

Risk of diabetes mellitus (DM) in high school students in Jambi City

Rd. Halim¹, Oka Lesmana¹, Dini Rudini², Sri Mulyani²

¹ Department of Public Health, Faculty of Medicine and Health Sciences, Universitas Jambi, Jambi, 36361, Indonesia

² Department of Nursing, Faculty of Medicine and Health Sciences, Universitas Jambi, Jambi, 36361, Indonesia

*Corresponding Authors: halim75@unja.ac.id

Abstract

Background: Type 2 Diabetes Mellitus (DM) is not only a disease in adults, but is also appearing in teenagers due to changes in lifestyle, eating patterns, and physical activities. Early identification of risk factors for DM in adolescents is important in prevention efforts. The Finnish Diabetes Risk Score (FINDRISC) is widely used to evaluate the risk of type 2 DM through simple parameters such as body mass index (BMI), stomach circumference, physical activity, and family history. **Objective:** This study aimed to analyze the risk factors for diabetes mellitus type 2 in high school adolescents in Jambi City based on the FINDRISC score. **Method:** This study used a descriptive quantitative design with a cross-sectional approach. The research sample comprised 414 high school students selected using total sampling technique. Data were collected through anthropometry (height, weight, BMI, waist circumference) stomach) and a modified version of the FINDRISC questionnaire. Data analysis was performed descriptively using distribution frequency and percentage. **Results:** Most respondents were aged 16 years (71%) with a balanced sex distribution (50% male and 50% female). As many as 21% were overweight/obese, 11.8% had abnormal stomach circumference, and 62.6% did physical activity ≥ 30 minutes per day, while 53.6% did not consume vegetables or fruits every day. As many as 15.9% of respondents had a history of high blood sugar levels, and 34.6% had a family history of DM. Based on the FINDRISC score, 73.4% were at very low risk, 22% at low risk, 3.1% at moderate risk, and 1.4% at high risk for type 2 DM. **Conclusion:** Partially big teenagers own risk low against type 2 DM, however there is proportion small with risk medium – high need get attention. Contributing factors to improvement risk include Excessive BMI, low physical activity, unhealthy eating patterns, and a family history of DM. Required education, health, and formation of a healthy lifestyle in the school environment to prevent the risk of DM at a young age.

Keywords: Diabetes Mellitus, adolescents, FINDRISC, risk factors, style life

Cite This Article

Halim, R., Lesmana, O., Rudini, D., & Mulyani, S. (2025). Risk of diabetes mellitus (DM) in high school students in Jambi City. *Proceedings Academic Universitas Jambi*, 1(2). 527-534.

Editor

I Made Dwi Mertha Adnyana, M.Ked.Trop.

Article info

Received: October 05, 2025. Revised: October 30, 2025. Accepted: November 09, 2025



INTRODUCTION

Diabetes Mellitus (DM) is a non-contagious Disease No global health problem whose prevalence continues to increase from year to year, not only in adults but also in teenagers. According to the International Diabetes Federation (IDF, 2023), the total number of people with DM worldwide is 537 million in the 20–79 years and it is projected to increase to 643 million by 2030 and 784 million by 2045. Increase This triggered by change style life, pattern Eat high in sugar and fat, and decline activity physical problems that are now also experienced by teenagers [1], [2]

Basic Health Research 2018 reported that the prevalence of DM based on a doctor's diagnosis was as high as 2.0%, while those who had high blood glucose levels but were not yet diagnosed reached 10.9%. This figure shows that a large part of DM cases is still not detected in the community. The 2023 Indonesian Health Survey (SKI) shows that the prevalence of national DM has increased to 3.2%, with an increasing trend that started appearing in younger age groups. The proportion of teenagers with nutritional status overweight and obesity increased compared to that in 2018. Prevalence excess weight and obesity in groups ages 13–15 years reached 19.7%, and in the group age 16–18 years by 12.1%, with trend improvement obesity teenager from 21.8% in 2018 to 37.1 % in 2023. This fact indicates the existence of an improvement in the risk of metabolic syndrome and type 2 DM, which is getting worse in teenagers in upper middle school. [3], [4]

Adolescence is a critical period for the formation of life and behavior health. A diet lacking balance, high consumption of sweetened drinks, and a low activity physique are important risk factors for the occurrence of central insulin resistance and obesity [5]. Various research also shows that habit No healthy that is formed at an age This tend endure until adults, improve future risk of DM [6]. Early detection of DM risk is necessary, even in teenagers, to prevent disease progression. One of the proven effective screening tools is the Finnish Diabetes Risk Score (FINDRISC), developed by Lindström and Tuomilehto (2003). This instrument evaluates eight main components of DM risk, namely age, body mass index (BMI), stomach circumference, physical activity, fruit and vegetable consumption, antihypertensive drug use, blood glucose level history, and family history of DM. [7]

In Indonesia, the 2023 Indonesian Health Survey (SKI) results show an improvement in the prevalence of DM at a young age, with an increasing trend of obesity in teenagers up to 23.6% and low physical activity at 67.7%. This signifies that teenagers have the potential to become a group at risk for the development of DM in adulthood if detection is not done early and behavioral health intervention is not done early. One of the screening methods that has been widely used internationally to identify the risk of DM is the Finnish Diabetes Risk Score (FINDRISC). FINDRISC is a noninvasive instrument that assesses eight component factor risk of type 2 DM, including age, blood sugar index mass body (BMI), circumference stomach, activity physical, habits consumption vegetables and fruit, history pressure blood high, level glucose blood, and history family with diabetes. This tool has been assessed as effective and practical for application to the general population and groups of teenagers [8], [9]

High school teenagers are phase transition going to marked adults with change style life significant, such as improvement consumption food fast serving, time excessive screen, as well as low activity physique [10] Habit the contribute to improvement risk syndrome metabolic and type 2 DM in the elderly young. Therefore, the use of FINDRISC in the school environment is a strategic step in

detecting the risk factors of DM early and building awareness among students about the importance of healthy life patterns [11], [12].

METHODS

This research is descriptive with a cross-sectional study approach. This study aimed to determine the risk factors for Diabetes Mellitus (DM) in adolescents based on the *Finnish Diabetes Risk Score* (FINDRISC) in Schools Senior High School (SMA). The research was conducted in a public high school in the city of [city], Indonesia, in [month, year], after obtaining permission from the school and approval from the ethics committee.

Study design and setting

This study used a descriptive quantitative design with a cross-sectional approach. To describe the risk factors of Diabetes Mellitus (DM) in adolescents based on the (FINDRISC) in a comprehensive manner in a single observation. This design was used to identify the distribution characteristics of the population and estimate the prevalence risk of type 2 DM without direct intervention in the study subjects.

Population and sample

The population in the study included all over eleventh grade high school students. Taking sample done The total sampling technique was used for the inclusion criteria.

1. Student active grade XI aged 15–18 years ,
2. Willing become respondents with sign sheet *informed consent* ,
3. No history of chronic disease diagnosed previously (such as type 1 DM, hypertension, or dyslipidemia).

The sample size was determined using the formula by Lemeshow (1997) for studies prevalence, with a 95% confidence level and margin.

Instruments and criteria

The main instrument used is the FINDRISC questionnaire (Finnish Diabetes Risk Score), which has been adapted to Indonesian. The questionnaire consists of eight component factor risks, namely:

1. Age,
2. Body Mass Index (BMI),
3. Circumference stomach,
4. Activity physique,
5. Habit consumption vegetables and fruit ,
6. History of hypertension ,
7. History of levels glucose blood high , and
8. Family history with DM.

The total FINDRISC score ranges from 0–26 and is categorized as follows (Lindström & Tuomilehto, 2003):

- <7 = Risk low ,
- 7–11 = Risk A little increase ,
- 12–14 = Risk currently ,
- 15–20 = Risk tall ,
- >20 = Very high risk .

In addition, anthropometry (weight, height, and waist circumference) was using calibrated tools, as well as observation of physical activity habits and eating patterns based on daily/weekly frequency.

Procedure and data collection

Researchers provided socialization and distributed *informed consent* to students and school parties. Willing respondents follow study fill in FINDRISC questionnaire with guidance researcher. A team of trained enumerators measured weight, height, and stomach circumference. The data were collected and verified. To ensure completeness and consistency, answer respondents.

Statistical analysis

Data were analyzed using a statistical program with application software (SPSS Analysis used to describe distribution frequency factor characteristics risk and FINDRISC scores). Data are presented in the form of distribution tael frequency.

Ethical considerations

This research was approved by the Committee Health Research Ethics [name institutions, for example, Faculty Faculty of Medicine and Health Sciences, University of Jambi with number letter 2544/UN21/8/PT01.04/ 2025, dated July 25, 2025. All respondents were given an explanation about the goals, benefits, and rights of confidentiality of personal data before the study was conducted.

RESULTS

Table 1 Characteristics Respondents

	Variables	Number (n)	Percentage (%)
Age	15 years	89	21.5
	16 years	294	71.0
	17 years	25	6.0
	18 years	5	1.2
	19 years old	1	0.2
	Total	414	100.0
Gender	Man	207	50.0
	Woman	207	50.0
	Total	414	100.0
Parental Education	S1	113	27.3
	Masters/Doctoral Degree	41	9.9
	Elementary School	21	5.1
	Junior High School/Senior High School	237	57.2
	No school	2	0.5
	Total	414	100.0
Pocket money	Not Filling	78	18.8
	<Rp. 10 thousand	15	3.6
	Rp. 10-20 thousand	131	31.6
	Rp. 21-30 thousand	103	24.9
	> Rp. 30 thousand	87	21.0
	Total	414	100.0
Parents' job	Civil Servants/Police/TNI	101	24.4
	Private	94	22.7
	Farm workers	87	21.0
	Entrepreneur / Entrepreneur	125	30.2
	Not Working	7	1.7
	Total	414	100.0

	Variables	Number (n)	Percentage (%)
BMI category	Very Skinny	56	13.5
	Skinny	66	15.9
	Normal / Ideal	207	50.0
	Fat	38	9.2
	Obesity	47	11.4
	Total	414	100.0
BMI Category	Normal	207	50.0
	Abnormal	207	50.0
	Total	414	100.0
Abdominal Circumference	Abnormal	49	11.8
	Normal	365	88.2
	Total	414	100.0
Blood pressure	Normal	297	71.7
	Pre- Hypertension	35	8.5
	Hypertension	82	19.8
	Total	414	100.0

Table 2 Results of Respondents ' Height and Weight Measurements

Variables	n	Min	Max	Mean	Standard Deviation
Height Measurement Results (cm)	414	138	185	161.85	8,459
Body Weight Measurement Results (kg)	414	27.90	124.40	56.5165	14.33958

Table 3. Distribution Frequency DM Risk (Find Risk Category)

No	Question	n	%	
1	Your age	< 45 Years	414	100.0
2	Body Mass Index (BMI)	< 25 kg/m ²	293	70.8
		25–30 kg/m ²	81	19.6
		> 30 kg/m ²	40	9.7
		Total	414	100.0
3	Circumference waist (measured above navel)?	Men: <94 cm / Women: <80 cm	350	84.5
		Male: 94–102 cm / Female: 80–88 cm	49	11.8
		Men: >102 cm / Women: >88 cm	15	3.6
		Total	414	100.0
4	Do you exercise ≥30 minutes per day ?	Yes	259	62.6
		No	155	37.4
		Total	414	100.0
5	How much how often do you eat vegetable or fruit every day ?	Every day	192	46.4
		Not Every Day	222	53.6
		Total	414	100.0
6	Have you ever declare you drink drug hypertension ?	No	352	85.0
		Yes	62	15.0
		Total	414	100.0
7	Whether Once informed that Are your blood sugar levels	No	348	84.1
		Yes	66	15.9

high ?	Total	414	100.0
8 Whether There is family members suffering from type 1 or 2 diabetes ?	No	271	65.5
	Yes , Grandpa / Grandma , Aunt/ Uncle	115	27.8
	Yes , Parents, Siblings sibling , child	28	6.8
	Total	414	100.0

Variables	N	%
Risk of Type 2 DM		
Very Low Risk	304	73.4
Risk Low	91	22.0
Moderate Risk	13	3.1
High Risk	6	1.4
Total	414	100.0

DISCUSSION

General description of respondents

The research results show that a large part of the respondents were aged 16 years (71%), with a balanced distribution of sex between male and female (50% each). Adolescence is an important phase for the formation of Healthy and No unhealthy behaviors. According to the Ministry of Health of the Republic of Indonesia (2023), this phase is critical because of the change in lifestyle, eating patterns, and physical activities that can influence the risk disease of non-infectious diseases (NCDs), including Diabetes Mellitus (DM).

An equal number of male and female respondents were included to provide a representative description of the potential difference in DM risk between the sexes. Rahmawati et al. (2023) mentioned that teenage girls generally have a lower level of physical activity compared to boys, which tends to increase the risk of metabolic disorders when there is no balanced pattern of eating healthy food.

Nutritional status based on body mass index (BMI)

As many as 50% of respondents had a normal BMI, whereas 21% were classified as fat or obese. This shows the existence of a significant proportion of teenagers with excess adequate body weight. Obesity is closely related to insulin resistance, namely the decline in the ability of the body to utilize insulin to control blood glucose levels. According to the World Health Organization (WHO, 2023), obesity in young adults accelerates the onset of type 2 DM. Suwanti et al. (2021) also found that teenagers with a BMI ≥ 25 kg/m² have a 2.5 times greater risk of experiencing improved blood glucose levels compared to those with a normal BMI. The proportion of obesity among this high school student was 21 %, which signifies that almost one in five teenagers potentially have metabolic disturbances that can develop into diabetes later in life. Thus, efforts to monitor nutritional status through the UKS (School Health Service) program are very important and should be done routinely.

Abdominal circumference (obesity) central

Most of the respondents (88.2%) had a normal stomach circumference, whereas 11.8% showed a circumference above the normal limit. Stomach circumference reflects the accumulation of visceral fat, which is more dangerous than subcutaneous fat because it is directly related to insulin resistance and increased triglyceride levels

(Alberti et al., 2022). According to the FINDRISC criteria, males with a stomach circumference >94 cm and females with a circumference >80 cm are classified as at risk. Teenagers with excessive stomach circumference, even though BMI remains normal, including in the category of central obesity". This result shows the existence of hidden risks among teenagers with normal weight but a large stomach circumference. High sugar consumption patterns and low physical activity may be the main reasons for the development of metabolic syndrome.

Activities physique

As many as 62.6% of respondents did physical activity for at least 30 minutes per day, while 37.4% were classified as inactive. Physical activity plays an important role in increasing insulin sensitivity and preventing obesity. This result is in line with the study by Almobarak et al. (2022), who reported that teenagers with a sedentary lifestyle have a risk of type 2 DM that is twice as high as that of active teenagers. This is aggravated by the excessive use of gadgets and the reduction of activities outside the room. More than one-third of the students engaged in physical activities that were not adequate. Intervention-based schools, such as morning exercise, competitions, fitness, and sports routines, can be an effective strategy for lowering DM risk.

Vegetable and fruit consumption patterns

As many as **53.6%** of respondents did not consume vegetables and fruits every day. Eating habits, such as consuming low fiber and high calorie foods, increase blood glucose levels and lower insulin sensitivity. According to Widyastuti et al. (2020), consuming at least 400 g of fiber from vegetables and fruits per day can lower the risk of type 2 diabetes by up to 25%. On the other hand, adolescents with a pattern of eating high in simple sugars and fast-serving foods are at a higher risk of metabolic disorders. This study shows that low consumption of vegetables and fruits indicates a lack of awareness of the importance of balanced nutrition in adolescents. Education on nutrition in schools and habituation bring supplies Healthy can become a prevention strategy.

History of hypertension and high blood sugar

The results show that 15% of respondents drank drug hypertension and 15.9% were informed that their blood sugar levels were high. Although the percentage is relatively small, this finding is important because it indicates the existence of metabolic syndrome early in life. Increased blood pressure and sugar levels with age in teenagers are strong predictors of type 2 DM in adulthood. These results show that teenagers with high blood pressure need to be monitored periodically, as well as intervention style live, because hypertension and hyperglycemia have synergistic effects on damaging blood vessels and the pancreas.

Family history with diabetes

As many as **34.6%** of respondents had a family history of DM (both parents, grandparents, and womb). Genetic factors increase the risk of DM through inheritance predisposition, insulin resistance, and dysfunction of pancreatic β cells (Zheng et al., 2022). However, according to Rahmawati et al. (2023), the risk can be minimized with healthy lifestyle behaviors, such as sports routines, maintaining ideal body weight, and eating balanced meals. This shows that there is a history of DM in the family, which signifies the need for early screening and education. Teenagers

with a positive genetic factor must be given a better understanding of more intensive related patterns of eating and exercising.

Overall FINDRISC Risk Score Distribution showed that the majority of teenagers (73.4%) had a very low risk of type 2 DM, 22% had a low risk, 3.1% had a moderate risk, and 1.4% had a high risk. Although the majority are in the safe category, existence group risk medium – high (around 4.5%) remains an important consideration. Tampubolon et al. (2023) reported that education-based health schools can lower the FINDRISC risk score significantly in six months. This highlights the importance of early preventive interventions. Although the prevalence risk is still low, the lifestyle of teenagers, who tend to be sedentary and consume low amounts of vegetables and fruits, can increase the risk in the long term when no intervention is made.

Based on findings descriptive, visible that variables with contribution dominant to improvement risk of DM in adolescents is: Excess overweight / obesity (21%), activity physique low (37.4%), Diet No healthy (53.6%), Family history of DM (34.6%). This combination of factors reflects a modern lifestyle that is not active and has high calorie intake, which is increasingly common among urban youth. Findings This confirms that the prevention of DM in young old individuals needs to be done with an educational, promotive, and preventive approach, not only curative. Schools play a strategic role in creating a healthy environment through sports activities and nutritional education. Although a large proportion of teenagers in Jambi City have a low risk of type 2 DM, there are indications of an unhealthy lifestyle, such as insufficient physical activity and low fiber consumption. The most influential risk factors were Excessive BMI, low physical activity, and family history of DM. If no intervention is performed early, the group may experience a potential improvement in the risk of DM at a mature age.

CONCLUSIONS

Most of the high school teenagers had a low risk and also showed medium-high results for type 2 DM based on the FINDRISC score. The most prominent factor category contributing to the improvement of risk was obesity (9.7%), large waist circumference (11.8%), low physical activity (37.4%), no routine vegetable/fruit consumption (53.6%), and family history of DM (34.6%). In general, the results show that the pattern style is still alive and needs to be repaired so that the risk of DM does not increase in the future.

REFERENCES

- [1] Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Research and Clinical Practice* 2019;157:107843. <https://doi.org/10.1016/j.diabres.2019.107843>.
- [2] Wild S1, Roglic G, Green A, Sicree R KH. Estimates for the year 2000 and projections for 2030. *World Health* 2004;27:1047–53.
- [3] Kementerian Kesehatan RI. Riset Kesehatan Dasar (Riskedas). Laporan Nasional Riskesdad.2018.Kementerian Kesehatan RI. Badan Penelitian dan Pengembangan Kesehatan. Laporan Nasional Riskesndas 2018 2018;44:181–222.
- [4] RISKESDAS. Survei Kesehatan Indonesia 2023 (SKI). Kemenkes 2023;235.
- [5] Kilpi F, Webber L, Musaigner A, Aitsi-selmi A, Marsh T, Rtveldze K, et al. Alarming predictions for obesity and non-communicable diseases in the Middle East 2013;17:1078–86. <https://doi.org/10.1017/S1368980013000840>.

-
- [6] Gromnatska NM, Lemishko BB, Kulya OO, Pasichna IO, Beliusova VM. Screening of metabolic syndrome in children and adolescents. *Miznarodnij Endokrinologicnij Zurnal* 2022;18:94–9. <https://doi.org/10.22141/2224-0721.18.2.2022.1153>.
- [7] Nnamudi AC, Orhue NEJ, Ijeh II. Assessment of the FINDRISC tool in predicting the risk of developing type 2 diabetes mellitus in a young adult Nigerian population. *Bulletin of the National Research Centre* 2020;44. <https://doi.org/10.1186/s42269-020-00440-7>.
- [8] Tarigan M, Setiawan, Tarigan R, Imelda F, Jongudomkarn D. Identifying diabetes risks among Indonesians: A cross-sectional study in a community setting. *Belitung Nursing Journal* 2024;10:41–7. <https://doi.org/10.33546/bnj.3112>.
- [9] Janghorbani M, Adineh H, Amini M. Evaluation of the Finnish Diabetes Risk Score (FINDRISC) as a screening tool for the metabolic syndrome. *The Review of Diabetic Studies : RDS* 2013;10:283–92. <https://doi.org/10.1900/RDS.2013.10.283>.
- [10] Ulya N, Sibuea AZE, Purba SS, Maharani AI, Herbawani CK. Analisis Faktor Risiko Diabetes Pada Remaja Di Indonesia. *Jurnal Kesehatan Tambusai* 2023;4:2332–41. <https://doi.org/10.31004/jkt.v4i3.16210>.
- [11] Qifti F, Malini H, Yetti H. Karakteristik Remaja SMA dengan Faktor Risiko Diabetes Melitus di Kota Padang. *Jurnal Ilmiah Universitas Batanghari Jambi* 2020;20:560. <https://doi.org/10.33087/jiubj.v20i2.950>.
- [12] Wallace AS, Wang D, Shin JI, Selvin E. Screening and diagnosis of prediabetes and diabetes in us children and adolescents. *Pediatrics* 2020;146:1–8. <https://doi.org/10.1542/PEDS.2020-0265>.