THE RISK OF DEGENERATIVE DISEASES BASED ON ENERGY CONSUMPTION AND EXERCISE HABITS

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Abstract

Obesity triggers the risk of degenerative diseases. An unhealthy diet and insufficient physical activity have been contributing to the rapid increase in obesity prevalence. This study aims at determining the differences in the risk of degenerative diseases based on energy consumption and exercise habits of City Disaster Management Board/DMB members, especially in Denpasar City. This research is an observational study, targeting all members of Denpasar DMB as a population. Samples were taken purposively with a total of 126 people. The risk difference was tested using chi-square, and the estimated risk of degenerative diseases was analyzed using the Mantel-Haentzel odds ratio. The risk of degenerative diseases based on energy consumption shows a significant risk only in the group of people who did not have exercise habits (Q-suare=4.53; p=0.03), with an estimated risk that is also significant (OR=2.48; 95% CI= 1.07 - 5.74). The estimated risk results indicated that exercise habit is a potential confounding variable in the risk of degenerative diseases based on energy consumption. Lowering energy consumption is not effective enough to prevent the increase of degenerative disease risk, and prevention of new risks of degenerative diseases must include regular exercise.

Keywords: *risk of degenerative disease; energy consumption; exercise habit*

1. Introduction

One fatal, degenerative disease is Coronary Heart Disease (CHD). According to the 2018 Riskesdas data, the prevalence of CHD in Indonesia ranges from 0.7 - 2.2% (WHO, 2022). Up to now, CHD and other non-communicable diseases are still the primary cause of death in adults. Non-communicable diseases (NCDs), including CHD, stroke, cancer, diabetes, and chronic lung diseases, are collectively responsible for 74% of deaths worldwide. More than three-quarters (86%) of NCD deaths or around 17 million people die below life expectancy, especially in low and middle-income countries (Badan Litbangkes Kemenkes RI, 2018).

The Ministry of Health reports that in the last two decades, NCDs have become the major cause of health cost increases borne by the government. Around 23.9% - 25% of health cost has been spent on NCDs with the highest costs incurred for four catastrophic diseases namely: Heart, Kidney Failure, Cancer, and Stroke (Ditjen Kesmas Kemenkes RI, 2022).

Before entering the degenerative phase, the disease symptoms have already appeared, but are often overlooked. A collection of symptoms leading to degenerative disease is known as the metabolic syndrome. Metabolic syndrome is an accumulation of several disorders, which

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together increase the risk of non-communicable diseases such as atherosclerotic cardiovascular and insulin resistance, as well as vascular neurological complications such as cerebrovascular damage (Swarup et al., 2022).

Individuals are considered to have metabolic syndrome if they have shown three of five symptoms, namely (1) Hyperglycemia (high blood sugar levels); (2) Hypertriglyceridemia (high levels of fat in the blood); (3) Low HDL (good cholesterol) in the blood; (4) Enlarged waist circumference or "apple-shaped" body; and (5) Hypertension (high blood pressure) (Xu et al., 2018). Being overweight (obesity) is therefore one symptom of metabolic syndrome. Obesity is a complex condition when a person's body weight exceeds the ideal body weight for an individual of the same height. The main factors triggering obesity include dietary habits, physical activity levels, and sleep patterns. Certain socioeconomic determinants, genetics, and drug addiction also contribute to increasing obesity risk (Centre for Diseases Control and Prevention, 2022).

Obesity can be determined based on the waist-to-hip ratio (WHR). Waist circumference describes the high deposit of harmful fat in the body, while the hip circumference is a protective factor against cardiovascular disease. Measurement results of more than 8000 samples in Beijing China confirm a positive relationship between WHR and the risk of metabolic syndrome. WHR indicator is even more sensitive for determining the risk of metabolic syndrome when compared to BMI in both men and women (Yang et al., 2017).

The Disaster Management Board/DMB (in Indonesia it is known as BNPB) was established based on Law Number 24 of 2007 to guarantee the implementation of disaster management in a planned, integrated, coordinated, and comprehensive manner; starting from early disaster prevention, mitigation, emergency response, rehabilitation, and reconstruction. Judging from the characteristics of their work, DMB members are included in the group of people who have a high risk of obesity. Their job requires them to be on 24-hour call and make

most of them develop an irregular diet and sleeping patterns. In addition, the stress of being in most suddenly-changing activities between disasters and sedentary situations also contributes to increasing overweight risk. To avoid the risk of degenerative diseases, DMB members are advised to adopt a regular diet to maintain their health. They are also encouraged to exercise regularly to maintain fitness to improve their performance according to the work demands and responsibilities. Based on a systematic review, working with a shift schedule triggers acute insulin resistance, and timely exercise can improve health markers in shift workers who are at risk of developing metabolic diseases (Gabriel & Zierath, 2019).

2. Method

This was an observational study with a cross-sectional design where risk factors (waist-to-hip ratio) and trigger factors (energy consumption and exercise habits) were collected simultaneously. The entire members of Denpasar City Disaster Management Board/DMB were taken in as population. Meanwhile, the members were selected purposively (willing to become research subjects voluntarily) and as many as 126 people were taken as a sample. Before becoming a research sample, all samples had filled out a consent form before the interview regarding the ethical eligibility letter number LB.02.03/EA/KEPK/0608/2022 issued by the Health Research Ethics Commission of the Denpasar Health Polytechnic.

The tools used in this study were a waist ruler to measure waist circumference with an accuracy of 0.1 cm, a digital scale to measure weight with an accuracy of 0.01 kg, and a microtoise to measure height with an accuracy of 0.1 cm. The research instrument was a questionnaire that includes a demographic form, a record of anthropometric results and exercise habits, and a consumption survey result by retrieving memory of the type and amount of food consumed in the last 24 hours (24-hour Food Recall). Other supporting data were obtained by direct interviews. Anthropometric data was collected by measurement, while

consumption data was by direct, two-day (non-consecutive) interviews.

Samples' demographies and other supporting data were then summarized into a frequency table and narrated to obtain an overview. From the anthropometric results, the WHR was then calculated by dividing the waist circumference by the hip in each sample. The results were categorized sequentially according to the standard risk of degenerative diseases as presented in Table 1.

Table 1. Degenerative Disease Risk Standards Based on the Waist-Hip Ratio

Sex	Group of Age	Degenerative Disease Risk Category			
		Low	Medium	High	Very high
Male	20-29	< 0.83	0.83-0.88	0.89-0.94	>0.94
	30-39	< 0.84	0.84-0.91	0.92-0.96	>0.96
	40-49	< 0.88	0.88-0.95	0.96-1.00	>1.00
	50-59	< 0.90	0.90-0.96	0.97-1.02	>1.02
	60-69	< 0.91	0.91-0.98	0.99-1.03	>1.03
Female	20-29	< 0.71	0.71-0.77	0.78-0.82	>0.82
	30-39	< 0.72	0.72-0.78	0.79-0.84	>0.84
	40-49	< 0.73	0.73-0.79	0.80-0.87	>0.87
	50-59	< 0.74	0.74-0.81	0.82-0.88	>0.88
	60-69	< 0.76	0.76-0.83	0.84-0.90	>0.90

Source : (Heuch et al., 2015)

For risk estimation modeling using logistic regression, the degenerative disease risk was then modified into only two categories, namely: (1) Risk Group, if the degenerative disease category was classified as high or very high; and (2) Not-At-Risk Group, if the degenerative disease category was classified as low or moderate.

Consumption data of a 24-hour food recall was taken in the form of dishes and any food ingredients during the last day. They were represented in estimated portions in household size which were then converted into grams. Using a computer application, the conversion results were then processed into energy consumption in calories. Next, the total obtained was compared with the level of individual needs determined by age, sex, body weight, and activities. The final comparative results were categorized into two observational groups: 1) Excessive Energy Consumption, if the total was greater than the individual needs level; and (2) Normal Energy Consumption, if the total was lower than or equal to the individual needs level (Setjen Kemenkes RI, 2019).

Exercise habits are determined on three scales: intensity, frequency, and duration of exercise. On these bases, subjects were included as a group that regularly exercises when having sufficient exercise intensity, with a minimum duration of 30 minutes more than three times a week (Anggriawan, 2015).

3. Result and Discussion

In the distribution of sample age by the criteria of the Ministry of Health (Windri et al., 2019), most of the samples were Early Adults (44 people/34.9%). Meanwhile, by the criteria of Management and Implementation of Education, as stipulated in Reg.No. 17 of 2010 (Mensetneg RI, 2010), most of the samples (76 people /60.3%) held middle school degrees (Senior High School or equivalent). The complete distribution of sample characteristics is presented in Table 2.

Table 2. Sample distribution based on age, education, exercise habits, energy consumption and generative risk

Characteristics	Category	f (%)
Group of age	Late teens (17-25 tahun)	16 (12.7)
	Early adulthood (26-35 tahun)	44 (34.9)
	Late adulthood (36-45 tahun)	28 (22.2)
	Early elderly (46-55 tahun)	36 (28.6)
	Late Seniors (56-65 tahun)	2 (1.6)
	Total	126 (100)
Last education	Basic (Primary – Junior high school)	2 (1.6)
	Middle (Senior high school)	76 (60.3)
	High (Diploma - Undergraduate)	48 (38.1)
	Total	126 (100)
Exercise Habits	Routine	33 (26.2)
	No	93 (73.8)
	Total	126 (100)
Energy Consumption	Enough	68 (54)
	Over	58 (46)
	Total	126 (100)
Risk of Degene-rative Disease	Normal	74 (58.7)
	High	52 (41.3)
	Total	126 (100)

As presented in Table 2, 52 samples (41.3%) had high risks of degenerative diseases, 58 (46%) consumed excessive energy, and only 33 (26.2%) exercised regularly. The relationship between the three variables is presented in detail in Tables 3 and 4.

Table 3. Distribution of Degenerative Disease Risk Based on Sample of Energy Consumption Level

Energy Consumption	Risk of Degenerative Disease						χ^2 & p value
	Normal		High		Total		
	f	%	f	%	f	%	
Enough	44	59.5	24	46.2	68	54	$\chi^2 = 2.176$
Over	30	40.5	28	53.8	58	46	p = 0.14
Total	74	100	52	100	126	100	

As seen in Table 3, among those with a high risk of degenerative diseases, 53.8% (28 samples) showed excessive energy consumption levels. While in the group with a low risk of degenerative diseases, only 40.5% (30 samples) showed the same levels. Those with higher levels of excessive energy consumption, therefore, tend to develop higher risks of degenerative diseases as compared to normal ones. However, this trend was not significant (p=0.14).

The risk of degenerative diseases based on energy consumption is only significant if the sub-sample is separated based on 'exercise habits'.

Table 4. Distribution Sample of Degenerative Disease Risks Based on the Level of Energy Consumption and Exercise Habits

| Exercise Habits | Energy Consumption | Risk of Degenerative Disease | | | | | | χ^2 & p value |
| | | Normal | | High | | Total | | |
		f	%	f	%	f	%	
Routine	Enough	11	52.4	8	66.7	19	57.6	χ^2 = 0.638
	Over	10	47.6	4	33.3	14	42.4	p = 0.42
	Total	21	100	12	100	33	100	
Not a routine	Enough	33	62.3	16	40	49	52.7	χ^2 = 4.53
	Over	20	37.7	24	60	44	47.3	p = 0.03
	Total	53	100	40	100	93	100	

Here it appears that, in the group regularly exercises, the high risk of degenerative diseases due to high levels of energy consumption shows insignificant (p=0.42). However, in the group that does not develop the habit the relationship shows otherwise (p=0.03). We can conclude that exercise habit is a potential confounding variable in the relationship between energy consumption level and degenerative disease risk. This can be proven based on the resulting estimated ratio. When viewed based on the total sample, it is known that the OR value in the relationship between the level of energy consumption and the high risk of degenerative diseases only reaches 1.71 and does not show a significant risk with a 95% interval ranging from 0.84 to 2.51. Meanwhile, if seen only in the group that does not develop the habit, the risk increases to 2.48 with a 95% significant confidence range of 1.07 – 5.74.

Triggering risk-increase of degenerative diseases, being overweight is a complex phenomenon. Restricting energy consumption is not necessarily effective in losing weight. A 3-year-spanned study on energy consumption restriction with more than 6000 samples only reduced body weight by 3% on average, with a range of 0.2 to 6.8% (Langeveld & Devries, 2015). In general, excessive weight gain is an interactional product of genetics, environment, psychology, lifestyle, knowledge, health, drugs, and physical activity. Unarguably, excessive energy consumption is not the only trigger for obesity. Alternative factors include inadequate physical activity, insomnia, endocrine disorders, drugs, low accessibility, excessive carbohydrate consumption, and insufficient energy metabolism (Panuganti et al., 2022).

In conclusion, the relationship between energy consumption and the risk of degenerative diseases is not in direct proportion. Obesity occurs due to an imbalance in energy expenditures, resulting in energy excess which is then stored in the body's fat tissue. Energy balance is regulated through the mechanisms of the nervous and hormonal systems. The leptin hormone acts on the central nervous system which functions to regulate metabolism for the balance in energy and body weight. In general, leptin plays a role as a hunger inhibitor and energy metabolism booster. When the body begins to experience weight gain, leptin level increases simultaneously with bodily fat stores increase. Excessive leptin levels decrease the brain's sensitivity to leptin. As a result, leptin resistance disturbs the control of appetite and energy expenditure. Leptin resistance is one of the basic pathologies in obesity (Obradovic et al., 2021).

A recent study on the molecular basis of leptin's etiopathophysiology in obesity revealed physical exercise induces leptin therapy management (Seth et al., 2020). This explains why weight loss management is more effective when followed by regular physical activity despite energy intake's hegemony on weight gain and loss (Centre for Disease Control and Prevention, 2022). Some scientists even argue that limiting energy consumption to lose weight may not be appropriate when prioritized in obesity management. Instead, they suggest a "fat-but-fit" approach based on the increased balance

between the levels of physical activity and cardiorespiratory fitness. This method is suggested as a primary focus for those wishing to lose excess weight and avoid the risk of degenerative diseases (Moholdt et al., 2018).

4. Conclusion and Suggestion

The risk difference of degenerative diseases is insignificant when seen solely based on energy consumption. After making adjustments to the partial analysis, we found that the increased risk of degenerative diseases due to differences in energy consumption was more apparent in groups that did not develop exercise habits. DMB members are encouraged to exercise regularly so they can carry out their duties professionally and responsibly.

5. Acknowledgments

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