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Original Research

Risk Factors for Type 2 Diabetes Mellitus in Women of Childbearing Age at Unaaha Public Health Center, Konawe Regency

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Abstract
Background: The prevalence of diabetes mellitus (DM) at the Unaaha Health Center was recorded at 1.12 per 1,000 population in 2017, increasing to 2.4 per 1.000 population in 2018, and further rising to 4.6 per 1.000 population in 2019. This study aimed to identify the risk factors associated with the incidence of type 2 diabetes mellitus (T2DM) among women of reproductive age at the Unaaha Health Center.
Methods: This research employed a quantitative approach with a case-control study design. The study population comprised 378 women of reproductive age. A total of 62 cases (women of reproductive age diagnosed with DM) were selected using a simple random sampling technique. Similarly, 62 controls (women of reproductive age without a DM diagnosis) were selected using a matching technique. Data analysis was conducted using the Chi-square test and Odds Ratio (OR) analysis.
Results: The results of the Chi-square and OR analyses indicated that obesity was significantly associated with T2DM (p-value = 0.001, OR = 3.561). Similarly, unhealthy eating habits were identified as a risk factor (p-value = 0.004, OR = 3.214). Blood pressure was found to have the strongest association with T2DM (p-value = 0.000, OR = 6.741).
Conclusion: Obesity, unhealthy eating habits, and elevated blood pressure are significant risk factors for type 2 diabetes mellitus. Future research is encouraged to adopt experimental designs that explore innovative interventions aimed at reducing blood pressure and blood glucose levels in patients with T2DM.

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Background

Diabetes Mellitus (DM) is one of the non-communicable diseases whose cases are increasing (Indriyawati et al., 2018). Diabetes Mellitus causes premature death, blindness, heart disease, and kidney failure. According to data from the World Health Organization (WHO) in 2018, the case fatality rate (CFR) was 1.3 million people died because of diabetes and 4% died before 70 years (Arisandi, 2019). The International Diabetes Federation (IDF) in 2019 estimated that as many as 463 million people aged 20-79 years in the world suffer from DM or equivalent to a prevalence of 9.3 per 1000 population at the same age

and will increase in 2020 according to WHO there are 422 million people in the world. The world suffers from DM or an increase of about 8.5% in the adult population (Arisandi, 2019).

The prevalence of diabetes mellitus cases in Indonesia is also increasing (Nurjana & Veridiana, 2019). Based on health research in 2013, the prevalence of diabetes mellitus in the > 15 years age group was 6.9 per 1000 population and increased in 2018 by 8.5 per 1000 population (Laksono & Kusrini, 2019; Hadafiah et al., 2020) Southeast Sulawesi is one of the regions of Indonesia with an increasing prevalence of diabetes, which is in 2017. The number of DM cases was 0.4 per 1000 population and increased in 2018 by 0.6 per 1000 population and in 2019 by 0.8 per 1000 population (Ratnaningsih et al., 2020).

Konawe Regency is one of the regencies in Southeast Sulawesi that provides the lowest DM services. The percentage of DM patients who received health services according to standards in Konawe Regency was 32% and is still far from the National target of 100%. The incidence of Diabetes mellitus in 2020 almost occurred in all Health Centers. However, the prevalence of DM at the Unaaha Health Center was higher than others with the prevalence of DM continuing to increase every year, people with diabetes mellitus in women of childbearing age at the Unaaha Health Center in 2017 of 1.12 per 1000 population, 2018 was 2.4 per 1000 population and in 2019 it was 4.6 per 1000 population. The incidence increases of DM every year in the Unaaha is caused by the cosmopolitan area where changes in behavior occur, especially changes in diet and community activities so people tend to consume fast food and rarely do physical activity. This situation can certainly cause obesity and can also trigger the occurrence of Diabetes Mellitus (Poshimbi & Lasahari, 2021).

Women of childbearing age are women with the age of 15-49 years and the peak of female fertility is in the age range of 20-29 years. Women have a considerable risk of type 2 diabetes mellitus. It is estimated that in 2015-2050 most women suffer from type 2 diabetes mellitus. Several factors that cause hypertension include obesity, eating habits, and hypertension (Nasution et al., 2018). The effect of hypertension on the incidence of diabetes mellitus is caused by the thickening of the arteries which causes of narrowing the diameter of the blood vessels (Dinata et al., 2014). It will cause the process of transporting glucose from the blood to be disrupted (Kementerian Kesehatan, 2011). In addition, another factor that affects blood sugar levels is stress levels. When people with type 2 DM experience mental stress, the patient's blood sugar will increase (Astuti, 2018). Adrenaline and cortisol are hormones that appear when you are stressed. This hormone will increase blood sugar to increase energy in the body (Aprilia Susanti, Dyah Rohmawati, 2019).

Based on the results of a preliminary survey at the Unaaha Health Center with 10 people with type 2 Diabetes Mellitus, 60% were found to be obese and 40% were not obese. Then 60% of them were found to have high glucose eating habits, like as sweet tea, bread sweet, and fried food, while 40% of them had enough eating habits. The results of blood pressure examinations also showed that 80% of DM patients' blood pressure was in the hypertension category and 20% were not hypertensive. Based on this survey, this study aims to determine the risk factors for the incidence of type 2 diabetes mellitus in women of childbearing age at the Unaaha Public Health Center, Konawe Regency.

Method

Study Location

This research was conducted at the Unaaha Public Health Center, located in Konawe Regency, Southeast Sulawesi, Indonesia. The location was chosen because it serves as a primary healthcare facility in the region and has comprehensive patient records, allowing for the identification of cases and controls from the same source population. Additionally, the health center is situated in a community with a diverse socioeconomic background, making it an ideal site for studying risk factors for Type 2 Diabetes Mellitus in women of childbearing age. The research was conducted over 90 days, from July to September 2021. This time frame was planned to ensure sufficient time for collecting, validating, and processing data. Data collection procedures included patient interviews, anthropometric measurements, and reviewing health records. The duration was deemed adequate to gather valid and representative data by employing systematic and standardized methods.

Study Design

This study is quantitative research utilizing a case-control study approach, which was chosen because it allows for the efficient examination of potential risk factors associated with the condition under investigation in this case, the relationship between obesity, eating habits, and blood pressure with the incidence of a specific health outcome. The case-control design is particularly relevant as it enables the comparison of individuals with the condition (cases) and those without it (controls) to identify differences in exposure to potential risk factors. This approach is suitable for studying outcomes that are relatively rare or require a retrospective analysis of exposures.

Source data

The data in this study consists of both primary and secondary sources. Primary data were collected directly from participants and included information on the incidence of obesity, eating habits, and blood pressure measurements. These data were obtained through direct measurements, structured questionnaires, and interviews to ensure accuracy and reliability. Secondary data were obtained from existing records at the Unaaha Health Center and included relevant contextual information such as the geographical characteristics of the study area and the available healthcare personnel. These data provided background insights essential for understanding the environment and resources influencing health outcomes but may also extend to patient registries or health service utilization statistics to support the analysis. This combination of data types ensures a comprehensive approach, enabling the study to link individual-level risk factors to broader environmental or systemic factors, thereby enhancing the relevance and applicability of the findings.

Population and Sample

The study population consisted of all women of childbearing age who received treatment at the Unaaha Health Center in 2020, totaling 378 individuals. From this population, a sample was selected using the following criteria:

1. Case group: Women of childbearing age diagnosed with diabetes mellitus (62 individuals). The cases were selected using a simple random sampling technique from eligible participants to avoid selection bias.
2. Control group: Women of childbearing age without diabetes mellitus (62 individuals). The controls were chosen using a matching technique, where age distribution in the case and control groups was equalized to control for age as a potential confounding factor.

The total sample size of 124 participants (62 cases and 62 controls) was determined based on statistical considerations for case-control studies, ensuring sufficient power to detect meaningful associations between exposures (e.g., obesity and eating habits) and the outcome (diabetes mellitus). Matching was conducted systematically by categorizing participants into age groups and selecting controls with similar age distributions to the cases. This approach minimized bias and enhanced the comparability between the two groups. To further ensure the validity of the study, all data collection used standardized, validated instruments, and the same procedures were applied consistently across both case and control groups. By drawing samples from the same source population, the study minimized the risk of selection bias, thereby increasing the reliability and generalizability of the findings.

Data Collection

Data on eating habits were collected through interviews using a semi-food frequency questionnaire (FFQ). To ensure the validity and reliability of the questionnaire, it underwent a pre-testing process with a representative sample from the study population. The content validity was assessed by experts in nutrition and public health, while a pilot study evaluated internal consistency and test-retest reliability. Adjustments were made to enhance clarity, relevance, and cultural appropriateness. Obesity data were obtained by measuring body weight and height using a GEA-branded weight and height scale, which was calibrated regularly to maintain an accuracy of 0.01 kg for weight and 0.01 m for height. The measurement procedures followed standard protocols to ensure accuracy:

1. Participants were instructed to wear light clothing and remove footwear.
2. Weight was measured to the nearest 0.01 kg, and height to the nearest 0.01 m.
3. Body Mass Index (BMI) was calculated using the formula that the classification of obesity followed WHO standards. All measurements were conducted by trained personnel to minimize errors and ensure consistency.

$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height (m)}^2}$$

Data Analysis

The collected data were processed and analyzed using SPSS software (version [X]) to ensure robust and accurate statistical analysis. The Chi-square test was selected because it is appropriate for examining the association between categorical variables, such as obesity and eating habits. This test helps determine whether there is a statistically significant relationship between the exposure (e.g., eating habits) and the outcome (e.g., obesity). The Odds Ratio (OR) was used to quantify the strength and direction of the association, providing insight into the likelihood of an outcome occurring given the presence of a specific risk factor. The results from these analyses were interpreted with a confidence interval of 95% and a

significance level of $p < 0.05$. This approach ensures that the findings are statistically robust and meaningful, with implications for understanding risk factors and designing interventions.

Results

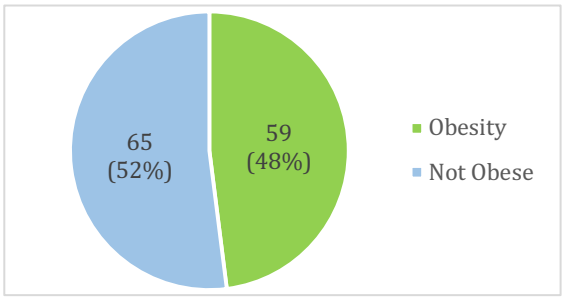

Figure 1 Distribution of Obesity Incidence in Women of Childbearing

Figure 1 illustrates that the majority of respondents are classified as non-obese, totaling 65 individuals, which constitutes 52% of the study population. This indicates that over half of the participants do not fall into the obese category, highlighting a notable proportion with a healthier body mass index classification.

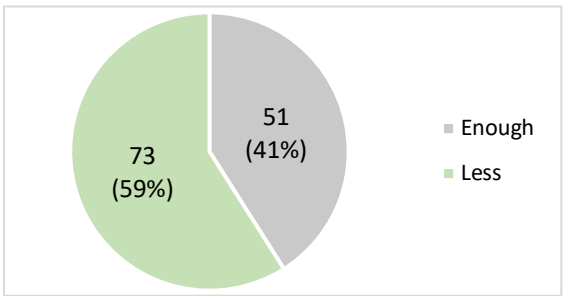

Figure 2 Distribution of Eating Habits in Women of Childbearing Age

Figure 2 reveals that the eating habits of most respondents are categorized as poor, with a total of 73 individuals, accounting for 59% of the study population. This finding highlights a significant portion of respondents with inadequate dietary patterns, which may contribute to the observed health outcomes and emphasizes the need for improved nutritional behavior interventions within the community.

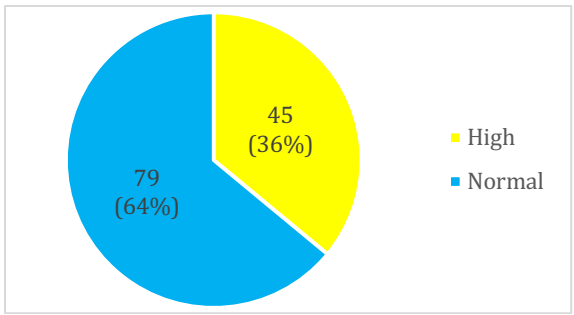

Figure 3 Distribution of Blood Pressure in Women of Childbearing Age

Figure 3 depicts that the majority of respondents have normal blood pressure, totaling 79 individuals, which represents 64% of the study population. This indicates that more than half of the participants maintain healthy blood pressure levels, reflecting a favorable condition within the group. The prevalence of normal blood pressure among respondents underscores the importance of regular monitoring and preventive measures to sustain cardiovascular health and reduce the risk of hypertension-related complications.

Table 1 shows that the incidence of type 2 diabetes mellitus in the case group is more obese as much as 66.1% and not obese as much as 35.4%, while in the control group, there are more who are not obese as much as 64.6% and were obese as much as 33.9%. The results of the Chi-Square test obtained a p-value of

0.001 < (0.05) and then the results of the Odd Ratio (OR) were 3.561. So, it was concluded that there was a relationship between obesity and the incidence of Type 2 DM and being a risk factor for DM type 2 in women of childbearing age, which means women of childbearing age with obesity have 3.561 times the risk of having type 2 diabetes compared to women of childbearing age with not obesity.

The risk factor for eating habits showed that the incidence of type 2 diabetes mellitus of the case group was higher in the women of childbearing age whose eating habits were less as much as namely 61.6% and was sufficient as much as 33.3%, while of the control group more who had sufficient eating habits. 66.7% and there are less as much as 38.4%. The results of the Chi-Square test obtained a p-value of 0.004 < (0.05) and then the results of the Odd Ratio (OR) were 3.214. So, it was concluded that there was a relationship between eating habits and the incidence of Type 2 DM and being a risk factor for DM type 2, which means women of childbearing age with less eating habits have a risk of 3.214 times having type 2 DM compared to women of childbearing age with enough eating habits.

Blood pressure risk factors indicate that the incidence of type 2 diabetes mellitus in the case group is higher in women of childbearing age whose pressure is high blood pressure is 77.8% and normal as much as 34.2%, while in the control group, most of them had normal blood pressure as much as 65.8% and with high blood pressure as much as 22.2%. The results of the Chi-Square test obtained a p-value of 0.000 < (0.05) and then the results of the Odd Ratio (OR) were 6.741. So, it was concluded that there was a relationship between blood pressure and the incidence of Type 2 DM, which means women of childbearing age with high blood pressure have a risk of 6.741 times having type 2 DM compared to women of childbearing age with normal blood pressure.

Table 1 Risk Factors for the Incidence of Diabetes Mellitus Type 2 in Women of Childbearing Age at The Unaaha Public Health Center, Konawe Regency

Variable	The incidence of type 2 diabetes mellitus				Total		X^2count p-value	Odd Ratio
	Case		Control					
	n	%	n	%	n	%		
Obesity								
Obesity	39	66.1	20	33.9	59	100.0	10.476 0.001	OR = 3.561
Not Obese	23	35.4	42	64.6	65	100.0		LL = 1.697
Total	62	50.0	62	50.0	124	100.0		UL = 7.471
Food Habits								
Less	45	61.6	28	38.4	73	100.0	8.526 0.004	OR = 3.214
Enough	17	33.3	34	66.7	51	100.0		LL = 1.519
Total	62	50.0	62	50.0	124	100.0		UL = 6.800
Blood Pressures								
High	35	77.8	10	22.2	45	100.0	20.091 0.000	OR = 6.741
Normal	27	34.2	52	65.8	79	100.0		LL = 2.902
Total	62	50.0	62	50.0	124	100.0		UL = 15.655

Discussion

Risk factors for obesity on the incidence of Type 2 Diabetes Mellitus in women of childbearing age

The results of this study indicate that the incidence of type 2 diabetes mellitus in the case group is more obese as much as namely 66.1%. This condition is due to carbohydrate metabolism that enters the body cannot be absorbed by cells effectively so it accumulates in the skin and tissues and cause obesity. However,33.9% of women of childbearing age who do not have diabetes are also found to be obese, caused by the eating habits of respondents who tend to eat fast food and also rarely do physical activity so it will have an impact on increasing their body mass index. The results of the Chi-Square and Odd Ratio (OR) concluded that there is a relationship between obesity and the incidence of Type 2 DM, which means obesity is a risk factor for the occurrence of Type 2 DM in women of childbearing age. Women of childbearing age with obesity have a 3.561 times risk of having type 2 DM compared to women of childbearing age with no obesity. Therefore, obesity can increase the incidence of type 2 DM, so someone with obesity has a high risk of suffering from type 2 diabetes mellitus.(Sari, 2020) Similarly research by Pratiwi, found that obese women with an estimated risk of 2.9 times will suffer from diabetes mellitus compared to those who are not obese (Pratiwi et al., 2019). It is also in line with other studies that have found that obesity is a risk factor for the incidence of Diabetes Mellitus Type with an OR value = 6.067 (Mulyani & Kasih, 2018).

This research is confirmed by the theory which states that obesity is an excess accumulation of fat in the body. However because body fat is difficult to measure, excess body weight is considered fat accumulation.(Nuraisyah et al., 2021) Obesity is a condition in which body fat has accumulated so it can have adverse effects on health. Overweight is an increase in body weight relative to the standard. Meanwhile, central obesity is an increase in body fat which is located more in the abdominal area than in the hips, thighs, or arms. Determination of the presence of central obesity is important because it is associated with the presence of insulin resistance which is the basis of the metabolic syndrome (Patimah, 2017; Haisa et al., 2019).

Risk factors for eating habits on the incidence of Type 2 Diabetes Mellitus in women of childbearing age

The results of this study indicate that the incidence of type 2 diabetes mellitus in the case group is higher in women of childbearing age with less eating habits, namely 61.6% and the rest is sufficient as much as 33.3%. Most of the control group have moderate eating habits as much as 66.7% and the rest is less as much as 38.4%. Women of childbearing age with less eating habits based on the interviews using semi-FFQ, it found they eating foods that are not by the DM diet given, such as consuming fast food that is high fat such as fried foods and high in like cakes. Besides that, there are also women of childbearing age who rarely eat fruits and vegetables which can inhibit the process of glucose metabolism in the blood. The results of the Chi-Square and Odd Ratio concluded that there is a relationship between eating habits and the incidence of Type 2 DM, which means that eating habits are a risk factor for type 2 DM in women of childbearing age, namely women of childbearing age who eat less at risk 3.214 times experiencing type 2 DM compared to women of childbearing age who eat enough habits.

This study is in line with other research, which found that there was a relationship between diet and the incidence of type 2 DM. People with high-risk diets have an 11.8 times greater risk of developing type 2 diabetes than people with no-risk diets (Wijayanti et al., 2020). Similarly, in Ravangard's study in 2017 with 504 women of childbearing age, 135 (26.8%) were conducted initial diabetes screening. Along with the progress of the times, humans are increasingly driven by an unhealthy modern lifestyle. Their business means there is no time for exercise and as a result, blood circulation in the body is not normal.

When the heart was disturbed, it will impact that the overall work of the body's organs is disturbed including insulin sensitivity (Rahmaningtyas, 2018). In addition, those who are used to eating instant food or fast food that contains a lot of salt and flavoring. When consumed regularly and not balanced with a healthy lifestyle, it will cause health problems, such as obesity, cholesterol, and others. This is what triggers the disruption of metabolism in the body, including insulin sensitivity which causes DM (Junita & Dewi, 2016). Diabetics should regulate their diet by observing the 3 J principles, namely the appropriate amount, regular schedule, and the right type of food (Lestari et al., 2021). Eating habits are determined by a food frequency questionnaire (FFQ) which is to obtain information on the frequency of eating certain foods in individuals who are suspected of being at high risk of suffering from nutritional deficiencies or excess intake of certain nutrients in the past period (Khairiyah, 2016). So, FFQ is used as a diagnostic tool for foods that cause cases of malnutrition (deficiency or excess) (Suyono, 2018). This is intended to determine the magnitude of certain food exposure factors to the incidence of diseases related to nutritional intake (Ii & Pustaka, 2002). Experimental research conducted to lower blood sugar levels with the consumption of brown rice revealed that the habit of consuming brown rice can reduce blood glucose levels in patients with diabetes mellitus (Ardiansyah & Nawawi, 2021). Therefore, it is recommended for patients with diabetes mellitus to avoid consuming foods that can increase blood glucose levels.

Risk factors for blood pressure on the incidence of Diabetes Mellitus Type 2 in women of childbearing age

The results of this study indicate that the incidence of type 2 diabetes mellitus in the case group is higher in women of childbearing age who have high blood pressure as much as 77.8%, this high blood pressure can increase blood glucose levels. However, it was found that 34.2% of women of childbearing age with DM type 2 have normal blood pressure, which caused women of childbearing age to restrict consumption of foods that can increase blood pressure such as limiting high-sodium foods whose raw materials come from salt. Then in the control group, most of them have normal blood pressure as much as 65.8%, and the rest are as high as 22.2%. This situation is because the control group is a sample group that does not have DM so most of their blood pressure is still within normal standards. The results of the Chi-Square and Odd Ratio concluded that there is a relationship between blood pressure and the incidence of Type 2 DM, which means that blood pressure is a risk factor for the occurrence of Type 2 DM in women of childbearing age. Women of childbearing age with high blood pressure are at risk of 6.741 times having type 2 DM compared to women of childbearing age with normal blood pressure. People with high blood at risk of having an increase in blood glucose levels, thereby increasing the incidence of type 2 diabetes.

This study is in line with Setyaningrum's research which found that a history of hypertension has a significant relationship with cases of Type 2 DM. The risk is 2.629 times higher than non-hypertensive (Setyaningrum & Sugiyanto, 2015). This research is also reinforced by the theory which states that excess blood pressure indicates that a person has hypertension. Hypertension can occur when blood pressure exceeds 140/90 mmHg (Ardian, I., Haiya, N. N., & Sari, 2018). Hypertension has a systolic pressure of 140 mmHg and a diastolic pressure of 90 mmHg. Hypertension can be classified into two types, namely primary or essential hypertension, and secondary hypertension (Yonata & Pratama, 2016). Increased blood pressure (hypertension) is common in people with type 2 diabetes, so controlling blood pressure as one of the management of DM patients is very important (Fadlilah et al., 2024).

Conclusion

Obesity, eating habits, and blood pressure are risk factors for type 2 diabetes mellitus. Suggestions for the next researchers are to conduct experimental research by implementing innovations that can reduce blood pressure and blood sugar levels in patients with Type 2 Diabetes Mellitus.

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Conflict of Interest

This research has no conflict of interest.

Author Contributions

Data curation, formal analysis, funding acquisition, investigation, methodology, project administration, **MN**; Conceptualization, project administration, resources, software, **SN**; Conceptualization, supervision; validation, **TS**; Conceptualization, Data curation, Methodology, Validation, Visualization, Writing - Review & Editing, **EAJ**; Roles/Writing - original draft, editing, **KAS**.

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