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Screening of Diabetes Mellitus and Physical Activity Analysis: A Stepwise WHO Approach

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Abstract

The largest number of diabetics is estimated to come from Southeast Asia and West Pacific, accounting for about half of diabetes cases in the world. The purpose of this research was to determine the general risk factors and specific activities of Diabetes Mellitus in Medan City, North Sumatra Province. This research method is a quantitative method with a cross-sectional design. Univariate and Bivariate analyses using the Chi-Square test were carried out in this research. 799 participants were recruited using the accidental sampling technique. The place of this research was conducted in Medan City, North Sumatra Province. The results of this research indicate that age 55-59 years old, last elementary school education, working as an entrepreneur and not eating vegetables are risk factors for diabetes mellitus in this research. It is suggested that local health workers provide health education through outreach to the community, especially the people of Medan City, on how to reduce the risk of increased blood sugar or diabetes mellitus incidence. In addition, participants or the community are expected to be able to maintain a good diet, namely by implementing balanced nutrition, especially paying attention to adequate vegetable consumption.

INTRODUCTION

World Health Organization (WHO) estimates that, globally 422 million adults aged over 18 years lived with diabetes in 2014. The largest number of people with diabetes is estimated to come from Southeast Asia and the Western Pacific, accounting for about half the cases of diabetes in the world. Worldwide, the number of diabetics has increased substantially between 1980 and 2014, increasing from 108 million to 422 million or about four times as much (WHO, 2014). Furthermore, the number of people with Diabetes Mellitus in 2015 was 415 million and it is estimated that in 2040 it will increase to 642 million people globally (International Diabetes Federation, 2015).

Diabetes in Southeast Asia in 2014 there were 96 million adults with Diabetes in 11 member countries in the Southeast Asia region. The prevalence of diabetes among adults in the Southeast Asian region increased from 4.1% in the 1980s to 8.6% in 2014 (WHO, 2014). Diabetes caused 1.5 million deaths in 2012. Blood sugar higher than the maximum limit resulted in an additional 2.2 million deaths, increasing the risk of cardiovascular and other diseases. Forty-three percent (43%) of these 3.7 million deaths occurred before the age of 70 years. The percentage of deaths due to diabetes that occurs before the age of 70 is higher in low and middle-income count-

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increased 4-fold from 108 million in the 1980s. By 2040 it is estimated that the number will be 642 million (IDF Atlas 2015). Nearly 80% of people with diabetes are in low-middle-income countries. In 2015, the percentage of adults with diabetes was 8.5% (1 out of 11 adults with Diabetes) (WHO, 2015). The Stepwise data functions among others, as information, the new NCD risk factor finder and a reference for the government for future state-level NCD countermeasures. In addition, the benefits of using Stepwise each country can have robust data on NCD risk factors and can be used as a government program in overcoming priority NCD in the last 15 years, for example, Togo, Benin, Mauritania and Cabo Verde (Riley, 2016).

In 2015, Indonesia ranked seventh in the world for the highest prevalence of Diabetes along with China, India, the United States, Brazil, Russia and Mexico with an estimated number of people with diabetes of 10 million people (IDF Atlas 2015). WHO estimates that in 2030 the number of sufferers of Diabetes Mellitus in Indonesia will be ranked 4th same as in 2000 but with the number of sufferers increasing from 8.4 million in 2000 to 21.3 million in 2030 among the 10 largest countries with diabetes mellitus (WHO, 2016). Diabetes with complicated deaths (6.7%) is the third-highest cause of death in Indonesia (SRS, 2014). The percentage of deaths due to Diabetes in Indonesia is the second-highest after Sri Lanka, the prevalence of Diabetics in Indonesia shows an increase from 5.7% in 2007 to 6.9% in 2016 (Riskesdas, 2016). The prevalence of diabetes mellitus in North Sumatera has increased from 2013 (1.3%) to (1.5%) in 2018 (Ministry of Health, 2018). Looking at this data, it is clear that Diabetes Mellitus has an impact on the quality of resources as well as a considerable increase in health costs, therefore it is necessary to control Diabetes Mellitus, one of which is to reduce diabetes risk factors (Ministry of Health, 2015).

The prevalence of Diabetes Mellitus based on a doctor's diagnosis increased from 6.9% in 2013 to 8.5% in 2018. In fact, only 25% of the Indonesian population knows that their condition is suffering from Diabetes Mellitus (The Indonesian Ministry of Health, 2020). From this data, it can be seen that the health screening carried out in Indonesia has not been maximized. Therefore, health screening is very important to be carried out effectively and efficiently so that people can know their actual condition. In addition, it is necessary to know the risk factors that may occur after screening is carried out. Risk factors are an important measure in overcoming non-communicable diseases, including Diabetes Mellitus. Without knowing the risk factors, disease control cannot be carried out optimally. Then, physical activity also contributes to preventing and managing noncommunicable diseases such as Diabetes Mellitus (WHO, 2020). Thus, researchers are interested in conducting a study entitled "Screening of Diabetes Mellitus and Physical Activity Analysis: a Stepwise WHO Approach. The purpose of this study was to determine the general risk factors and specific activities of Diabetes Mellitus in Medan City, North Sumatra Province.

METHOD

The method in this research is a quantitative method with a cross-sectional design. The analysis in this research is descriptive analysis with frequency distribution and central distribution. The research site was conducted in Medan, North Sumatra. When the research is in 2019. A total of 799 people were selected and invited to participate in this research. The inclusion criteria were people aged 25 to 64 years. The exclusion criteria were pregnant women and people who were experiencing infection.

This research works in conjunction with several licensed screening checkpoints in Medan city parks so that the samples taken are people who volunteer to come for inspection. Thus the sampling technique used in this research was accidental sampling. Before being examined, the community filled out the approval form. To find out the participants were in the age range of 25 to 64 years was seen from the participant's identity card (KTP). Data collection related to blood biochemistry was collected by health workers at the screening post.

The method of data collection is carried out in this research, namely using primary data collected and processed by the researcher directly from the subject and the object of research. Research instruments using the Stepwise WHO questionnaire (WHO, 2004). The WHO stepwise questionnaire contains 3 examinations.

The first examination is about demographic data (gender, age, latest education, occupation) which is measured by the questions in the WHO stepwise questionnaire. The second examination is regarding physical activity data (High-Intensity Physical Activity at Workplace, Moderate Intensity Physical Activity at Workplace, High-Intensity Exercise, Medium Intensity Exercise and Cycling) which is measured by the questions in the WHO stepwise questionnaire. The third examination is direct measurements namely: measurement of height using the Stature

ries than in high-income countries (WHO, 2016).

The incidence of diabetes in the world in 2015, there were 415 million adults from countries: in North America, the Caribbean, South and Middle America, Africa, the Middle East, North Africa, the Western Pacific, and Europe, diabetes

Table 1. Risk Factors for Diabetes Mellitus Incidence Based on the Demographic Characteristics

Variable	n	Glucose		Sig	PR	95% CI of OR	
		High	Normal			lower	Upper
Gender							
Man	358 (44.8%)	77 (21.5%)	281 (78.5%)	0.286	0.870	0.673	1.124
Woman	441 (55.2%)	109 (24.7%)	332 (75.3%)				
Age (years)							
60-64	53 (6.6%)	17 (32.1%)	36 (67.9%)	0.001*	6.768	2.339	10.342
55-59	76 (9.5%)	27 (35.5%)	49 (64.5%)	0.001*	7.897	2.704	10.975
50-54	160 (20%)	49 (30.6%)	111 (69.4%)	0.001*	6.327	2.395	9.207
45-49	100 (12.5%)	24 (24.0%)	76 (76%)	0.001*	4.526	1.788	7.572
40-44	119 (14.9%)	30 (25.2%)	89 (74.8%)	0.001*	4.831	1.913	7.811
35-39	79 (9.9%)	15 (19.0%)	64 (81.0%)	0.005*	3.359	1.336	6.343
30-34	74 (9.3%)	15 (20.3%)	59 (79.7%)	0.003*	3.644	1.430	6.758
25-29	138 (17.3%)	9 (6.5%)	129 (93.5%)	reference	reference	reference	reference
Last Education							
No education	2 (0.3%)	0 (0%)	2 (100%)	0.481	0	1.177	1.325
Primary School	63 (7.9%)	26 (41.27%)	37 (58.73%)	0.001*	3.727	1.578	5.053
Junior High School	79 (9.9%)	19 (24.05%)	60 (75.95%)	0.426	8.270	0.764	1.907
Senior High School	379 (47.4%)	86 (22.69%)	293 (77.31%)	0.395	8.923	0.843	1.538
College	276 (34.5%)	55 (19.93%)	21 (80.07%)	reference	reference	reference	reference
Occupation							
Housewife	236 (29.5%)	58 (24.6%)	178 (75.4%)	0.093	0.944	0.387	1.043
Self-employment	261 (32.7%)	62 (23.8%)	199 (76.2%)	0.070	0.987	0.375	1.005
Government Officials	170 (21.3%)	40 (23.5%)	130 (76.5%)	*reference*	*reference*	*reference*	*reference*
Non-Government Officials	71 (8.9%)	8 (11.3%)	63 (88.7%)	0.076	2.423	0.362	1.022
Private employees	30 (3.8%)	6 (20%)	24 (80%)	0.001*	1.231	0.547	2.529
Unemployment	31 (3.9%)	12 (38.7%)	19 (61.3%)	0.109	0.487	0.223	1.199

* Information: The variable is significant at 5% alpha

Meter (stadiometer), weight measurement using scales, measuring cholesterol levels using cholesterol check tool, measurement of the current level of glucose with a blood sugar check tool, blood pressure measurements with a Spigmomanometer with a cuff type on the upper arm. Univariate analysis was carried out in this research to describe the distribution and frequency of each variable. Furthermore, bivariate analysis was also carried out in this research to see the *Chi-Square* risk factors for diabetes mellitus using the Chi-Square test.

RESULT AND DISCUSSION

Based on table 1, it is known that the sex distribution of all participants shows that the majority of the participants are women as many as 441 (55.2%) with a significance value of 0.286; meaning that there is no relationship between Gender with people having high blood sugar.

The age distribution shows the majority of participants aged are 50-54 years, as many as 160 participants (20%) with a significance value of 0.001; PR: 6.327 and CI: 2.395-9.207. The 55-59 age category was the age category that had the highest PR value, namely 7.897 with a significance value of 0.001 and CI: 2.704-10.975. Furthermore, the distribution of the latest education shows that the majority of participants have the latest education at the high school level, namely 379 participants (47.4%) with a significance value of 0.395; PR: 8.923 and CI: 0.843-1.538. Participants who had the latest education at the elementary level had a relationship with the risk of diabetes mellitus with a significance value of 0.001, PR: 3.727 and CI: 1.578-5.053. The majority of the participants worked as entrepreneurs, namely 261 participants (32.7%) with a significance (P-value of 0.070) meaning that there is no relationship between entrepreneurs with people having high blood sugar. Participants who work as private employees have a relationship with the risk of diabetes mellitus with a significance value of 0.001, PR: 1.230 and CI: 0.132-0.641.

Based on table 2, it is known that the distribution of participants who did High-Intensity Physical Activity in the Workplace was 40 participants (5%) and did not do High-Intensity Physi-

Table 2. Risk Factors for Diabetes Mellitus Based on the physical activity of the participants

Variable	n	Glucose		Sig	PR	95% CI of PR	
		High	Normal			Lower	Upper
High-Intensity Physical Activity in The Workplace							
Yes	40 (5%)	0 (0.0%)	40 (100%)				
No	759 (95%)	112 (14%)	647 (85.3%)	0.355	1.173	1.079	1.275
Moderate-Intensity Physical Activity in The Workplace							
Yes	224 (28%)	16 (2%)	248 (31%)	0.108	0.338	0.180	1.425
No	575 (72%)	96 (12%)	439 (55%)				
High Exercise Intensity							
Yes	40 (5%)	0 (0.0%)	40 (100%)				
No	759 (95%)	112 (14%)	647 (85.3%)	0.355	0.853	0.777	0.918
Moderate Exercise Intensity							
Yes	224 (28%)	199 (88.8%)	25 (11.2%)	0.663	0.947	0.136	3.237
No	575 (72%)	484 (84.2%)	91 (15.8%)				
Cycling							
Yes	343 (43%)	32 (9.3%)	311 (90.7%)				
No	456 (57%)	80 (17.5%)	376 (82.5%)	0.240	1.886	0.640	8.069

cal activity in the Workplace was 759 participants (95%) with a significance value of 0.355 meaning that there is no relationship between High-Intensity Physical activity at Workplace with people having high blood sugar.

The distribution of participants who did the moderate-intensity physical activity at the Workplace was 224 participants (28%) and did not do moderate-intensity physical activity at Workplace were 575 participants (72%) with a significance value of 0.3338 which means there is no relationship between not doing moderate-intensity physical activity at work with people having high blood sugar.

The distribution of participants who did high intensity exercise was 40 participants (5%) and did not do high intensity exercise were as many as 759 participants (95%) with a significance value of 0.355 which means there is no relationship between not doing high intensity exercise with people having high blood sugar.

Then, the distribution of participants who did moderate-intensity exercise were 224 participants (28%) and did not do moderate-intensity exercise was 575 participants (72%) with a significance value of 0.663 which means there is no relationship between not doing moderate-intensity exercise with people having high blood sugar.

The distribution of participants who did exercise cycling was 343 participants (43%) and did not exercise cycling were 456 participants (72%) with a significance value of 0.355 which means there is no relationship between cycling with people having high blood sugar.

Based on table 3, it is known that the distribution of participants who smoked as many as 57 participants (24.1%) with a significance value of 0.738 means there is no relationship between smoking and the risk of people having high blood sugar.

The distribution of participants who rarely ate fruit was 5 participants (16.7%) with a significance value of 0.331 which means there is no relationship between rarely ate fruit and the risk of people having high blood sugar.

Then the distribution of participants who rarely consumed vegetables was 37 participants (60.65%) with a significance value of 0.000; PR: 6.294 and CI: 2.383-3.989. Then the distribution of participants who rarely consume vegetables is 37 participants (60.65%) with a significance value of 0.000; PR: 6.294 and CI: 2.383-3.989. It means that there is a relationship between rarely eating vegetables and the risk of people having high blood sugar.

This measurement of high blood sugar levels refers to the theory of the Indonesian Ministry of Health which states that high blood sugar levels are> 140 mg/dl. Based on table 4. It is known that 51.4% were obese, were as many as 117 participants (62.9%) of them had high blood sugar levels with a significance value of 0.001; PR 1.955 and CI: 1.241-2.283. It means that there is a relationship between obesity with the risk of people having high blood sugar.

Risk Factors for Diabetes Mellitus Based on Demographic Characteristics

Age

The results of this research indicate that the age of 55-59 years has a significant relationship with the incidence of diabetes mellitus with a significance value of 0.001, where 27 participants (35.5%) who are in this age category have high blood sugar levels. This is in line with Yosmar's research (2018) which reported that age has a close relationship with an increase in blood sugar, meaning that the older you get, the risk of experiencing type 2 diabetes is higher.

At the age of 55-59 years, a person will be 7.897 times more likely to suffer from diabetes mellitus. This is in line with Isnaini & Ratnasari's research (2018) which showed that age ≥ 45 years has a significant relationship with the incidence of type 2 diabetes mellitus (p-value = 0.010; OR: 0.312 and CI: 0.126-0.770). Age causes a decrease in all body systems, including the endocrine, where this causes insulin to be in a state of resistance so that blood sugar becomes unstable (Isnaini & Ratnasari, 2018). In addition, the older a person is, there will be a decrease in mitochondrial activity in muscle cells by 35%, whereas this decrease will cause an increase in fat levels in muscle by 30% and lead to insulin resistance (Sari & Purnama, 2019). 40 years generally do not realize that he has diabetes mellitus (Phillips et al., 2018).

Education

The results of this research indicate that participants who have the latest education at the Primary School level have a relationship with the risk of diabetes mellitus with a significance value of 0.001, PR: 3.727 and CI: 1.578-5.053. This means that people who have their last primary school education will be 3,727 times more likely to suffer from diabetes mellitus. In this research, it can be seen in Table 1 that as many as 26 participants (41.27%) in the last elementary education category had diabetes mellitus. This research is in line with Isnaini & Ratnasari's research (2018) that low education has a significant relationship to the incidence of type 2 diabetes mellitus (p-value = 0.007; OR: 0.272 and CI: 0.103-0.721).

Education is related to the health knowledge that a person has (Wang et al., 2018). Moreover, health literacy as a person's ability to process health knowledge will make that person having more awareness for maintaining their health (Liu et al., 2020).

Research conducted by Yosmar (2018) also showed the same thing as the results of this research, namely that there is a relationship (p-value = 0.000) between the level of education to the risk of the incidence of type 2 diabetes mellitus. When a person has low education, their knowledge of health will be low so it increases the risk of diabetes mellitus (Mathisen et al., 2020).

Occupation

Type of occupation is also closely related to the incidence of Diabetes mellitus, where a person's occupation affects a person's level of physical activity (Sari & Purnama, 2019; Wulandari et al., 2019). This research shows results that working as a private employee has a relationship with the incidence of diabetes mellitus with a significance value of 0.001, PR: 1.231 and CI: 0.132-0.641. This means that people who work as private employees have a risk of 1,231 times higher than people who do not work as private employees. In the occupation category of private employees, as many as 6 participants (20%) suffer from diabetes mellitus. This may occur because of being busy at work causing a person's eating frequency to be irregular and eating out of control (Sukmaningsih, 2016; Shafitra et al., 2020).

Risk Factors for Diabetes Mellitus Based on Physical Activity

Physical activity is the movement of limbs that produces simple energy which is very important for the body, spirit and the quality of a healthy lifestyle (Widyasari & Turnip, 2019), besides that physical activity is also a major determinant of energy expenditure so it is important for energy balance and weight control. Based on Riskesdas 2018 data, non-communicable diseases were caused by the proportion of less physical activity of 35.5%. Inadequate physical activity is one of the ten main risk factors for global death (The Indonesian Ministry of Health, 2018).

Physical activity can control blood sugar in the body. Glucose will be converted into energy during physical activities. In people who rarely

Table 3. Risk Factors for Diabetes Mellitus Based on the physical Behavioral of the participants

Variable	N	Glucosa		Sig	PR	95% CI of PR	
		High	Normal			Lower	Upper
Smoking							
Yes	237 (29.7%)	57 (24.1%)	180 (75.9%)	0.738	1.048	0.798	1.376
No	562 (70.3%)	129(22.9%)	433(77.04%)				
Fruit consumption a day (portion)							
Do not consume	30 (3.75%)	5 (16.7%)	25 (83.3%)	0.331	0.611	0.296	1.547
1	153 (19.14%)	30(19.60%)	123 (80.39%)	0.236	0.746	0.543	1.167
2	187 (23.4%)	44 (23.52%)	143 (76.47%)	0.786	3.130	0.686	1.331
3	157 (19.64%)	40 (25.47%)	117(74.52%)	0.845	1.229	0.737	1.451
≥4	272 (34.04%)	67 (24.63%)	205 (75.36%)	Reference	Reference	Reference	Reference
Consumption of vegetables a day (portion)							
Do not consume	61 (7.63%)	37(60.65%)	24(39.34%)	0.000*	6.294	2.383	3.989
1	31 (3.87%)	10(33.5%)	21(67.74%)	0.089	1.944	0.961	2.798
2	38(4.75%)	8(21.05%)	30 (78.94%)	0.836	1.088	0.566	2.021
3	54(6.75%)	10 (18.51%)	44(81.48%)	0.837	0.927	0.526	1.684
≥4	615(76.97%)	121 (19.67%)	494 (80.32%)	Reference	Reference	Reference	Reference

* Information: The variable is significant at 5% alpha

do a physical activity such as exercising, all the food substances that enter the body will not be burned but stored in the body as fat and sugar. If the insulin in the body is not enough to convert glucose into energy, it can cause diabetes mellitus (Agusti, 2017). Isnaini & Ratnasari's research (2018) states that diabetes mellitus occurs due to several risk factors, namely lack of physical activity, genetic factors, unhealthy lifestyles, and smoking behaviour. This was also reported in Basic Health Research 2018 that people who do not do physical activity (20-30%) are more at risk of contracting non-communicable diseases and even causing death (The Indonesian Ministry of Health, 2018).

The physical activity variables in this research were categorized into 5, namely high intensity physical activity in the Workplace, moderate-intensity physical activity in the Workplace, cycling, high intensity exercise and moderate-intensity exercise. But this research shows that there is no significant relationship between the participants' physical activity and the incidence of diabetes mellitus. That is, physical activity is not a risk factor for diabetes mellitus. This is inversely proportional to the results of Amelia et al. research (2020) which showed that there was a relationship between physical activity and fasting blood sugar levels of participants with type 2 Diabetes Mellitus with a p-value = 0.000.

It's also inversely proportional to the results of Sari & Purnama's research (2019) which showed that there was a relationship between physical activity and fasting blood sugar levels of participants in Diabetes Mellitus with a p-value = 0.009. Where in Sari & Purnama's (2019) study most of the participants were in the non-working group and were also female. This group is housewives. Therefore, based on the results of this study, the researchers assessed that physical activity was not a risk factor for diabetes mellitus because the majority of participants in this study were not housewives but they were a group of workers, whose occupations included self-employment (32.7%), Government Officials 170 (21.3%), Non-Government Officials (8.9%) and Private employees (3.8%) compared to participants who were only a housewife (29.5%).

Risk Factors for Diabetes Mellitus Based on Participants' Physical Behavior in Vegetable Consumption

This research in Medan City shows that participants who rarely consume are at risk of suffering from diabetes mellitus with a significance value of 0.000; PR = 6,294. These findings indicate that rarely eating vegetables makes individuals at risk of 6,294 times suffering from Diabetes Mellitus.

Supported by previous research that consumption of vegetables and fruit has a relationship with increased blood sugar levels obtained p = 0.037 less than 0.05 (Liu et al., 2020; Mathisen et al., 2020). It is because the consumption of fruits and vegetables can reduce the risk of developing Diabetes Mellitus. Consumption of fibre found in vegetables can reduce insulin resistance in the body. When a person has eaten foods that contain fibre, it can make a person feel full and can delay hunger and slow down the intake of glucose in the blood. Increased glucose occurs because foods containing fibre can reduce total cholesterol levels in the body because there is a hypocholesterolemic effect that can reduce cholesterol absorption (Liu et al., 2020; Mathisen et al., 2020).

Risk Factors for Diabetes Mellitus Based on Biochemical Measurements

Participants were categorized as obese with a BMI status > 25. In this research, the calculation of PR 1.955 means that obese people will be at a risk of 1.955 suffering from diabetes. Obesity is a risk factor that plays an important role in diabetes mellitus. A person who is obese in his body accumulates excess fat. Fat tissue is an active endocrine tissue that can release adipose cytokines. These adipose cytokines have a proinflammato-

Table 4. Diabetes Mellitus Risk Factors Based on Biochemical Measurements

Variable	N	Glucose		Sig	PR	95% CI of PR	
		High	Normal			Lower	Upper
IMT							
Normal	272 (34.04%)	46 (16.91)	226 (83.08%)	Reference	Reference	Reference	Reference
Underweight	31 (3.87%)	6 (19.35%)	25 (80.64%)	0.732	1.179	0.532	2.460
Over Weight	85 (10.63%)	17 (20%)	68 (80%)	0.514	2.197	0.717	1.950
Obesity	411 (51.43%)	117 (28.46)	294(71.53%)	0.001	1.955	1.241	2.283

ry effect and can interfere with insulin signalling pathways, leading to insulin resistance. This situation causes an increase in blood glucose levels in a person (Putri et al., 2015). A research was conducted by Kabosu et al. (2019) at Bhayangkara Hospital, Kupang City showed that subjects who were obese had a 3,826 times greater risk of suffering from type 2 diabetes than subjects who were not obese. It's also in line with Trisnawati & Setyorogo's research (2013) that showed obesity had a significant relationship with the incidence of diabetes mellitus where participants who were obese were 4.43 times greater than those who were not obese.

The results showed that the participants who were obese were 51.4%. Diabetes Mellitus sufferers are expected to be able to control their blood sugar levels properly by adjusting the diet of each patient according to the 3J principle, namely the amount of food, type of food), and a regular eating schedule).

CONCLUSION

Risk factors for the incidence of diabetes mellitus in this research included age with the most risk age category in the 55-59 years age category, last primary school education, work as a private employee and not consuming vegetables. The advice given by researchers to reduce high blood sugar levels is that local health workers should provide health education through outreach to the community, especially the people of Medan City about how to reduce the risk of increased blood sugar or diabetes mellitus. In addition, participants or the community are expected to be able to maintain a good diet, namely by implementing balanced nutrition, especially paying attention to adequate vegetable consumption.

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