Lifestyle on Hypercholesterolemia Risk.

Variable	RR	95%CI	*P* Value
Smoking Habit	-	-	-
Yes	Ref	-	-

(Table 2) contd.....

Variable	RR	95%CI	*P* Value
No	1,4	1,3-1,6	0,001
Physical Activity	-	-	-
Enough	Ref	-	-
Less	5,9	4,1-8,4	0,001
Consumption of Vegetables and Fruits	-	-	-
Enough	Ref	-	-
Less	1,0	0,9-1,2	0,762
Blood Pressure	-	-	-
Normal	Ref	-	-
Hypertension	1,3	1,1-1,4	0,001
Nutritional Status	-	-	-
Normal	Ref	-	-
Obesity	1,4	1,3-1,6	0,001

3.4. The Potential Impact

The results of the potential impact measurement showed that an inadequate level of physical activity was the most likely cause of 56.4% (95% CI 50.7-61.6%) of cases of hypercholesterolemia in the exposed group and 78.2% (95% CI 69.5-84.5%) of cases of hypercholesterolemia in the population. Smoking habits accounted for 20.8% (95% CI 14.4-27.0%) of cases of hypercholesterolemia in the exposed group and 17.0% (95% CI 11.4-2-2.3%) of cases of hypercholesterolemia in the population.

Table 3. Calculation of Attributable Fraction Value in Exposed Group (AFE) and Population Attributable Fraction (PAF) Smoking Habit and Physical Activity with Hypercholesterolemia.

Variable	AFE%	95%CI	PAF%	95%CI
Smoking Habit	20,8	14,4-27,0	17,0	11,4-22,3
Less Physical Activity	56,4	50,7-61,6	78,2	69,5-84,5

4. DISCUSSION

Based on the results of the analysis, the prevalence of hypercholesterolemia was higher (49.5%) than the national rate (35.9%). The increase was explained by the high level of living competition in DKI Jakarta in Indonesia. The latter may lead to changes in lifestyle-related factors, such as food habits, physical activity, stress, smoking, and alcohol consumption, all of which may culminate in the emergence of health problems [4, 5].

The prevalence of hypercholesterolemia is high in almost all countries. In a survey in 1998-2007 of 79,039 adults aged 40-79 years in the U.K., Germany, Japan, Jordan, Mexico, Scotland, Thailand, and the U.S., the highest prevalence of hypercholesterolemia was in Thailand (78%), and the lowest was in the U.S. (16%) [6]. A study in Brazil (n = 2,471) reported a prevalence of 61.9% [7]. A study on 52,601 women in China reported that the prevalence of hypercholesterolemia was 40% [8].

In this study, respondents with an inadequate level of physical activity had a 5.9 times higher risk of hypercholesterolemia (95% CI 4.1-8.4) and those who smoked had a 1.4 times higher risk of hypercholesterolemia (95% CI 1.3-1.6) The findings of the present study are in line with those of Nindriani *et al.*, who found that the number of cigarettes smoked (P = 0.010, odds ratio [OR] = 10), smoking duration (P = 0.027, OR = 7.5), and exercise habits (P = 0.010, OR = 9.6) were associated with the total cholesterol level [9]. Other research also reported that heavy smoking (OR = 2.5, 95% CI 1.6-4.0) and physical activity (OR = 1.2, 95% CI 1.0-1.34) were related to cholesterol levels [10].

In a study by Gordon et al. in 1983 of 7,106 individuals aged 35–59 years, the authors reported that physical activity significantly (P = 0.0001) predicted the total cholesterol level after controlling for age, body mass index, smoking habits, and alcohol consumption [11]. In the ATTICA study in Athens, Greece, a nutrition and health survey showed that the level of physical activity of rural inhabitants was higher than that of an urban population (55% *vs*. 45%) (P = 0.02) and that individuals with a higher level of activity had a 48% lower chance of being obese (95% CI 0.42-0.64) after controlling for sex, smoking habits, blood pressure, total cholesterol, and blood sugar [12].

In a study conducted in 2003, Lee et al. reported a relationship between physical activity and the risk of coronary heart disease (P = 0.002) [13]. In a study in 2012 of 3,148 individuals, in which 30% of the participants had hypercholesterolemia, the authors reported that physical fitness and the body mass index were associated with hypercholesterolemia [14]. In the study, undertaking physical exercise once or twice a week decreased the incidence of hypercholesterolemia by 12%. Conversely, an increase of one unit of body mass index increased the incidence of hypercholesterolemia by 18%. Williams also reported that the odds of hypercholesterolemia decreased in accordance with the amount of physical activity performed [15]. In the same study, the prevalence of males with hypercholesterolemia was 12.2% versus 5.14% in females. Fatima and Kartini reported that physical exercise habits were an important factor in the control of blood cholesterol levels when compared with that of the amount and type of fat in the diet [16]. In the same study, families who consumed dietary sources of fat but undertook regular exercise had the same blood cholesterol levels as those of families who consumed low-fat foods but undertook little physical activity. Saputri reported a significant difference between total cholesterol in the blood before and after low-impact aerobic exercise (P = 0.001) [17].

A study conducted by Health Advancement Services (n = 2,840 male adults) to determine the relationship between smoking and hypercholesterolemia found that males who consumed tobacco had an RR of 2.51 (95% CI 1.47-4.29) as compared with RRs of 1.51 (95% CI 1.14-2.00) and 1.98 (95% CI 1.29-3.03) for those who smoked 1-20 cigarettes a day and > 20 cigarettes a day, respectively [18]. In the study, the confounder variables were age, education, physical activity, and body mass index.

The present study also investigated the relationship between fruit and vegetable consumption and hypercholesterolemia. The results revealed no relationship between this variable and hypercholesterolemia. However, previous studies pointed to a strong relationship between fruit and vegetable consumption and hypercholesterolemia.

In addition to smoking habits and inadequate physical activity, other causes of hypercholesterolemia in this study were nutritional status and blood pressure. Respondents who were obese had 1.4 times higher risk of hypercholesterolemia (95% CI 1.3-1.76) and respondents with hypertension had 1.3 times higher risk of hypercholesterolemia (95% CI 1.1-1.4). A prospective study that included 48,287 males and females found an increased risk of death from coronary heart disease in males due to obesity (RR = 1.5, 95% CI 1.1-2.0), with smoking, hypertension, hypercholesterolemia, and diabetes mellitus as confounding variables [19]. Hasrulsah and Muhartono also found a relationship between obesity and cholesterolemia [20]. Given that risk factors for obesity can be modified, the development of preventive initiatives is warranted. Raising awareness of the importance of diet and the value of consuming healthy food can help modify obesity [21].

In this study, based on the results of a potential impact analysis, the Attributable Fraction in the Exposed group (AFE) value for hypercholesterolemia caused by smoking habits was 20.8%. This means that the incidence of hypercholesterolemia in the exposed group (smokers) could be reduced by 20.8% if smoking habits were eliminated. The Population Attributable Fraction (PAF) value for smokers was 17.0%, indicating that the smoker population contributed to the incidence of hypercholesterolemia by 17.0%. In other words, if smoking habits were eliminated in the population, hypercholesterolemia could be reduced by 17.0%. The AFE value for hypercholesterolemia attributed to inadequate physical activity was 56.4%. This means that the incidence of hypercholesterolemia in the exposed group (a reduced level of physical activity) could be reduced by 56.4% if smoking habits could be eliminated. The PAF value for those with a reduced level of physical activity was 78.2%, indicating that the population with an inadequate level of physical activity contributed to 78.2% of the incidence of hypercholesterolemia. In other words, if the level of physical activity in the population could be increased, hypercholesterolemia could be reduced by 78.2%.

Promotional and preventive efforts are very effective in the prevention of high morbidity and mortality from noncommunicable diseases. As disease prevention is highly dependent on individual behavior, supported by environmental quality, availability of facilities and infrastructure, and regulatory support for healthy living, continuous active involvement of all components of both central and local government, the nongovernmental sector, and society is required. For that, a movement to encourage people to behave healthy is needed.

CONCLUSION

The prevalence of hypercholesterolemia in this study was quite high. Physical activity and smoking habits were significant determinants of hypercholesterolemia. Inadequate physical activity most contributed to hypercholesterolemia in the exposed group and the population.

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

The ethical clearance of this study was granted by The Ethics Commission for Research and Public Health Service – Faculty of Public Health, University of Indonesia with the certificate of approval number 114/UN2.F10/PPM.00. 02/2017, dated April 18, 2017.

HUMAN AND ANIMAL RIGHTS

No humans/animals were used for the studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest, financial or otherwise.

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