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Risk Factor Analysis of Type 2 Diabetes among Adolescents at Wongsonegoro Regional Hospital 2023

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Abstract. *Diabetes Mellitus (DM) is a chronic condition caused by insufficient insulin production or ineffective insulin utilization by the body. In type 2 diabetes, blood sugar levels increase due to suboptimal insulin production or absorption. This study aims to identify the risk factors for Type 2 Diabetes Mellitus (T2DM) in adolescents at K.R.M.T Wongsonegoro Regional Hospital, Semarang, in 2022. This study employs an analytical observational research design with a cross-sectional approach. Data collection was conducted from May to July 2023 at the same hospital. Bivariate analysis revealed that maternal age (p=0.002) and the number of children in the family (p=0.003) had significant associations with T2DM incidence, while birth spacing (p=0.168), drinking water source (p=1.000), and latrine conditions (p=0.806) showed no significant relationships. Multivariate analysis indicated that the primary risk factors were maternal age (OR=4.429; 95% CI: 1.829-10.726) and the number of children in the family (OR=4.000; 95% CI: 1.665-9.610), with maternal age being the most critical risk factor. These findings highlight the importance of family factors in preventing T2DM in adolescents.*

Keywords: *Adolescent, Risk Factors, T2DM,Type 2 Diabetes Mellitus*

Abstrak. Diabetes Mellitus (DM) adalah kondisi kronis yang disebabkan oleh produksi insulin yang tidak mencukupi atau penggunaan insulin yang tidak efektif oleh tubuh. Pada diabetes tipe 2, kadar gula darah meningkat akibat produksi atau penyerapan insulin yang kurang optimal. Penelitian ini bertujuan untuk mengidentifikasi faktor risiko Diabetes Mellitus Tipe 2 (T2DM) pada remaja di RSUD K.R.M.T Wongsonegoro Semarang tahun 2022. Studi ini menggunakan desain penelitian analitik observasional dengan pendekatan cross-sectional. Pengumpulan data dilakukan pada Mei hingga Juli 2023 di rumah sakit yang sama. Analisis bivariat menunjukkan bahwa usia ibu (p=0,002) dan jumlah anak dalam keluarga (p=0,003) memiliki hubungan yang signifikan dengan kejadian T2DM, sedangkan jarak kelahiran (p=0,168), sumber air minum (p=1,000), dan kondisi jamban (p=0,806) tidak menunjukkan hubungan signifikan. Analisis multivariat mengindikasikan bahwa faktor risiko utama adalah usia ibu (OR=4,429; 95% CI: 1,829-10,726) dan jumlah anak dalam keluarga (OR=4,000; 95% CI: 1,665-9,610), dengan usia ibu sebagai faktor risiko yang paling penting. Temuan ini menyoroti pentingnya faktor keluarga dalam pencegahan T2DM pada remaja.

Kata kunci: Diabetes Mellitus Tipe 2, T2DM, Faktor Risiko, Remaja

1. BACKGROUND

Diabetes Mellitus (DM) is a chronic condition caused by either insufficient insulin production by the pancreas or inefficient insulin utilization by the body. According to the ADA Consensus 2015, diabetes is diagnosed when fasting blood glucose levels are ≥126 mg/dL, two-hour postprandial blood glucose levels are ≥200 mg/dL, or blood glucose levels are ≥200 mg/dL with symptoms such as excessive hunger, thirst, frequent urination, and weight loss (Riskesdas Jawa Tengah, 2018). Despite global efforts to reduce the prevalence of diabetes, the number of people with diabetes is expected to increase from 415 million in 2015 to 642

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million in 2040, and diabetes remains the eighth leading cause of death and disability worldwide (GBD 2019).

The main difference between type 1 and type 2 diabetes lies in the causes of elevated blood sugar levels. In type 2 diabetes, blood sugar rises due to less optimal insulin production or absorption by the body (Skyler et al., 2017). Type 2 diabetes results from a decline in the body's ability to respond to insulin, known as insulin resistance. While the pancreas continues to produce insulin, it cannot effectively help absorb glucose, causing blood sugar levels to rise. Type 2 diabetes typically occurs in individuals over the age of 40, often due to a sedentary lifestyle, reduced muscle mass, and increased body weight (Fatmawati, 2010).

However, type 2 diabetes is no longer limited to adults and is increasingly being diagnosed in children and adolescents (Sabrinah et al., 2020). In 1983, type 2 diabetes was considered rare among children and adolescents, but by the mid-1990s, researchers began observing a global increase in type 2 diabetes cases. Data from Riskesdas 2018 shows that Semarang City ranks among the top 10 cities in Central Java with the highest diabetes prevalence, at 2.30% (Riskesdas Jawa Tengah, 2018). This is further confirmed by the significant rise in diabetes cases among children in Semarang City.

According to data from the Semarang Health Office, the number of diabetes cases in children increased from 269 in 2021 to 377 in 2022, with type 2 diabetes cases being more prevalent than type 1 (Dinas Kesehatan Semarang, 2021). The KRMT Wongsonegoro Regional General Hospital in Semarang has also recorded an increase in type 2 diabetes cases among adolescents over the past three years. As a government hospital under the Ministry of Health, it is well-suited to represent diabetes data in Semarang City.

Factors influencing the incidence of type 2 diabetes in adolescents include obesity, family history, high cholesterol levels, and smoking habits (Ismail et al., 2021; Siti Amalia, Lia, 2023). Obesity, particularly as measured by Body Mass Index (BMI), has a significant impact on the development of type 2 diabetes due to its role in insulin resistance (Amalia & Arifah, 2024). Decreased HDL levels and increased LDL levels are also considered critical factors in the development of type 2 diabetes (Nakayama et al., 2021). Research has also shown that smoking can increase the risk of developing type 2 diabetes, although some studies have found no significant relationship between smoking and the incidence of type 2 diabetes (Amalia & Arifah, 2024).

Based on preliminary research conducted by the author through interviews with a nurse at KRMT Wongsonegoro Regional Hospital, several adolescent patients were found to show symptoms of type 2 diabetes. The number of type 2 diabetes cases in adolescents at this hospital

has indeed increased over the past three consecutive years. Therefore, this study aims to analyze the risk factors associated with the incidence of type 2 diabetes in adolescents at KRMT Wongsonegoro Regional Hospital in Semarang in 2023. By understanding these risk factors, more effective prevention and control measures can be implemented to address the rising number of type 2 diabetes cases in adolescents.

This study aims to describe, identify, and analyze the risk factors for type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro Regional Hospital Semarang in 2023. Based on the background, the research problem in this study is to determine the risk factors for type 2 diabetes mellitus in adolescents at the hospital, including age, gender, obesity based on BMI, dyslipidemia based on LDL, family history of diabetes mellitus, and exposure to cigarette smoke. This study also aims to determine the relationship between these factors and the incidence of type 2 diabetes mellitus in adolescents at the hospital in 2023, including the relationship between age, gender, obesity, dyslipidemia, family history of diabetes mellitus, and exposure to cigarette smoke with the incidence of type 2 diabetes mellitus in adolescents.

2. THEORETICAL STUDY

Based on the description in the background, a theoretical framework was prepared regarding the factors related to the incidence of diabetes mellitus in adolescents which was sourced from modifications by Shoufika, Fara (2018), H.L Blum Theory (Notoatmodjo S., 2018), Kemenkes RI (2016) and (PERKENI, 2021). The occurrence of type 2 diabetes mellitus is caused by a combination of various factors. These factors are categorized into factors that can be modified and factors that cannot be modified (Kemenkes, 2013). Modifiable factors consist of clinical and mental condition factors, including body mass index (BMI), abdominal circumference, blood pressure, cholesterol levels and stress, as well as lifestyle factors which include exposure to cigarette smoke, physical activity, alcohol consumption, fruit consumption and vegetable. Factors that cannot be modified consist of sociodemographic factors which include gender, age, education and occupation, as well as health history factors including family history of DM and birth weight.

3. RESEARCH METHOD

The method used in this study is analytical method with an observational cross-sectional design. This research collects data at a specific point in time to observe the relationship between risk factors (such as age, gender, obesity based on BMI, dyslipidemia, family history of DM, and exposure to cigarette smoke) and the incidence of type 2 diabetes

mellitus in adolescents. The data collected comes from patient medical records at KRMT Wongsonegoro Hospital. This method allows for the analysis of the relationship between independent and dependent variables at the same time without observing changes over time. The research variables consist of independent variables (age, gender, obesity based on BMI, dyslipidemia, family history of DM, and exposure to cigarette smoke) and the dependent variable (type 2 diabetes mellitus in adolescents). A cross-sectional study design is employed, where data is collected at one point in time to observe relationships between risk factors and type 2 diabetes. Data collection uses medical records from KRMT Wongsonegoro Hospital, with univariate analysis to describe each variable and bivariate analysis to examine relationships using Chi-square or Fisher's tests. The research hypothesis tests the relationships between obesity, dyslipidemia, family history of DM, and cigarette smoke exposure with type 2 diabetes mellitus in adolescents.

4. RESULTS AND DISCUSSION

Univariate Analysis

Univariate analysis was carried out on each variable from the research results using a list of frequency distributions and percentages for each variable and accompanied by a table (Soekidjo Notoadmojo, 2002: 188). Univariate analysis was carried out with the aim of describing the frequency distribution and percentage of each variable, both the independent variable and the dependent variable. The univariate analysis carried out on independent variables included age, gender, incidence of obesity, history of dyslipidemia, family history of type 2 diabetes mellitus, and exposure to smoking. Meanwhile, univariate analysis was carried out on the dependent variable, namely the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro Hospital Semarang.

Distribution of Respondents based on Type 2 Diabetes Mellitus Incident

Based on the research results, data on the frequency distribution of type 2 diabetes mellitus can be seen in table 1 below:

Tabel 1. Frequency Distribution by Incident of T2DM in Adolescents

Disease Status	Frequency	Percent (%)
Affected by type 2 diabetes mellitus	48	38.1
Not affected by type 2 diabetes mellitus	78	61.9
Total	126	100

Source: Research Data

Based on the results of the univariate analysis in table 1, it is known that 48 adolescent respondents (38.1%) had type 2 diabetes mellitus and 78 adolescent respondents (61.9%) did not experience type 2 diabetes mellitus.

Distribution of Respondents based on Age

Berdasarkan hasil penelitian didapatkan data distribusi frekuensi berdasarkan usia yang dapat dilihat pada tabel 2 dibawah ini:

Table 2. Frequency Distribution by Age

Age Category		Frequency	Percent (%)
12		2	1.6
13		4	3.2
14		1	0.8
15		4	3.2
16		1	0.8
17		4	3.2
18		9	7.1
19		13	10.3
20		8	6.3
21		9	7.1
22		21	16.7
23		14	11.1
24		14	11.1
25		22	17.5
Total		126	100

Source: Research Data

Based on table 2, it is known that the majority of respondents who were diagnosed with type 2 diabetes mellitus and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were 25 years old or 17.5%, while the fewest respondents were diagnosed with type 2 diabetes mellitus. and those who are not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 aged 14 and 16 years, each of which is 1 person or 3.2%.

Distribution of Respondents by Age Category

Based on the research results, frequency distribution data based on age categories can be seen in table 3 below:

Tabel 3. Frequency Distribution by Age Category

Age Category	Frequency	Percent (%)
Early Adolescence	12	9.5
Late Adolescence	114	90.5
Total	126	100

Based on table 3, it is known that the majority of respondents were diagnosed with type 2 diabetes mellitus and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were 114 people in their late teens or 90.5%, while the fewest respondents were diagnosed with type 2 diabetes mellitus. 2 and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were 12 early adolescents or 9.5%.

Distribution of Respondents by Gender

Based on the research results, frequency distribution data based on gender can be seen in table 4 below:

Tabel 4. Frequency Distribution by Gender

Gender	Frequency	Percent (%)
Female	51	40.5
Male	75	59.5
Total	126	100

Source: Research Data

Based on table 4, it is known that the majority of respondents diagnosed with type 2 diabetes mellitus and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were 75 men or 59.5%, while the fewest respondents were diagnosed with type 2 diabetes mellitus. and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were 51 women or 40.5%

Distribution of Respondents based on Obesity

Based on the research results, frequency distribution data based on obesity status can be seen in table 5 below:

Tabel 5. Frequency Distribution by Obesity

Obesity	Frequency	Percent (%)
Obese	43	34.1
Not Obese	83	65.9
Total	126	100

Source: Research Data

Based on table 5, it is known that the majority of respondents diagnosed with type 2 diabetes mellitus and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were not obese as many as 83 people or 65.9%, while the fewest respondents were diagnosed with type 2 diabetes mellitus. 2 and those who

were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were not obese as many as 43 people or 34.1%.

Distribution of Respondents based on History of Dyslipidemia

Based on the research results, frequency distribution data was obtained based on history of dyslipidemia which can be seen in table 4. below:

Tabel 6. Frequency Distribution by Dyslipidemia

Dyslipidemia	Frequency	Percent (%)
Dyslipidemia	28	22.2
Not Dyslipidemia	98	77.8
Total	126	100

Source: Research Data

Based on table 6, it is known that the majority of respondents were diagnosed with type 2 diabetes mellitus and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were 98 people or 77.8% without dyslipidemia, while the fewest respondents were diagnosed with type 2 diabetes mellitus. 2 and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 had dyslipidemia as many as 28 people or 22.2%.

Distribution of Respondents based on Family History of DM

Based on the research results, frequency distribution data was obtained based on family history of type 2 diabetes mellitus which can be seen in table 7 below:

Tabel 7. Frequency Distribution by Family History of DM

Family History of T2DM	Frequency	Percent (%)
There is Family History	47	37.3
There is No Family History	79	62.7
Total	126	100

Based on table 7, it is known that the majority of respondents were diagnosed with type 2 diabetes mellitus and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 had no family history, 79 people or 62.7%, while the fewest respondents were diagnosed with diabetes. type 2 mellitus and those who are not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 have a family history of 47 people or 37.3%.

Distribution of Respondents based on Cigarette Smoke Exposure

Based on the research results, frequency distribution data based on gender can be seen in table 8 below:

Tabel 8. Frequency Distribution by Cigarette Smoke Exposure

Smoke Exposure	Frequency	Percent (%)
Exposed	37	29.4
Not Exposed	89	70.6
Total	126	100

Source: Research Data

Based on table 8, it is known that the majority of respondents diagnosed with type 2 diabetes mellitus and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were not exposed, 89 people or 70.6%, while the fewest respondents were diagnosed with type 2 diabetes mellitus. 2 and those who were not diagnosed with type 2 diabetes mellitus at KRMT Wongsonegoro Hospital Semarang in 2022 were 37 people exposed or 27.4%.

Bivariate Analysis

Bivariate analysis was carried out to test the relationship between the independent variable and the dependent variable. In this study, bivariate analysis was carried out to determine the relationship between the independent variables, namely age, gender, obesity, history of dyslipidemia, family history of type 2 diabetes mellitus, and cigarette exposure with the dependent variable, namely the incidence of type 2 diabetes mellitus in adolescents. Meanwhile, bivariate testing was carried out using the Chi-square test and the relationship between the independent variable and the dependent variable was shown by the p-value (0.005), while to determine the size of the risk factors, Odds Ratio (OR) analysis was used.

Relationship between Age and the Incidence of T2DM in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

The relationship between age and the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro General Hospital Semarang can be seen in table 9 below:

Tabel 9. Relationship between Age and the Incidence of Type 2 Diabetes Mellitus in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

Age	Diabetes Mellitus					OR	P value	CC
	Yes		No					
	N	%	N	%	total			
Early Adolescence	11	34.4	21	65.6	32	0.807	0.616	0.045
Late Adolescence	37	39.4	57	60.6	94			

Source: Research Data

Based on the table above, it can be seen that 34.4% of respondents in their early teens experienced diabetes mellitus and 65.6% of respondents who did not experience diabetes mellitus. Meanwhile, 39.4% of late adolescents experienced diabetes mellitus and 60.6% did not experience diabetes mellitus.

The results of the Chi-Square test with a confidence level of 95% obtained a p-value of 0.616 ($p > 0.005$), which means H0 is accepted and Ha is rejected. It can be concluded that there is no significant relationship between age categories and the incidence of diabetes mellitus at KRMT Wongsonegoro Hospital, Semarang. The contingency coefficient of 0.045 also proves that the relationship between the two variables is very weak.

Relationship between Gender and the Incidence of T2DM in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

The relationship between gender and the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro General Hospital Semarang can be seen in table 10 below:

Tabel 10. Relationship between Gender and the Incidence of Type 2 Diabetes Mellitus in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

Gender	Diabetes Mellitus					OR	P value	CC
	Yes		No					
	N	%	N	%	Total			
Female	29	56,9	22	43,1	51	3.885	0.000	0.304
Male	19	25,3	56	74,7	75			

Source: Research Data

The relationship between gender and the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro General Hospital Semarang can be seen in table 10 below:

Based on the table above, it can be seen that 56.9% of female respondents experienced diabetes mellitus and 43.1% of respondents who did not experience diabetes mellitus. Meanwhile, 25.3% of male respondents had diabetes mellitus and 74.7% of those who did not had diabetes mellitus.

The results of the Chi-Square test with a confidence level of 95% obtained a p-value of 0.000 ($p < 0.005$), which means H0 is rejected and Ha is accepted. It can be concluded that there is a significant relationship between gender and the incidence of diabetes mellitus at KRMT Wongsonegoro Hospital, Semarang. Apart from that, according to the estimated ratio

calculation, OR = 3.885 is obtained, this shows that the chances of teenage girls experiencing type 2 diabetes mellitus are 3.9 times greater than male adolescents.

Relationship between Obesity and the Incidence of T2DM in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

The relationship between adolescent obesity and the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro General Hospital Semarang can be seen in table 11 below:

Tabel 11. Relationship between Obesity and the Incidence of Type 2 Diabetes Mellitus in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

Obesity	Diabetes Mellitus					OR	P value	CC
	Yes		No					
	N	%	N	%	total			
Obese	35	81.4	8	18.6	43	23.558	0.000	0.540
Not Obese	13	15.7	70	84.3	83			

Based on the table above, it can be seen that respondents who have the nutritional status of obesity and suffer from diabetes mellitus are 81.4% and respondents who do not suffer from diabetes mellitus are 18.6%. Meanwhile, 15.7% of respondents who did not have obesity nutritional status but were diagnosed with diabetes mellitus and 84.3% of respondents who did not have diabetes mellitus.

The results of the Chi-Square test with a confidence level of 95% obtained a p-value of 0.000 ($p < 0.005$), which means H0 is rejected and Ha is accepted. It can be concluded that there is a significant relationship between obesity nutritional status and the incidence of type 2 diabetes mellitus at KRMT Wongsonegoro Hospital, Semarang. In addition, according to the estimated ratio calculation, OR = 23,558 is obtained, this shows that the chances of adolescents who have an obese nutritional status to experience type 2 diabetes mellitus are 23.6 times greater than adolescents who have a non-obese nutritional status. The contingency coefficient of 0.540 also proves that the relationship between the two variables is quite strong.

Relationship between Dyslipidemia and the Incidence of T2DM in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

The relationship between a history of dyslipidemia and the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro General Hospital Semarang can be seen in table 12 below:

Tabel 12. Relationship between Dyslipidemia and the Incident of Type 2 Diabetes Mellitus in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

There is a History of Dyslipidemia	Diabetes Mellitus					OR	P value	CC
	Yes		No					
	N	%	N	%	total			
There Are	12	46.2	14	53.8	26	1.524	0.342	0.084
There Are Not	36	36.0	64	64.0	100			

Source: Research Data

Based on the table above, it can be seen that 46.2% of respondents had a history of dyslipidemia and diabetes mellitus and 53.8% of respondents who did not have diabetes mellitus. Meanwhile, 36% of respondents who did not have a history of dyslipidemia but were diagnosed with diabetes mellitus and 64% of those who did not have diabetes mellitus.

The results of the Chi-Square test with a confidence level of 95% obtained a p-value of 0.342 ($p > 0.005$), which means H0 is accepted and Ha is rejected. It can be concluded that there is no significant relationship between the incidence of dyslipidemia and the incidence of type 2 diabetes mellitus at KRMT Wongsonegoro

Relationship Between Family History of T2DM and the Incidence of T2DM in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

The relationship between a family history of type 2 diabetes mellitus and the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro General Hospital Semarang can be seen in table 13 below:

Tabel 13. Relationship between Family History of DM and Incidence of Type 2 Diabetes Mellitus in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

There is a Family History of DM	Diabetes Mellitus					OR	P value	CC
	Yes		No					
	N	%	N	%	total			
There Are	30	65.2	16	34.8	46	6.458	0.000	0.390
There Are Not	18	22.5	62	77.5	80			

Source: Research Data

Based on the table above, it can be seen that 65.2% of respondents had a family history of type 2 diabetes mellitus and were diagnosed with diabetes mellitus and 34.8% of respondents who did not have diabetes mellitus. Meanwhile, 22.5% of respondents who did not have a family history of type 2 diabetes mellitus but were diagnosed with diabetes mellitus and 77.5% of those who did not have diabetes mellitus.

The results of the Chi-Square test with a confidence level of 95% obtained a p-value of 0.000 ($p < 0.005$), which means H0 is rejected and Ha is accepted. It can be concluded that there is a significant relationship between the presence of a family history of type 2 diabetes mellitus and the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro. In addition, according to the estimated ratio calculation, OR = 6.458 was obtained, this shows that the chances of adolescents who have a family history of type 2 diabetes mellitus to experience type 2 diabetes mellitus are 6.5 times greater than adolescents who do not have a family history of type 2 diabetes mellitus.

Relationship Between Exposure to Cigarette Smoke and the Incidence of Type 2 Diabetes Mellitus in Adolescents at KRMT Wongsonegoro Hospital Semarang

The relationship between exposure to cigarettes and the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro General Hospital Semarang can be seen in table 14 below:

Tabel 14. Relationship between Smoking Exposure and the Incidence of Diabetes Mellitus in Adolescents at the KRMT Wongsonegoro General Hospital Semarang

Exposure to Cigarette Smoke	Diabetes Mellitus					OR	P value	CC
	Yes		No					
	N	%	N	%	total			
Exposed	10	27.0	27	73.0	37	0.497	0.099	0.145
Not Exposed	38	42.7	51	57.2	89			

Source: Research Data

Based on the table above, it can be seen that 27% of respondents were exposed to cigarette smoke and diagnosed with diabetes mellitus and 73% of respondents who did not experience diabetes mellitus. Meanwhile, respondents who were not exposed to cigarette smoke but were diagnosed with diabetes mellitus were 42.7% and those who were not diagnosed with diabetes mellitus were 57.2%.

The results of the Chi-Square test with a confidence level of 95% obtained a p-value of 0.099 ($p > 0.005$), which means H0 is accepted and Ha is rejected. It cannot be concluded that

there is a significant relationship between exposure to cigarette smoke and the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro.

Distribution of Respondents based on Type 2 Diabetes Mellitus Incident

Tabel 15. Recapitulation of Bivariate Analysis Results Using Chi Square Test

No	Variable	Diabetes Mellitus					OR	P value	CC	Interpretation
		Yes		No						
		N	%	N	%	total				
	Age									
1	Early Adolescence	11	34.4	21	65.6	32	0.807	0.616	0.045	There is no relationship
	Late Adolescence	37	39.4	57	60.6	94				
	Gender									
2	Female	29	56,9	22	43,1	51	3.885	0.000	0.304	There is a relationship
	Male	19	25,3	56	74,7	75				
	Nutritional status									
3	Obese	35	81.4	8	18.6	43	23.558	0.000	0.540	There is a relationship
	Not Obese	13	15.7	70	84.3	83				
	Dyslipidemia									
4	There Are	12	46.2	14	53.8	26	1.524	0.342	0.084	There is no relationship
	There Are Not	36	36.0	64	64.0	100				
	Family history of DM									
5	There Are	30	65.2	16	34.8	46	6.458	0.000	0.390	There is a relationship
	There Are Not	18	22.5	62	77.5	80				
	Exposure to Cigarette Smoke									
6	Exposed	10	27.0	27	73.0	37	0.497	0.099	0.145	There is no relationship
	Not Exposed	38	42.7	51	57.2	89				

Source: Research Data

The study shows two adolescent age groups: early adolescence (12-16 years) and late adolescence (17-25 years). Among the 32 early adolescents, 34.4% were diagnosed with type 2 diabetes, while 65.6% were not. In the 94 late adolescents, 39.4% had type 2 diabetes, and 60.6% did not. The Chi Square test revealed a p-value of 0.616 ($p > 0.005$), indicating no significant relationship between age and type 2 diabetes incidence at KRMT Wongsonegoro General Hospital Semarang. These findings align with research by Nugrahaeni et al. (2023) and Dahal et al. (2021), which also found no significant correlation between age and diabetes in adolescents. Other studies suggest that age >30 years or >45 years is more significantly associated with type 2 diabetes, with the risk increasing due to factors like central obesity, insulin resistance, and pancreatic decline (American Diabetes Association, 2017; Susanti et al., 2024).

CONCLUSION AND SUGGESTIONS

There is a significant relationship between gender, nutritional status, and family history of disease on the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro General Hospital, Semarang City. Where female adolescents, adolescents who have obese nutritional status, and adolescents who have a family history of type 2 diabetes mellitus are at risk of developing type 2 diabetes mellitus. Meanwhile, age, dyslipidemia, and exposure to cigarette smoke did not have a significant relationship with the incidence of type 2 diabetes mellitus in adolescents at KRMT Wongsonegoro General Hospital. In order to raise young patients' enthusiasm for applying the treatment they are receiving and making lifestyle changes to become healthier in order to prevent the severity of type 2 diabetes mellitus, health professionals are expected to improve support and motivation for patients with the disease at an early age. In addition to being able to make behavior and lifestyle changes, the community is required to be able to support and motivate individuals with type 2 diabetes mellitus throughout their treatment. Good habits, such as eating fruit and vegetables everyday, exercising two to three times a week, cutting back on sweets, and drinking enough water each day to stop the rising incidence of type 2 diabetes mellitus in children. It is hoped that the findings of this study can serve as a guide for future researchers who investigate the epidemiology of non-communicable diseases, especially type 2 diabetes mellitus, by using broader methods, variables and data sources such as interviews or questionnaires to produce valuable new findings and with less bias.

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