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Individual Health History, Body Mass Index, and Behavior as Causative Factors of Non-Communicable Diseases

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Abstract

Microorganisms do not cause non-communicable diseases (NCDs) but tend to change in modern lifestyles that do not apply CERDIK. In past research, the risk of suffering from non-communicable diseases was influenced by behavior, which consisted of three domains, namely knowledge, attitudes, and actions, without considering other individual factors. This study aims to assess the influence of individual health history factors, BMI, and behavior. The design used is cross-sectional. A sample of 302 people aged 15-59 are at risk of NCD and often visit fast food restaurants. Sampling using cluster random sampling. The variables collected are individual health history, BMI, and behavior. Data collection was carried out from April to June 2023. The analysis carried out was descriptive and structural equation modeling using PLS (Partial Least Square) software. The influence of the individual health history factor is 0.116, the BMI factor is 0.277, and the behavioral factor is -0.107. The resulting formula is $\Pi(Y) = \frac{e^{(0.116*X_1)+(0.277*X_2)-(0.107*X_3)}}{1+ e^{(0.116*X_1)+(0.277*X_2)-(0.107*X_3)}}$ x 100%. This formula can be used as a method to calculate the individual risk of suffering from NCDs.

Keywords: NCDs, Individual Health History, BMI, Behavior.

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1. INTRODUCTION

Non-communicable diseases (NCDs), also known as chronic diseases, are not spread through infection. A combination of genetic, physiological, and behavioral factors causes NCDs. NCDs are of long duration and can have significant health consequences. Types of NCDs include cancers, chronic respiratory diseases, diabetes mellitus, and cardiovascular disease (IFRC, 2018; Tulchinsky & Varavikova, 2014; WHO, 2023). Causative factors of non-communicable diseases are as follows (1) Unhealthy behavior includes harmful alcohol use, physical inactivity, unhealthy diet, and tobacco use; (2) Metabolic changes in the body include overweight, blood glucose, cholesterol, and blood pressure; (3) Genetic factors as the risk for cancer, diabetes, and cardiovascular disease; (4) Environmental factors as exposure to toxins, healthy food, and air pollution as a predisposition of NCDs; and (5) Socioeconomic factors as limited access to healthcare, poverty, and education can increase the risk of NCDs (Kementerian Kesehatan Republik Indonesia, 2019a; Kishorbhai & Masharu, 2021; WHO, 2022b).

Research in Australia describes children who suffer from type 2 diabetes and hypertension have a family history of non-communicable diseases (Downing et al., 2020). The causes of non-communicable diseases in Indonesia are identified as being influenced by family and individual health history, namely diabetes mellitus, hypertension, heart disease and stroke, asthma, cancer, and chronic obstructive pulmonary disease as surveillance material (Kementerian Kesehatan Republik Indonesia, 2014). Existing research only behavior considers knowledge, attitudes, and actions (Suprajitno & Mugianti, 2020).

This study aimed to identify the influence of behavioral factors and family and individual health history as causes of non-communicable diseases.

2. RESEARCH METHOD

Research design using cross-sectional. A sample of 302 people aged between 15 to 59 years, at risk of suffering from NCDs, and often visiting fast food and beverage restaurants were selected by cluster sampling based on the restaurant's location. The confidence level is 95% and the error is 10%. Data collection was carried out from April to June 2023 in Blitar. The variables studied were individual health history, weight, height, knowledge, attitudes, and actions. Individual health history data were obtained by questionnaire (Kementerian Kesehatan Republik Indonesia, 2014). Body weight and height were measured directly using a body weight and height meter. Knowledge, attitudes, and actions are measured using a questionnaire (Suprajitno et al., 2023). Analysis used PLS (Partial Least Square). Ethical eligibility was obtained from the Health Research Ethics Committee of the Poltekkes Kemenkes Malang, Number: 160/III/KEPK POLKESMA/2023 dated March 30, 2023.

3. RESULTS AND DISCUSSION

The data collection results on research variables are presented in Tables 1 and 2, while the result of the regression using PLS is shown in Figure 1.

Table 1. Data on individual variables at risk of suffering from non-communicable diseases

No.	Variable	Min	Max	Mean	SD
1	Height	93.00	185.00	160.80	9.56
2	Weight	38.00	120.00	63.01	13.44
3	BMI	15.03	90.18	24.51	6.13
4	Knowledge score	9.00	21.00	19.10	2.33
5	Attitude score	17.00	28.00	22.79	2.51
6	Action score	6.00	15.00	11.16	1.92

Note: SD: Standard deviation; BMI: Body Mass Index

Based on body weight in Table 1, it is illustrated that there are individuals who are very at risk of suffering from non-communicable diseases. This condition is consistent with the fact that the lifestyle of urban or rural communities is already changing into a modern lifestyle that tends to consume fast food and drinks.

Table 2. BMI category and number of individual risks

No.	Variable	f	%
1	**BMI categories:**		
	Thin	26	8.6
	Normal	108	35.8
	Overweight	135	44.7
	Obese	33	10.9
2	**A number of individual health risks:**		
	No risk	79	26.2
	One risk	87	28.8
	Two risks	56	18.5
	Three risks	52	17.2
	Four risks	20	6.6
	Five risks	6	2.0
	Six risks	2	0.7

In Table 2, the individual BMI categories are classified as fat and obese as much as 55.6%, supported by the number of risks according to the individual's health history.

The results of the analysis of the influence of individual medical history, BMI, and behavior (knowledge, attitudes, and actions) on the risk of suffering from non-communicable diseases using PLS are shown in Figure 1.

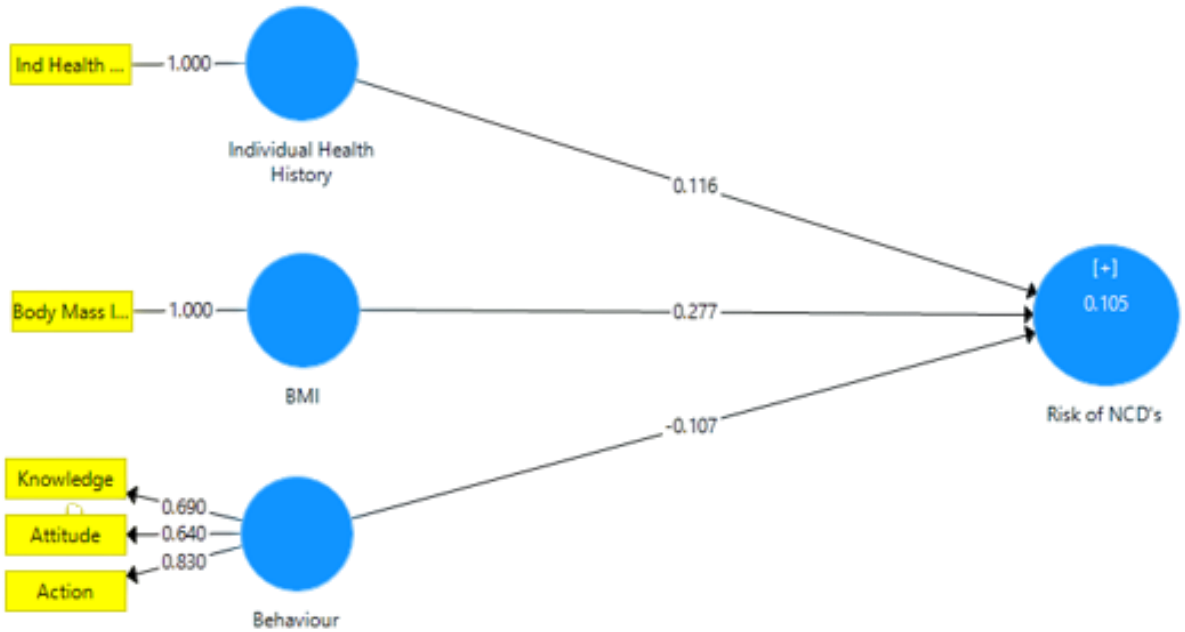

Figure 1 The results of the influence analysis using PLS

The convergent validity of behavioral factors is measured by AVE (Average Variance Extracted) of 0.525 and CR (Composite Reliability) of 0.766. The model suitability is measured from the value of SRMR (Standardized Root Mean Square Residual) obtained 0.08.

Based on Figure 1, the formula for calculating an individual's risk of suffering from non-communicable diseases is obtained:

$$\Pi(Y) = \frac{e^{(0.116*X_1)+(0.277*X_2)-(0.107*X_3)}}{1+e^{(0.116*X_1)+(0.277*X_2)-(0.107*X_3)}} x\ 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

Y : Risk of suffering from NCDs

X_1 : Number of individual health history as a factor risk

X_2 : Body Mass Index, where: $BMI = \frac{Weight\ (kg)}{(Height\ (m))^2}$

X_3 : Behaviors, where: $X_3 = (0.690 * X_{3.1}) + (0.640 * X_{3.2}) + (0.830 * X_{3.3})$

$X_{3.1}$: Knowledge score

$X_{3.2}$: Attitude score

$X_{3.3}$: Actions score

Furthermore, the risk of suffering from NCDs is categorized as follows:

$\leq 80\%$: No risk of NCDs

$81 - 90\%$: Low risk of NCDs

$\geq 91\%$: High risk of NCDs

The body mass index can describe the condition of individual fat accumulation, which can cause health problems (Nuttall, 2015) and the risk of suffering from non-communicable diseases. Body mass index measurements are based on height (m) and weight (kg). The body mass index category according to WHO in 1997 there are four categories, namely < 18.5 is called thin, 18.5 to 24.9 is called normal, 25 to 29.9 is called overweight, and > 30 is called obesity (Flegal, 2023). Whereas in Indonesia there are four categories, namely < 18.5 is called thin, 18.5 to 25.0 is called normal, > 25 to 27.0 is called overweight, and > 27.0 is called obesity (Kementerian Kesehatan Republik Indonesia, 2021). The grouping of BMI categories in Indonesia is also different from that in Asia Pacific (Lim et al., 2017).

Indonesian and WHO BMI categories differ between normal, overweight, and obesity. The influencing factor is that Indonesians tend to consume foods low in fiber and high in calories and fat compared to fruits and vegetables (WFP, 2018), and also consume rice or a high number of calories (Ariani et al., 2022; Arifin et al., 2019). Based on Table 1, some individuals have a very high BMI and are dangerous, also supported by their height, which can be categorized as low. Carbohydrate Calories are the main contributor to obesity if not balanced with adequate physical activity.

More than 50% of respondents are classified as overweight and obese (Table 2) and prone to non-communicable diseases. Vulnerability can be triggered by food consumption and unhealthy lifestyles every day. Excessive consumption of carbohydrate foods as the main trigger comes from foods and drinks containing glucose, which can be obtained at restaurants providing fast food and drinks. It is also supported by unhealthy lifestyle changes and not doing physical activity as a way to break down glucose in the blood, which, if not metabolized, will be stored as glycogen and fat (Aronoff et al., 2004; Han et al., 2016; Kowalski & Bruce, 2014).

The risk of suffering from non-communicable diseases is influenced by three factors, namely predisposing, enabling, and reinforcing factors. Individual health history can be categorized as a predisposing factor (Rachmawati, 2019) because it is influenced by knowledge, attitudes, and actions that have been held for a long time. The individual's health history studied included six diseases, including Diabetes Mellitus, Hypertension, Heart disease, Stroke, Cancer, or Chronic Lung (Kementerian Kesehatan Republik Indonesia, 2014). Table 2 illustrates that almost 50% of the respondents had a history of suffering from the disease, which made it possible for unhealthy behavior to be carried out. This condition is in line with more than 50% of respondents who have the overweight and obese BMI category. Individual health history, BMI, and behavior (knowledge, attitudes, and actions) together influence the risk of suffering from non-communicable diseases (Figure 1).

Diabetes mellitus, hypertension, heart disease, stroke, cancer, or chronic lung disease are chronic diseases identified as non-communicable diseases and common in low- and middle-income countries (WHO, 2022a). Metabolic risk factors that can increase the risk of non-communicable diseases are increased blood pressure, overweight, hyperglycemia, and hyperlipemia. Meanwhile, the factors of smoking habits, lack of physical activity, unhealthy eating patterns, and alcohol consumption need to be changed or stopped to reduce the risk.

Behavior is a habit that is entrenched and carried out at any time. Behavior is an internally coordinated response (action or inaction) of all living organisms to internal and/or external stimuli (Baum, 2013). An action taken based on sufficient knowledge and good attitude of an individual. Bloom's taxonomy based on a person's behavior has three domains: knowledge, attitudes, and actions (Adams, 2015; Nafiati, 2021; Pujawan et al., 2022). The behavior of preventing non-communicable diseases for individuals is important to do, in Indonesia it is known as Clean and Healthy Behavior (PHBS / *Perilaku Hidup Bersih dan Sehat*) by implementing of CERDIK (*Cek kesehatan berkala, Enyahkan rokok, Rajin olah raga, Diet sehat seimbang, Istirahat cukup*, and *Kelola Stress* / Periodical health checks, Stop of cigarettes, Exercise routinely, Balanced health diet, Get enough rest, and Manage stress) (Kementerian Kesehatan Republik Indonesia, 2019a; Kementerian Kesehatan Republik Indonesia, 2019b).

The influence of individual risk factors for non-communicable diseases (Figure 1) is 0.116 for individual health history; 0.277 for BMI, and -0.107 for behavior. Individual health history calculated the number of risks that are owned. BMI is measured from body weight and height; and behavior is measured from the scores of knowledge, attitudes, and actions. AVE (Average Variance Extracted) and CR (Composite Reliability) do not assess individual health history factors and BMI because they are a single factor without indicators. While behavior has three indicators that are measured, AVE and CR must be assessed.

The factors value of individual risk from non-communicable diseases (Figure 1) is 0.116 for individual health history, 0.277 for BMI, and -0.107 for behavior. Individual health history calculates the number of risks owned, BMI is measured from weight and height, and behavior is measured from the scores of knowledge, attitudes, and actions. AVE (Average Variance Extracted) and CR (Composite Reliability) do not assess individual health history and BMI factors because they are a single factor without indicators. While behavior has three indicators that are measured, AVE and CR must be assessed.

Behavioral factors that have indicators of knowledge, attitudes, and actions have an AVE value of 0.525, which is in the range ($0.50 < AVE < 1.00$) describing the internal consistency value of a factor with a sample of more than 100 (Dos Santos & Cirillo, 2021). Also, the behavior factor CR of 0.766 is the combined reliability of the three indicators, which is declared reliable if it is greater than or equal to 0.70. The model's suitability was assessed using SRMR (Standardized Root Mean Square Residual), which means that the model can be used as a method for measurement based on the factors that influence it. SRMR as an absolute measure of model fit. The SRMR value of models of 0.08 (Pavlov et al., 2021; Shi et al., 2019) is a suitable model to be applied in the model found.

4. CONCLUSION

Factors that influence individuals at risk of suffering from non-communicable diseases are the individual's medical history, which is calculated by the number of diseases experienced. BMI, which is measured by weight and height, and behavior based on scores of knowledge, attitudes, and actions. The formula for calculating the risk of suffering from non-communicable diseases is $\Pi\,(Y) = \frac{e^{(0.116*X_1)+(0.277*X_2)-(0.107*X_3)}}{1+e^{(0.116*X_1)+(0.277*X_2)-(0.107*X_3)}}\ x\ 100\%$.

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