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Analysis of Risk Factors Related Incidence of Type II Diabetes Mellitus in Kolongan Public Health Center, North Minahasa Regency

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ABSTRACT

The aim of this study is to analyze the risk factors of type II diabetes mellitus at Kolongan Public Health Center, North Minahasa Regency. This research is an analytical observational study with a case-control approach matched by gender. The study was conducted at the Kolongan Public Health Center, North Minahasa Regency, during February–March 2025. The population consisted of 505 respondents diagnosed with Type II Diabetes Mellitus from January to December 2024. The sample was selected using a 1:1 ratio between the case group and the control group, based on the Lemeshow formula (1997) for matched case-control studies, resulting in a minimum required sample of 63 cases and 63 controls. Bivariate analysis using the Chi-Square Test and Logistic Regression Test showed a significant relationship between age and the incidence of type II diabetes mellitus (p-value = 0.009; OR = 2.985). A significant association was also found between family history and the incidence of type II diabetes mellitus (p-value = 0.001; OR = 3.520). However, no significant relationship was found between physical activity and the incidence of type II diabetes mellitus (p-value = 0.707; OR = 1.236). The conclusion of this study is that age and family history are associated with the incidence of type II diabetes mellitus at the Kolongan Public Health Center, North Minahasa Regency. Meanwhile, physical activity is not associated with the incidence of type II diabetes mellitus at the same location.

Introduction

The incidence of type II diabetes mellitus in the Southeast Asian region is 59.5% (Nugrahani, et al, 2024). Diabetes mellitus is based on a doctor's diagnosis in the population of all ages by province in Indonesia based on existing data from the 2023 Indonesian Health Survey (SKI) of 1.7%. There are 6 provinces with the top 5 highest prevalence of Diabetes Mellitus in Indonesia and one of them is the 5th highest North Sulawesi province which is 2.1%. The 2023 Indonesian Health Survey (SKI) explains the characteristics of the age group with the prevalence of diabetes mellitus, starting from the age group of 25-34 years (0.2%) to the characteristics of the age group with the highest prevalence of diabetes mellitus, which is 65-74 years old (6.7%). Diabetes Mellitus occurs due to several risk factors, both changeable and irreversible. The results of the literature review of the most risk factors for diabetes mellitus according to Utomo, et.al (2020), Journal of literature studies from Tuti, et. al (2023) and literature review from Fauziyyah and Utama (2024). Mamahit, et al. (2024) explained that Indonesia is one of the ten

countries with the highest number of diabetes sufferers in the world, and is ranked seventh with 10 million people. explained that the most common risk factors of the three studies were found that age, physical activity and family history were the risk factors for the occurrence of diabetes mellitus.

Research conducted by Namayandeh, et al (2019) in Yazd City, Iran explained that the incidence of type 2 diabetes occurs in patients aged 20-74 years so it is recognized that age is a risk factor that affects the incidence of type 2 diabetes mellitus. Squirrels, et. al (2022) at Talang Ubi Hospital, PALI Regency, South Sumatra, explained that in his study, elderly respondents (aged 46-65 years) had a 2.16 times greater risk of suffering from type II diabetes mellitus compared to respondents aged 26-45 years. The results of research from Rosita, et al (2022) carried out at the Balaraja Health Center, Tangerang Regency showed that there was an age relationship with the incidence of type 2 diabetes mellitus with a PR of 1.75 (95% CI: 1.1-3.9).

Making, et.al (2023) explained in his research journal in the Work Area of the Waepana and Riung Health Centers in Ngada Regency, people who have a family history of suffering from Type 2 DM are 3.21 times greater at risk of suffering from Type 2 DM compared to people who do not have a family history of suffering from type 2 diabetes mellitus. Research conducted by Rediningsih and Lestari (2022) conducted in Kembang Village, Banyubiru District, Semarang Regency showed that there was a relationship between family history and the incidence of type 2 diabetes mellitus. Research conducted by Nasution, et al (2021) in the working area of the Tanjung Rejo Percut Sei Tuan Health Center found that family history has a relationship with the incidence of type 2 diabetes mellitus.

The research conducted by Taja et al (2024) was conducted in the Sikumana Health Center Working Area in 2021 where there was a relationship between physical activity and the incidence of type 2 diabetes mellitus (p-value = 0.0001) and an OR value of 5.117. Research conducted by Irayani Salsa Putri, (2024) conducted at the Tanah Sareal Health Center found that there is a relationship between physical activity and the incidence of type 2 diabetes mellitus. The research was conducted by Hikmah, et al (2023) in the working area of the Landasan Ulin health center and there was a significant relationship between physical activity and the incidence of type 2 diabetes mellitus.

North Minahasa is one of the districts in North Sulawesi Province. According to the North Minahasa Regency Health Office from January to June 2024, the Kolongan health center is the health center with the highest number of patients in North Minahasa Regency, which is 268 patients. Data from the Kolongan health center for type 2 diabetes mellitus from January-December 2024 as many as 505 sufferers.

The lack of previous studies that specifically explain the risk factors for type II DM in Kolongan Health Center strengthens the urgency of conducting this study. The high burden of disease but limited risk data, then analysis of specific risk factors such as age, family history, and physical activity becomes very important as a basis for intervention. Therefore, this study was conducted to analyze the risk factors associated with the incidence of type II DM in Kolongan Health Center. The existing data and the many factors that cause type 2 diabetes mellitus, the author is interested in conducting research on the analysis of factors that cause the incidence of type 2 diabetes mellitus in Kolongan Health Center, North Minahasa Regency.

Research methods

Research Type and Design

The research design used was observational analysis with a case-control approach matching with gender. This research was conducted at the Kolongan Health Center, North Minahasa Regency in February-March 2025. The population in this study is all patients with type II diabetes mellitus who come for treatment at the health center. This study was taken from the population of patients with Type II Diabetes Mellitus from January-December 2024, which was 505 respondents. The data collection in this study is divided into two types, namely:

1. Primary Data: Primary data is data obtained directly by the author from interviews using questionnaires conducted on respondents, namely people with type 2 diabetes mellitus.
2. Secondary Data: Secondary data is supporting data from primary data taken from the work area of the Kolongan Health Center, namely the number of patients with Type 2 Diabetes Mellitus. The stages of data processing in this study are as follows:
   a. Data Editing: Checking and editing the questionnaire data so that the answers obtained are clear and complete.
   b. Coding: converting data that was previously in the form of letters into data in the form of numbers so that the data can be entered into the data processing application.
   c. Data Entry: Data entry is done by entering data in the form of numbers / codes into a data processing application on a computer for analysis.
   d. Cleaning: Once all the data has been entered, it is double-checked for possible input errors or biases to be corrected.

The data analysis in this study is as follows:

1. Univariate Analysis: Univariate analysis aims to describe the distribution of age frequency, family history and physical activity with the incidence of type 2 diabetes mellitus and presented through tables and narratives based on the number (n) and percentage (%).
2. Bivariate Analysis: The purpose of the bivariate analysis was to determine the significant value (p value) $p < 0.05$, Odds Ratio (OR) of the relationship between age, family history, physical activity with the incidence of type 2 diabetes mellitus at the Kolongan Health Center, North Minahasa Regency and the data is presented in the form of tables and narrations using the Chi-Square test. OR = 1 means there is no positive relationship between exposure and incidence, OR > 1 means there is a positive relationship between exposure and incidence. While OR < 1 means a negative relationship between exposure and incidence. This means that exposure reduces the risk of occurrence (may be protective).

Results and Discussion

1. Respondent characteristics

Table 1. Respondent characteristics

Respondent characteristics	DMT2+ cases (n=63)	%	Control DMT2 - (n=63)	%	Mean	standard deviation
Age					0.34	0.502
Adult (18-59 Years)	34	54.0	49	77.8		
Elderly (60+ Years)	29	46.0	14	22.2		
Gender					0.76	0.428
Male	14	22.2	16	25.4		
Female	49	77.8	47	74.6		

Table 1 shows that the most cases are in adults aged 18-59 years (54.0%) and the most gender is in women 49 (77.8%).

The age distribution in the case group is mostly in the adult age range (18 - 59 years) as many as 34 (54.0%) people and in the control group the adult age range (18 - 59 years) as many as 49 (77.8%) people.

While for the elderly (60+ years) in the case group as many as 29 (46.0%) people and the control group as many as 14 (22.2%) people. The mean value for the age distribution is 0.34% and the standard deviation value is 0.502%.

The distribution of male gender in the case group was 14 (22.2%) people and the control group was 16 (25.4%). Meanwhile, the distribution of female gender in the case group was 49 (77.8%) people and the distribution of female gender in the control group was 47 (74.6%). The mean value for gender distribution was 0.76% and the standard deviation value was 0.428%.

2. Risk Factor Frequency Distribution

Table 2. Distribution of Respondents Based on the Incidence of Type II Diabetes Mellitus

Incidence of Type II Diabetes Mellitus	n = 126	%
Case	63	50.0
Control	63	50.0

Table 2 shows that for the incidence of type II diabetes mellitus, there are 63 case groups (50.0%) and 63 control groups (50.0%) and the number of samples is 126 people.

Table 3. Distribution of Respondents based on Family History with the Incidence of Type II Diabetes Mellitus

Family History with Type II Diabetes Mellitus	DMT2+ cases (n=63)	%	Control DMT2 - (n=63)	%

Exist	38	60.3	19	30.2
None	25	39.7	44	69.8

Family history with the incidence of type II diabetes mellitus in table 4 shows that as many as 25 (69.8%) of the case group respondents did not have a family history of type 2 diabetes mellitus while as many as 44 (69.8%) of the respondents in the control group did not have a family history of type 2 diabetes mellitus. A total of 38 (60.3%) respondents in the case group had a family history of type 2 diabetes mellitus and 19 (30.2%) of the control group respondents had a family history of type 2 diabetes mellitus.

Table 4. Distribution of Respondents by Physical Activity

Status Responden	DMT2+ cases (n=63)	%	Control DMT2 - (n=63)	%
Low Physical Activity	40	63.5	43	68.3
High Physical Activity	23	36.6	20	31.7

Physical activity with the incidence of type II diabetes mellitus in table 5 above shows that in the group of cases of low physical activity, namely 40 (63.5%) people, high physical activity as many as 23 (36.5%) people and in the control group, respondents who had low physical activity were 43 (68.3%) people, and high physical activity were 20 (31.7%) people.

3. Analysis of Risk Factors Related to the Incidence of Type II Diabetes Mellitus.

Bivariate analysis was conducted to determine whether there was a meaningful relationship between two variables that were suspected to be related between the independent variable (age, family history with the incidence of type II diabetes mellitus and physical activity) and the bound variable (the incidence of type II diabetes mellitus).

Table 5. Relationship between Age and the Incidence of Type II Diabetes Mellitus

Age	DMT2+ cases (n=63)	Control DMT2 - (n=63)	CI = 95%			
			p-Value	OR	Lower	Upper
Adult (18-59 Years)	34	49	0.009	2.985	1.377	6.470
Eledrly (60+ Years)	29	14				

Table 5 shows that the results of the statistical test from the *p-value* are 0.009 with an Odds Ratio (OR) value of 2.985. These results show that there is a relationship between age and the incidence of type II diabetes mellitus. OR 2.985 that age has a 2.985 times greater chance of developing type II diabetes mellitus.

Table 6. The Relationship Between Family History and the Incidence of Type II Diabetes Mellitus

Family History with Type II Diabetes Mellitus	DMT2+ cases (n=63)	DMT2 Case Control - (n=63)	p-Value	CI = 95%		
				OR	Lower	Upper
Exist	38	19	0.001	3.520	1.683	7.361
None	25	44				

The results of the statistical test are based on table 6 with a p-value of 0.001 and an Odds Ratio (OR) value of 3.520. These results show that there is a meaningful relationship between family history and the incidence of type II diabetes mellitus. OR family history with the incidence of type II diabetes mellitus from this statistical test has a 3.520 times greater chance of developing type II diabetes mellitus.

Table 7. The Relationship between Physical Activity and the Incidence of Type II Diabetes Mellitus.

Physical Activity	DMT2 Case Cases + (n=63)	DMT2 Case Control – (n=63)	p-Value	CI = 95%		
				OR	Lower	Upper
Low	40	43	0.707	1.236	0.591	2.586
Tall	23	20				

The statistical test based on table 7 above, has results with *a p-value* of 0.707 and an Odds Ratio (OR) value of 1.236. These results show that there is no significant association between family history and the incidence of type II diabetes mellitus and the incidence of type II diabetes mellitus.

Discussion

1. Respondent Characteristic

The age of respondents in this study was adults (18-59 years) as many as 34 people for the case category and 49 people for the control category, and for the elderly age category (60+ years) in this study as many as 29 people with the case group and 14 people in the control group. This study is in line with the study conducted by Mustika, et al. (2024) in the Working Area of the UPT BLUD Bajoe Health Center, Bone Regency, which showed the results of this study, namely the highest age characteristics were in the 46-55 year age group as many as 33 respondents.

Respondent characteristics by gender show that the female gender is the most in this study, both in the case group, which is 49 people and in the control group, which is 47 people. Meanwhile, for the male gender, there are 14 people in the case group and 16 people in the control group. This study is in line with the study conducted by

Febrriyantika, et al. (2021) in Banyumas, where in the study the majority of the gender was female, which was 53 people.

2. Risk Factor Frequency Distribution

a. Overview of the incidence of diabetes mellitus

In this study, it was divided by a ratio of 1:1. It was found that as many as 63 respondents were included in the case group and 63 respondents were included in the control group. Type 2 diabetes mellitus is a common public health problem where there is a continuous increase everywhere.

Research conducted by Sattu, et al. (2024), explains that type II diabetes mellitus has several risk factors for type II diabetes mellitus, namely family history, physical activity, and other risk factors. Another study is a *systematic review* study conducted by Utomo, et al. (2020) that age, family history, and physical activity are one of the risk factors for type II diabetes mellitus.

b. Overview of Age Risk Factors

The overview of age risk factors in this study shows that the most case groups are found in the adult age range (18 – 59 years) as many as 34 people and in the control group of the adult age range (18 – 59 years) as many as 49 people.

Research conducted by Rosita, et al. (2022) at the Balaraja Health Center, Tangerang Regency showed that the highest proportion based on age obtained by the elderly (60+ years) was 126 people. A person over the age of 45 has a higher risk of developing type 2 diabetes mellitus than those under 45 years of age due to the increased incidence of glucose intolerance caused by degenerative factors that interfere with the body's capacity to manage glucose, (Scarton et al. 2023 in the journal from Romhatulloh, et al. 2024).

c. Overview of Risk Factors for Family History

This study showed that the overview of family history risk factors with the incidence of type 2 diabetes mellitus as many as 44 case group respondents did not have a family history with type 2 diabetes mellitus and as many as 38 control group respondents had a family history with type 2 diabetes mellitus.

Research conducted by Rahmi, et al. (2024) at the Ingin Jaya Health Center, Ingin Jaya District, Aceh Besar Regency had the result that respondents with a family history were 60 respondents compared to respondents who had no family history, namely 30 respondents. If one of the parents has type II diabetes mellitus, the child's risk of developing type II diabetes mellitus is greater than that of a child who does not have a family history of type II diabetes mellitus. This risk will increase even more if both parents have type II diabetes mellitus. This is strengthened by the theory that states, if one of the parents suffers from type II diabetes mellitus, the child will have a 40% risk of suffering from type II diabetes mellitus, especially if both parents suffer from type II diabetes mellitus, it will increase by 70% for the child to suffer from type II diabetes mellitus, (Rediningsih and Lestari, 2022).

d. Overview of Risk Factors for Physical Activity

Physical activity with the incidence of type II diabetes mellitus showed that in the group of cases with high physical activity as many as 46 people and in the control group with the most respondents who had high physical activity as many as 38 people.

The results of the distribution of the frequency of physical activity from the research conducted by Cristinawati Maya and Okti Sri Purnawati (2025) in the working area of the Kartasura health center show the same results as this study where

high physical activity is the highest of 50 people compared to low activity of 7 people and moderate activity of 39 people. According to Murtiningsih et al. (2021), the intensity of moderate and heavy physical activity needs to be increased to prevent the occurrence of risk factors for type II diabetes mellitus and for light physical activity to be avoided as much as possible.

3. Analysis of Risk Factors Related to the Incidence of Type II Diabetes Mellitus.
   a. Analysis of Age Risk Factors with the Incidence of Type II Diabetes Mellitus.
   The results of the statistical test from the *p-value* were 0.009 with an Odds Ratio (OR) value of 2.985 which means that there is a relationship between age and the incidence of type II diabetes mellitus. OR 2.985 that age has a 2.985 times greater chance of developing type II diabetes mellitus.

   This study is in line with research conducted by Harefa, et al. (2023) which states that age is related to the incidence of type II diabetes mellitus with *p-value*= 0.000. OR results showed that respondents with > age of 45 years were 0.157 times more likely to experience Type II DM compared to respondents with < age of 45 years (95% CI 1,071 –5,215). However, this study is not in line with the research conducted by Rohmatulloh (2024), who explained that in the study the p value was 0.397 which was >0.05 (insignificant), so it means that there is no relationship between age and the incidence of type 2 diabetes mellitus at Karsa Husada Hospital, Batu City.

   Age has a relationship with the incidence of diabetes mellitus, where in this study it was found that the proportion of type II diabetes mellitus is higher in the elderly age group of 60+ years compared to adults 18-59 years where the older the respondents, the less active the respondents. As age increases, there are also changes in lifestyle and levels of physical activity. The elderly tend to experience decreased muscle strength. This condition causes them to become more physically passive, reducing the frequency of walking, active work, or regular exercise. Activities that were previously routinely carried out during productive age become less frequent due to physical limitations, the emergence of joint complaints or fatigue, or because of changes in life priorities when entering retirement for those who have worked.

   b. Analysis of Risk Factors for Family History with the Incidence of Type II Diabetes Mellitus.

   This study shows that the p-value is 0.001 and the Odds Ratio (OR) value is 3.520. These results show that there is a meaningful relationship between family history and the incidence of type II diabetes mellitus and the incidence of type II diabetes mellitus. OR family history with the incidence of type II diabetes mellitus from this statistical test has a 3 times greater chance of developing type II diabetes mellitus.

   This research is in line with research conducted by Nababan, et al. (2020) which shows that the value of genetic history is the value of p-value is 0.034, This proves that hereditary history/genetics have an influence on the blood sugar levels of people with type 2 Diabetes Mellitus at dr. Djasamen Saragih Hospital, Pematangsiantar City. This study is also in line with the study conducted by Lagarense et al. (2023) that there is a significant relationship between family history and the incidence of type II diabetes mellitus with a p-value <0.001 and OR = 6.00. However, this study is not in line with the research conducted by Wahyudi, et al. (2023), which shows the value of p-value 0,434 (*p-value* > 0.05) with an OR of 1.727 which means that there

is no significant association between family history and the incidence of type II diabetes mellitus.

Diabetes mellitus is one of the diseases that is not contagious but can be genetically inherited. This study found that respondents with a family history of type II diabetes mellitus from family members such as mothers, fathers and even grandmothers. Some respondents also said that their parents had had type II diabetes mellitus for a long time.

c. Analysis of Risk Factors for Physical Activity with the Incidence of Type II Diabetes Mellitus.

Statistical tests from this study showed that the *p-value* was 0.707 and the Odds Ratio (OR) value was 1.236 which showed that there was no meaningful relationship between family history and the incidence of type II diabetes mellitus and the incidence of type II diabetes mellitus.

This study is in line with research conducted by Rosita (2023) which showed that there was no relationship between physical activity and the incidence of type II diabetes mellitus (p-value 1,000 > 0.05) OR indicates that physical activity is a protective factor against the incidence of type II diabetes mellitus. This study is not in line with the research conducted by Astutisari, et al. (2022) which has results that physical activity has a significant relationship with type 2 diabetes mellitus where the results of the study are *p value* = 0.009.

In this study, it was found that many respondents often do physical activities every day because many of the respondents were married so that their daily activities are related to taking care of the family or house (washing dishes, cooking, sweeping the house or yard, taking care of husband and children, including toddlers, etc.). Respondents in this study also walked from home to other places almost every day (going to church, to the market, to relatives' houses) even though it took more than five minutes to get to their destination. Although these activities are not included in the category of structured sports or physical exercise, they still contribute to the level of daily physical activity of the respondents. In the group of male respondents, most of them work as farmers or gardeners. Their activities tend to be carried out intensively from morning to evening, involving heavy and continuous physical work such as hoeing, harvesting, or clearing land.

This is one of the reasons why the level of physical activity does not have a significant relationship with the incidence of type II diabetes mellitus in this study, because the activities carried out tend to be routine and not intense. In this study, the absence of a relationship between physical activity and the incidence of type II diabetes mellitus could also be caused by the presence of other risk factors (confounding variables), including gender, history of pregnancy with DM, history of giving birth to a child with more or less weight, history of hypertension, the influence of weight, dyslipidemia or because of an unhealthy diet.

Conclusion

The results of the study regarding "Analysis of Risk Factors for the Incidence of Type II Diabetes Mellitus at the Kolongan Health Center, North Minahasa Regency" can be concluded that: This study shows that there is a relationship between age and the incidence of type II diabetes mellitus at the Kolongan Health Center, North Minahasa Regency. This study shows that there is a relationship between family history and the incidence of type II diabetes mellitus at the Kolongan Health Center, North Minahasa

Regency. This study shows that there is no relationship between physical activity and the incidence of type II diabetes mellitus at the Kolongan Health Center, North Minahasa Regency.

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