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Research Article

A Path Model of Factors Associated With Cardiovascular Disease in West Borneo: Analysis of Indonesian Basic Health Survey 2018

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ABSTRACT

Objective: Non-communicable diseases are estimated to account for 73% of all deaths in Indonesia and Cardiovascular Disease contributed 35%. Unhealthy dietary behavior leads to several NCDs, such as diabetes mellitus, obesity, hypertension, Cardiovascular Disease, and stroke. This study aimed to examine factors associated with hypertension and coronary disease using Basic Health Survey and path analysis model.

Methods: This was a cross sectional study using a secondary data from Indonesian Basic Health Survey Year 2018. The study selected 10,171 samples aged ≥ 15 years from West Borneo Province. The dependent variable was coronary disease. The independent variables were hypertension, age, gender, education, smoking, vegetables consumption, fruit consumption, fat intake, alcohol consumption, instant noodles consumption, soft drink consumption, physical activity, and residence. Data analysis was conducted by a path analysis.

Results: Coronary disease was directly increased by hypertension (b=1.19; 95% CI (Confidence Interval)=0.90 to 1.48; p<0.001), age ≥ 43 years (b=0.88; 95% CI=0.55 to 1.21; p<0.001), and high physical activity (b=-0.49; 95% CI=-0.81 to -0.17; p=0.003). It was directly decreased by alcohol consumption, but it was statistically non significant (b=-0.71; 95% CI=-1.54 to 0.11; p=0.088).

Conclusion: Coronary disease was indirectly affected by male, smoking, vegetables consumption, fruits consumption, fat intake, grilled food consumption, energy drink consumption, instant noodles consumption, soft drink consumption, residence, and education.

Keywords: Heart disease, Hypertension, Path analysis, Physical activity, Vegetables consumption

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ABBREVIATIONS

CB: Census Blocks; CBSL: Census Block Sample List; CHD: Coronary Heart Disease; CVDs: Cardiovascular Diseases; DALYS: Disability-Adjusted Life Years; MET: Metabolic Equivalent of Task; NCDs: Non Communicable Diseases; NHANES: National Health And Nutrition Examination Survey; YLD: Years of healthy life Lost due to Disability; YLL: Years of Life Lost due to premature mortality

INTRODUCTION

Cardiovascular Diseases account for most NCD deaths worldwide (17.9 million people) annually. Tobacco use, physical inactivity, the harmful use of alcohol and unhealthy diets all increase the risk of dying from a NCD. In Indonesia, Coronary Heart Disease (CHD) and stroke are estimated to cause more than 470 000 deaths annually (Hussain MA, *et al.*, 2016). Cardiovascular Diseases account for 37% of deaths in Indonesia. The burden of disease for 2012 was approximately 18,000 Disability-Adjusted Life Years (DALYS), of which 17,500 were Years of Life Lost due to premature mortality (YLL) and the remainder due to Years of healthy Life Lost due to Disability (YLD). The George Institute for Global Health suggests there is substantial variation in the frequency of ischemic heart disease and other competing causes of death between urban and rural settings in Indonesia.

Evidence from previous scientific studies reported that reducing these risk factors decreases the chance of having a heart attack or experiencing another cardiac event, such as a stroke, and reduces the possibility of needing a coronary revascularization procedure. Regular exercise has a favourable effect on many of the established risk factors for Cardiovascular Disease (Myers J, 2003).

Many cardio metabolic risk factors are known to be modified by lifestyle behaviours including diet. Among many diet-related behaviours, avoiding instant foods and/or fast food and increasing the intake of basic and unprocessed foods, is considered a simple but pivotal strategy (Huh IS, *et al.*, 2017).

Reducing the incidence of hypertension by implementing population-wide policies to reduce behavioural risk factors, including harmful use of alcohol, physical inactivity, overweight, obesity and high salt intake, is essential to attaining this target. A total-risk approach needs to be adopted for early detection and cost-effective management of hypertension in order to prevent heart attacks, strokes and other complications.

The purpose of this study was to describe and examine factors associated with hypertension and coronary disease using path analysis model.

MATERIALS AND METHODS

Study design

This was a cross-sectional study using Indonesian Basic Health Survey year 2018. The study selected 10,171 samples aged ≥ 15 years from West Borneo Province. The dependent variable was coronary disease. The independent variables were hypertension, age, gender, education, smoking, vegetables consumption, fruit consumption, fat intake, alcohol consumption, instant noodles consumption, soft drink consumption, physical activity, and residence.

Research sample

The population is all households in Indonesia. The target samples (300,000 households) were visited and become Census Blocks (BS) which has conducted by the Central Statistics Agency (Bayesian penalized spline (BPS)) using the PPS (Probability Proportional to Size) method using linear systematic sampling, with two stage sampling.

Phase 1: Implicit stratification of all Census Blocks (CB) from the 2010 Population Census (CP) based on welfare strata. From the

720,000 CB master frame the results of the SP 2010, 180,000 CB (25%) were selected on a PPS basis to be the sampling frame for the CB selection. Select a number of CB with the PPS method in each strata urban/rural per district/city in a systematic manner resulting in a Census Block Sample List (CBSL). The total amount of CB selected is 30,000.

Phase 2: Selection of 10 households in each CB updated by systematic sampling with the highest implicit stratification education completed by head of household. This was to maintain representation of the value of the diversity of household characteristics. The individuals who be interviewed were all household members in the selected household.

Phase 3: West Borneo provincial sample data were selected from national data for analysis.

Data collection

Demographic characteristics (age, gender, education, occupation and area of residence) collected by interview using a questionnaire.

Food consumption

Fruit and vegetables consumption and physical activity collected by interview using a questionnaire. Consume risky foods includes consumption of sweet foods/drinks, salty foods, fatty/cholesterol/fried foods, baked goods, processed meat/chicken/fish foods with preservatives, seasonings, soft drinks or carbonated drinks, energy drinks, instant noodles/other instant food. Consumption habits are grouped into >once per day, 1-6 times per week and <3 times per month. Fruits and vegetables consumption is the frequency and portion of fruit and vegetable consumption in household members aged 5 years and over, by calculating the number of days consumed in a week and the average number of servings in a day. The instrument used to collect data on vegetable and fruit consumption was the step wise instrument from the World Health Organization (WHO). It is categorized as "sufficient" when consuming vegetables and/or fruit (a combination of vegetables and fruit) at least 5 servings per day for 7 days a week. It is categorized as 'less' if the consumption of vegetables and fruit is less than the provisions above.

Hypertension

Measuring blood pressure using a digital sphygnomanometer. The measurement result following the JNC VII criteria. Hypertension defined as the systolic blood pressure is ≥ 140 mmHg and or diastolic blood pressure ≥ 90 mmHg.

Physical activity

The physical activity behaviors that were collected included heavy and moderate physical activity in daily activities (combined at work/at home, free time and transportation) in the number of days per week and the number of minutes per day, which were asked to household members aged 10 years old. Heavy physical activity is physical activity carried out for >3 days per week and MET minutes per week >1500 (MET minute value for strenuous physical activity=8). MET is a unit of energy expenditure and is used to measure physical activity in minutes. MET minute is a unit used to measure the volume of individual physical activity. Moderate physical activity is moderate physical activity carried out for >5 days a week with an average length of activity >150 minutes a week (or >30 minutes per day). Smoking habit defined as smoking practice carried out by respondents in the past month. Risky foods consumption defined as consuming alcoholic beverages in the past month.

Data management and analysis

In addition to data collection, a fairly important stage in basic health survey is data management. Data processing started from editing the questionnaire and giving codes at the research location by the enumerator. The questionnaire has been edited and coded correctly, followed by entering the data into the application that has been determined. After the data is entered, the data is sent *via* email to the data management team of the National Research and Development Agency for data merging and data cleaning. Data cleaning was done to check inconsistent data and data outliers. Inconsistent data and outliers were traced back to the questionnaire to perform a validity check of the resulting data. Clean data (consistent and free from outliers) is given a weighted value by BPS and become final data that can be used for analysis. Data analysis was conducted by a path analysis run on Stata 13.

RESULTS

Univariate analysis

Sample characteristics of continuous data, *Table 1* reported sample characteristics of continuous data and showed that the average age of the samples were 43 years (Mean=43.12; SD (Standard Deviation)=15.39). The average of fruits consumption was 2 times a week (Mean=2.32; SD=2.10). The average of vegetables consumption was 5 times a week (Mean=5.96; SD=1.84). The average of instant noodle consumption was 4 times a week (Mean=4.18; SD=1.19). The average of soft drink consumption was 5 times a week (Mean=5.53; SD=0.95). The average of preserved food intake was 5 times a week (Mean=5.17; SD=1.07). The average of fat intake was 3 times a week (Mean=3.42; SD=1.37). The average of grilled food consumption was 5 times a week (Mean=5.04; SD=1.00). The average of energy drink consumption was 5 time a week (Mean=5.60; SD=0.91).

Sample characteristics of dichotomous data *(Table 2)* showed that most of sample never been diagnosed coronary disease by doctor (97.85%), did not experience hypertension (83.55%), no alcohol consumption (93.44%), energy drink consumption <5 times a week (97.3%), and soft drink consumption 5 times a week (97.70%). Half of samples were at age <43 years (51.38%). A third of samples consumed instant noodles ≥ 5 times per weeks (38.06%) and had high physical activity (36.56%).

Table 1: Sample characteristics (continuous data)

Variables	n	Mean	SD	Minimum	Maximum
Age (year)	10171	43.12	15.39	15	97
Fruits consumption (days in a week)	10171	2.32	2.1	0	7
Vegetables consumption (days in a week)	10171	5.96	1.84	0	7
Instant noodles consumption (per weeks)	10171	4.18	1.19	1	6
Soft drink consumption (per weeks)	10171	5.53	0.95	1	6
Preservative food consumption (per week)	10171	5.17	1.07	1	6
Fat intake (per week)	10171	3.42	1.37	1	6
Grilled food consumption (per week)	10171	5.04	1	1	6
Energy drink intake (per week)	10171	5.6	0.91	1	6

Table 2: Sample characteristics (dichotomous data)

Variables	n	%
Coronary disease		
No	9,952	97.85
Yes	219	2.15
Hypertension		
No	8,498	83.55
Yes	1,673	16.45
Residence		
Rural	7,136	70.16
Urban	3,035	29.84
Gender		
Female	6,223	61.18
Male	3,948	38.82
Age		
<43 years	5,226	51.38
≥ 43 years	4,945	48.62
Education		
<Senior high school	7,350	72.26
≥ Senior high school	2,821	27.74
Smoking		
No	7,276	71.54
Yes	2,895	28.46
Alcohol consumption		
No	9,504	93.44
Yes	667	6.56
Fruits consumption per weeks		
Non-daily consumption	6,311	62.05
Daily consumption	3,860	37.95
Vegetables consumption per weeks		
Non-daily consumption	2,025	19.91
Daily consumption	8,146	80.09
Fat intake		
<3 times per week	7,620	74.92
≥ 3 times per week	2,551	25.08
Grilled food consumption		
<5 times per week	9,966	97.98
≥ 5 times per week	205	2.02
Instant noodles consumption		
<5 times per week	6,300	61.94
≥ 5 times per week	3,871	38.06
Soft drink intake		
<5 times per week	9,937	97.7
≥ 5 times per week	234	230
Energy drink intake		
<5 times per week	9,960	97.93
≥ 5 times per week	211	207
Physical activity		
Low	6,452	63.44
High	3,719	36.56

Bivariate analysis

Analysis on the relationships of hypertension, age, gender, smoking alcohol consumption, fat intake, grilled food consumption, soft drink consumption, and coronary disease *(Table 3)*.

Table 3 reported crosstab analysis on the relationships of hypertension, age, gender, smoking alcohol consumption, fat intake, grilled food consumption, soft drink consumption, and coronary disease. *Table 3* showed that hypertensive person (6.10%) had higher possibility to experience coronary disease that those with normotension (1.38%), with p<0.001.

Sample who had age ≥ 43 years (3.38%) had higher possibility to experience coronary disease than those with age <43 years (1.00%), with p<0.001. Sample who consume alcohol (0.90%) had lower possibility to experience coronary disease than those who did not consume alcohol (2.24%), with p=0.021. There was no difference between female (1.99%) and male (2.11%) to experience coronary disease, with p=0.161. There was no difference between smokers (2.99%) and non-smokers (2.11%) to experience coronary disease, with p=0.607. There was no difference of fat consumption <3 times a week (2.13%) and fat consumption ≥ 3 times a week (2.23%) to experience coronary disease, with p=0.744. There was no difference between people who consume grilled food <5 times per week (2.17%) and those who consume grilled food ≥ 5 times per week (1.46%) to experience coronary disease (p=0.492). There was no difference between sample who consume soft drink <5 times a week (2.13%) and those who consume soft drink ≥ 5 times a week (2.99%) to experience coronary disease (p=0.371).

Path analysis

Path analysis on the associations between hypertension, age, gender, smoking, alcohol consumption, soft drink consumption, energy drink consumption, instant noodle consumption, vegetables consumption, fruits consumption, fat intake, grilled food consumption, soft drink consumption, physical activity, education, residence, and coronary disease *(Table 4)*.

Table 4 showed that coronary disease was directly affected by hypertension, age ≥ 43 years, alcohol consumption, and high physical activity.

Table 3: Analysis on the relationships of hypertension, age, gender, smoking alcohol consumption, fat intake, grilled food consumption, soft drink consumption, and coronary disease

Independent variables	Coronary disease	High	High	High	P
	No		Yes		
	n	%	n	%	
Hypertension					
No	8.381	98.62	117	1.38	<0.001
Yes	1,571	93.9	102	6.1	
Smoking					
No	7,123	97.9	153	2.1	0.579
Yes	2,829	97.72	66	2.28	
Age					
<43 years	5,174	99	52	1	<0.001
≥ 43 years	4,778	96.62	167	3.38	
Gender					
Female	6,099	98.01	124	1.99	0.161
Male	3,853	97.59	95	2.41	
Alcohol consumption					
No	9,291	97.76	213	2.24	0.021
Yes	661	99.1	6	0.9	
Fat intake					
<3 times a weeks	7,458	97.87	162	2.13	0.744
≥ 3 times a weeks	2,494	97.77	57	2.23	
Grilled food consumption					
<5 times a weeks	9,750	97.83	216	2.17	0.492
≥ 5 times a weeks	202	98.54	3	1.46	
Soft drink consumption					
<5 times a weeks	9,725	97.87	212	2.13	0.371
≥ 5 times a weeks	227	97.01	7	2.99	

Table 4: Path analysis on the associations between hypertension, age, gender, smoking, alcohol consumption, soft drink consumption, energy drink consumption, instant noodle consumption, vegetables consumption, fruits consumption, fat intake, grilled food consumption, soft drink consumption, physical activity, education, residence, and coronary disease

Dependent variables	Independent variables	Path analysis coefficient (b)	95% CI		p
			Lower limit	Upper limit	
Direct effect					
Coronary disease	Hypertension	1.19	0.9	1.48	<0.001
	Age ≥ 43 years	0.88	0.55	1.21	<0.001
	Alcohol consumption	-0.71	-1.54	0.11	0.088
	High physical activity	-0.49	-0.81	-0.17	0.003
Hypertension	Male	-0.22	-0.37	-0.08	0.003
	Age ≥ 43 years	1.76	1.63	1.9	<0.001
	Vegetables consumption (every day)	-0.14	-0.28	-0.01	0.04
	Fruits consumption (every day)	-0.06	-0.18	0.05	0.267
	Fat intake ≥ 3 times a week	0.1	-0.02	0.23	0.111
	Grilled food consumption ≥ 5 times a week	0.42	0.05	0.8	0.027
	Energy drink consumption ≥ 5 times a week	0.27	-0.19	0.74	0.253
	Instants noodle consumption ≥ 5 times a week	0.15	0.04	0.26	0.01
	Smoking	-0.08	-0.24	0.07	0.292
	Soft drink consumption ≥ 5 times a week	0.15	-0.28	0.59	0.495
	High physical activity	-0.38	-0.59	-0.26	<0.001
Alcohol consumption	Male	0.77	0.54	1	<0.001
	Smoking	1.27	1.06	1.49	<0.001
	Urban resident	-1.11	-1.35	-0.88	<0.001
	Energy drink consumption ≥ 5 times a week	0.83	0.44	1.23	<0.001
Smoking	Male	0.65	0.38	0.92	<0.001
	Urban resident	-0.11	-0.21	-0.01	0.027
	Education ≥ Senior high school	-0.07	-0.17	-0.03	0.17
High physical activity	Urban resident	-0.85	-0.94	-0.75	<0.001
Fruits consumption (every day)	Education ≥ Senior high school	0.78	0.68	0.87	<0.001
Vegetables consumption (every day)	Education ≥ Senior high school	0.16	0.05	0.27	0.005
Note: N observation=10,171; Log likelihood=-32636.925					

Hypertension was directly increased logodd (possibility) to experience coronary disease 1.19 units (b=1.19; 95% CI=0.90 to 1.48; p<0.001). Age ≥ 43 years was directly increased logodd (possibility) to experience coronary disease 0.88 units (b=0.88; 95% CI=0.55 to 1.21; p <0.001). High physical activity directly decreased logodd (possibility) to experience coronary disease 0.49 units (b=-0.49; 95% CI=-0.81 to -0.17; p=0.003). Alcohol consumption directly decreased logodd (possibility) to experience coronary disease 0.71 units, but it was statistically non significant (b=-0.71; 95% CI=-1.54 to 0.11; p=0.088). *Table 4* showed that coronary disease was indirectly affected by male, vegetables consumption, fruits consumption, fat intake, grilled food consumption, energy drink consumption, instant noodles consumption, smoking, soft drink consumption, residence, and education. Age ≥ 43 years increased logodd (possibility) to experience hypertension 1.76 units (b=1.76; 95% CI=1.63 to 1.90; p<0.001). Grilled food consumption ≥ 5 times a week increased logodd (possibility) to experience hypertension 0.42 unit (b=0.42; 95% CI=0.05 to 0.80; p=0.027). Instant noodle consumption ≥ 5 times a week increased logodd (possibility) to experience hypertension 0.15 unit (b=0.15; 95% CI=0.04 to 0.26; p=0.010). Soft drink consumption ≥ 5 times a week increased logodd (possibility) to experience hypertension 0.15 unit, but it was statistically non-significant (b=0.15; 95% CI=-0.28 to 0.59; p=0.495).

Energy drink consumption ≥ 5 times a week increased logodd (possibility) to experience hypertension 0.27 units, but it was statistically non-significant (b=0.27; 95% CI=-0.19 to 0.74; p=0.253). Fat intake 3 times a week increased logodd (possibility) to experience hypertension 0.10 units, but it was statistically non-significant (b=0.10; 95% CI=-0.02 to 0.23; p=0.111). Vegetables consumption (everyday) decreased logodd (possibility) to experience hypertension 0.14 units (b=-0.14; 95% CI=-0.28 to -0.01; p=0.040). Male decreased logodd (possibility) to experience hypertension 0.22 units (b=-0.22; 95% CI=-0.37 to -0.08; p=0.003). High physical activity decreased logodd (possibility) to experience hypertension 0.38 unit (b=-0.38; 95% CI=-0.59 to -0.26; p<0.001). Fruits consumption (everyday) decreased logodd (possibility) to experience hypertension 0.06 units, but it was statistically non-significant (b=-0.06; 95% CI=-0.18 to 0.05; p=0.267). Smoking decreased logodd (possibility) to experience hypertension 0.08 units, but it was statistically non-significant (b=-0.08; 95% CI=-0.24 to 0.07; p=0.292). Male increased logodd (possibility) to consume alcohol 0.77 units (b=0.77; 95% CI=0.54 to 1.00; p<0.001).

Smoking increased logodd (possibility) to consume alcohol 1.27 units (b=1.27; 95% CI=1.06 to 1.49; p<0.001). Energy drink consumption ≥ 5 times a week increased logodd (possibility) to consume alcohol 0.83 units (b=0.83; 95% CI=0.44 to 1.23; p<0.001). Urban resident decreased logodd (possibility) to consume alcohol 1.11 units (b=-1.11; CI 95%=-1.35 to -0.88; p<0.001). Male increased logodd (possibility) to consume energy drink ≥ 5 times a week 0.65 units (b=0.65; 95% CI=0.38 to 0.92; p<0.001). Urban resident decreased logodd (possibility) to smoke 0.11 units (b=-0.11; 95% CI=-0.21 to -0.01; p=0.027). Education ≥ Senior high school decreased logodd (possibility) to smoke 0.07 units, but it was statistically non-significant (b=-0.07; 95% CI=-0.17 to -0.03; p=0.170). Urban resident decreased logodd (possibility) of high physical activity 0.85 units (b=-0.85; 95% CI=-0.94 to -0.75; p<0.001). Education ≥ Senior high school increased logodd (possibility) of fruits consumption (everyday) 0.78 units (b=0.78; 95% CI=0.68 to 0.87; p <0.001). Education ≥ Senior high school increased logodd (possibility) to eat vegetables everyday 0.16 units (b=0.16; 95% CI=0.05 to 0.27; p=0.005). Path analysis model on the factors associated with hypertension and coronary disease.

DISCUSSION

Hypertension has a negative impact on mortality and on the development of Cardiovascular Diseases and other NCDs (World Health Organization, 2007). Regular physical activity is a determinant of energy expenditure and, along with healthy dietary behavior, can impact cardio-respiratory and metabolic health (World Health Organization, 2010; World Health Organization, 2014). The reduction in blood pressure with physical activity is thought to be due to attenuation in peripheral vascular resistance, which may be due to neurohormonal and structural responses with reductions in sympathetic nerve activity and an increase in arterial lumen diameters, respectively (Hamer M, 2006). Other proposed mechanisms for blood pressure reduction include favorable changes in oxidative stress, inflammation, endothelial function, arterial compliance, body mass, renin-angiotensin system activity, parasympathetic activity, renal function, and insulin sensitivity (Diaz KM and Shimbo D, 2013).

Female sex is associated with a longer life expectancy than male sex, women constitute a larger proportion of the elderly population in which the prevalence of CVD is greatest (Mosca L, *et al.*, 2011). The higher mortality rate among women appears to be limited primarily to ST-segment-elevation MI (Berger JS, *et al.*, 2009). Although women with acute coronary syndromes may have similar benefits from antiplatelet pharmacotherapy as men, they are more likely to have bleeding problems, possibly as a result of excess dosing (Alexander KP, *et al.*, 2006). Previous study reported that women and men overall have nearly equal percentages of hypertension (1 in 3 adults). Data from the National Health and Nutrition Examination Survey (NHANES) showed that the prevalence of high blood pressure is greater in women >65 years (National Center for Health Statistics, 2009).

Alcohol drinking is an inseparable part of the indigenous culture in many local communities across Indonesia, where it often plays a large role in religious festivals and social gatherings (Muthia R, 2018). In 2018, the alcohol consumption per capita in Indonesia amounted to approximately 0.48 liters annually. The relationship between alcohol and hypertension is well known, and a reduction in the alcohol intake is widely recommended in the management of hypertension (Kawano Y, 2010). Previous studies reported several mechanisms that may underlie alcohol's effects on blood pressure. High alcohol consumption caused impairments in cells that lead to buildup of plaque in arteries (i.e., through alterations in endothelial cell function and nitric oxide availability), and disruptions in arterial-vascular function (i.e., through myogenic mechanisms and changes in baroreceptor function), and hormonal imbalances that control the body's fluid and BP regulation (through the Renin-Angiotensin-Aldosterone System [RAAS]) (Marchi KC, *et al.*, 2014; Piano MR, 2017).

A cross-sectional study in Chinese men examined the associations between alcohol intake and blood pressure. Men with the highest alcohol intake category (≥ 30 drinks/week) were twice as likely as non-drinkers to have hypertension (Wildman RP, *et al.*, 2005). The type, quantity, and pattern of drinking are all highly correlated with socioeconomic and other lifestyle behaviors (Beilin LJ and Puddey IB, 2006). Among drinkers, those living in accessible small towns had higher odds of weekly drinking and drunkenness compared to urban areas. Higher odds of drunkenness were also found in remote rural areas. Those residing in the least deprived areas had lower odds of weekly drinking (Martin G, *et al.*, 2019).

Smoking and consuming alcohol are both related to increased mortality risk (Hart CL, *et al.*, 2010). Drinking and smoking together is strongly socially patterned, being normative behavior in pubs, bars and clubs worldwide until the recent introduction in some countries of smoking restrictions in public places. The neurochemical mechanisms of action of nicotine and alcohol appear to be mutually reinforcing (Larsson A and Engel JA, 2004).

Another drink often consumed daily by the community is soft drink and sweet beverages. Soft drink and sweetened beverages have little nutritional value (Malik VS and Hu FB, 2019). A meta-analysis study conducted by Narain A, *et al.*, 2016 reported that soft drink intake suggests a significant increase in stroke (RR (Respiratory Rate)=1.13; 95% CI=1.02 to 1.24, and Coronary Heart Disease (RR=1.22; 95% CI=1.14 to 1.30).

Instant noodle is one the most popular processed foods and practically every Indonesians have ever consumed. While instant noodle might be considered as unhealthy food, millions of people consume it due to the cheap price, tasty flavors, and easy-to-prepare. In 2018, approximately 12.5 billion servings of instant noodles were consumed in Indonesia. Previous study reported that increased consumption of instant noodles has recently been reported to be positively associated with obesity and cardiometabolic syndrome in South Korea. The study subjects with a higher frequency of instant noodle consumption were more likely to have multiple cardiometabolic risk factors (Miller V, *et al.*, 2017).

Instant noodles are generally high in refined carbohydrates but low in fiber. Most instant noodles are deep-fried, so they are high in calories, refined carbohydrates, saturated fat, and sodium. Several studies have suggested that the high energy density, glycemic load (due to the refined carbohydrates), saturated fat content, and sodium content of instant noodles, may contribute to increase the risk of heart disease (Huh IS, *et al.*, 2017).

Fruits and vegetables have long been regarded as essential to a healthy diet (Lipoeto NI and Nindrea RD, 2020; Hasanudin A, *et al.*, 2020). A recent WHO/FAO (Food and Agriculture Organization) expert consultation report on diet, nutrition and prevention of chronic diseases, sets population nutrient goals and recommends intake of a minimum of 400 g of fruits

and vegetables per day for the prevention of chronic diseases such as heart diseases, cancer, diabetes and obesity. Worldwide, low intake of fruits and vegetables is estimated to cause about 19% of gastrointestinal cancer, about 31% of ischemic heart disease and 11% of stroke (Usman E and Nindrea RD, 2020). Previous study reported that fruits and vegetables consumption 200 g/day reduced the risk of Cardiovascular Disease (Aune D, *et al.*, 2017; Heffron SP, *et al.*, 2017).

CONCLUSION

A path model can be used to describe the correlations of factors associated with hypertension and coronary disease. Coronary disease is directly increased by hypertension, age ≥ 43 years, and high physical activity. It is directly decreased by alcohol consumption, but it was statistically non significant. Coronary disease was indirectly affected by male, vegetables consumption, fruits consumption, fat intake, grilled food consumption, energy drink consumption, instant noodles consumption, smoking, soft drink consumption, residence, and education.

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AUTHORS' CONTRIBUTIONS

DH conceived and designed the study. DH, HH, and DA collected the data and performed analysis and interpretation. DH and RDN wrote the first draft with critical feedback from all authors. All authors read, reviewed and edited the draft and approved the final version of the manuscript.

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