RESEARCH ARTICLE

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Analysis of Associated Factors Contributing to Type 2 Diabetes Mellitus in the Coastal Community of Bahari Village, Southeast Sulawesi, Indonesia: A Cross-Sectional Study

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Abstract:

Background: Type 2 diabetes mellitus (T2DM) has become a major lifestyle disease that threatens communities in the world. The lifestyles of undiagnosed T2DM are a major issue in Indonesia.

Objective: This study aims to analyze the contribution of associated factors to T2DM in Bahari Village.

Methods: The study was conducted by cross-sectional study. Respondents included 113 men and 157 women were established through simple randomized sampling from March to May 2023. Data analysis using chi-square and logistic regression at p<0.05 using SPSS 25.

Results: The prevalence of T2DM for women (74.2%), 45-65 years (90.9%), no education (58.7%), overweight (38.2%), heavy drinking sweet tea/coffee (77.5%), never physical activity (87.1%), diabetic father and mother (40.3%), and father's OR 1.42 (CI 95%:0.73-2.75), significantly associated with T2DM. Gender, age, education, BMI, and occupation simultaneously influence (72.7%), and age partially affects T2DM.

Discussion: Decreased insulin sensitivity and increased risk of developing diabetes can be influenced by various factors, such as genetics, lifestyle, physical activity, and the environment, either partially or simultaneously.

Conclusion: The respondents' advanced age, obesity, lack of education, preference for sweet foods, and inactivity all contributed to their type 2 diabetes. These coastal communities need to make lifestyle changes to reduce the burden of diabetes.

Classification: Epidemiology; Environmental Health; Science of Nutrition MeSH.

Keywords: Lifestyle, Diet, Diabetes risk, T2DM characteristics, Coastal living, Coastal villages.

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1. INTRODUCTION

Indonesia is an archipelagic country with 25,625 coastal villages, and poverty is an inhibiting factor in fulfilling basic health needs. Type 2 diabetes mellitus (T2DM) has become a major lifestyle disease that threatens communities [1]. In the world, T2DM influences 462 million or 6.28% of the population, covering 4.4% of 15–49 years, 15% of 50–69, and 22% of 70+ [2]. In Indonesia, the prevalence of undiagnosed T2DM has

reached 4.1%, related to age, obesity, central obesity, hypertension, and smoking habits [3]. A healthy lifestyle has a major impact on controlling and helping maintain normal blood sugar levels [4], such as a healthy diet, lower body weight, no smoking, no alcohol, and adequate exercise. A better understanding of knowledge related to lifestyle and increased intake of adequate nutrition can minimize T2DM [5], including women, older, and pregnant [6]. Strategies to mitigate oxidative stress in diabetes can be done through antioxidant therapy, lifestyle modifications, and effective management of hyperglycemia [7], and healthy lifestyles are first-line therapies to manage blood glucose and prevent other disease complications [8]. Through a comprehensive and promotive approach, the lifestyle of coastal communities could be explored for better management to support a healthy and productive life for reducing the burden of T2DM. This study aims to analyze the prevalence of characteristics and lifestyles and associated factors contributing to simultaneously influencing the respondents living with T2DM.

2. MATERIALS AND METHODS

2.1. Study Design and Setting

This research was carried out using a cross-sectional design for 3 (three) months, from March to May 2023, in the Bahari Village. To detect the lifestyle of individuals living with T2DM, the sample size has been counted considering an incidence rate of 22% and *p*-value = 0.05. The sample size is 113 men and 157 women.

Inclusive criteria include residents aged 17 to 65 years, both men and women. Participants have the opportunity and agree to answer all questions provided in the form of a questionnaire. Exclusion criteria include the presence of severe mental and communication disorders.

2.2. Data Collection

Observations in the lifestyles of individuals living with diabetes based on T2DM control and prevention guidelines in Indonesia 2021, blood sugar levels of 200 mg/dL+ or fasting blood sugar of 126 mg/dL+ can be diagnosed as T2DM. Symptoms of type 2 diabetes include the need to urinate often, thirst, constant hunger, weight loss, vision changes, and fatigue [1].

Observation also included lifestyles, such as drinking sweet tea or coffee, physical activity, family history, and smoking. Data on the following variables were collected: age (17–25; 26–35; 36–45; and 46–55 or 56+ years), gender (woman or men), education level (no education, class 1–6, class 7–12, or college/university), occupation (fisheries, and others), and family history of T2DM. Body Mass Index (BMI) was calculated as body weight (kg) divided by height (m) squared. The BMI of participants was categorized based on reference ranges specific to the Indonesian population as 'not overweight' if (BMI < 23 kg/m^2), 'overweight' (BMI = 23.0 - 25.0 kg/m^2), or 'obese' (BMI = 25.0 kg/m^2 +). Physical activity was defined as currently meeting the criteria for never, incidental, and regular. Data on drinking sweet tea or coffee was defined as meeting the criteria mild, moderate, or heavy. Current smoking status was defined as yes or no. Data was obtained through self-writing and reporting *via* the aforementioned quantitative questionnaire. All participants were asked for verbal consent before the interview.

2.3. Data Analysis

Data are displayed in frequency and percentage. Chi-square was used to determine the relationship between characteristics, lifestyle, and family history to T2DM, and (OR: CI 95%) significant at p-value <0.05. Meanwhile, logistic regression was used to assess the simultaneously associated factors to T2DM. The data were analyzed by SPSS version 25.0 for Windows (SPSS Inc., Chicago, IL, the USA).

3. RESULTS

3.1. Prevalence of T2DM

The prevalence of individuals living with T2DM for men (25.8%) and women (74.2%); respondents have an average age of 56.45±5.94 and height of 160.29±4.53. The prevalence of T2DM for 36-45 years is 21.0%, 46-65 years (48.4%), and 56+ (21.0%), underweight (12.5%), normal (19.2%), overweight (38.2%), and obese (50.0%). Family history of T2DM for the father (25.8%), mother (14.5%), and father and mother (40.3%), no education (59.7%), class 1-6 (19.4%), and class 7-9 (8.1%). There was a significant association between gender, age, BMI, education level, and occupation with T2DM at p < 0.05 (Table **1**). Gender, age, education, BMI, and occupation simultaneously influence (72.7%), and age partially affects T2DM.

Table 1. The associated characteristic variables to the prevalence of T2DM, chi-square, and logistic regression

Characteristics Variables	∑ Participants (n=270)			Prevalence of T2DM		p-value
	Men	**Women**	**Total**	**n**	**(%)**	
Gender	-	-	-	-	-	-
Men	113	-	113	16	25.8	0.00*
Women	-	157	157	46	74.2	-
Age Group (Years)	-	-	-	-	-	-
17-25	43	48	91	1	1.6	-
26-35	47	56	103	5	8.1	-

(Table 1) contd.....

Characteristics Variables	∑ Participants (n=270)			Prevalence of T2DM		p-value
	Men	Women	Total	n	(%)	
36-45	9	20	29	13	21.0	0.00*
46-55	9	24	33	30	48.4	-
56+	5	9	14	13	21.0	-
BMI Index Group	-	-	-	-	-	-
< 18.5 (Underweight)	0	8	8	1	1.6	-
18.5-22.9 (normal)	91	123	214	41	66.1	-
23-25 (Overweight)	19	15	34	13	21.0	0.01*
25+ (Obese)	3	11	14	7	11/3	-
Education Group	-	-	-	-	-	-
No education	16	47	63	37	59.7	-
Class 1-6	12	11	23	12	19.4	-
Class 7-9	3	8	11	5	8.1	0.00*
Class 10-12	57	55	112	6	9.7	-
College/university	24	36	60	2	3.2	-
Occupation Group	-	-	-	-	-	-
Fishermen	64	1	65	11	17.7	0.12
Others	49	156	205	51	82.3	-

Note: * Significantly associated at p < 0.05
n = frequency; % = percentage.

Table 2. The associated lifestyle of participants with the prevalence of T2DM, chi-square test.

Lifestyles of Participants	∑ Participant (n=270)			Prevalence of T2DM		p-value
	Men	Women	Total	n	%	-
Food/drink Sweet Group	-	-	-	-	-	-
Mild	113	157	270	0	0.0	-
Moderate	113	157	270	4	6.5	0.00*
Heavy	113	157	270	58	93.5	-
Physical activity Group	-	-	-	-	-	-
Never	113	157	270	54	87.1	-
Incidentally	113	157	270	8	12.9	0.00*
Regularly	113	157	270	0	0.0	-
Smoking Group	-	-	-	-	-	-
Yes	44	24	68	14	22.6	0.36
No	89	133	222	48	77.4	-

Note: *Significantly associated at p<0.05
n = frequency; % = percentage.

3.2. Lifestyle of Participants

The prevalence of T2DM for drinking tea or coffee is mild (0%), moderate (6.5%), and heavy (77.5%), physical activity for never (87.1%), incidental (12.9%), and regular category (0%). There was a significant association between drinking sweet tea or coffee and physical activity with T2DM but not for smoking habits at p<0.05, (Table **2**).

Table 3. The associated Family history with the prevalence of T2DM, chi-square and logistic regression.

Variables	∑ Participants (n=270)			Prevalence T2DM		p-value	Odds Ratio (OR:CI 95%)
	Men	Women	Total	n	(%)	-	-
Family history	-	-	-	-	-	-	-
Father with T2DM	-	-	-	-	-	-	-
Yes	21	36	57	16	25.8	0.20	1.42:0.73-2.75
No	92	121	213	46	74.2	-	-

(Table 3) contd.....

Variables	∑ Participants (n=270)			Prevalence T2DM		p-value	Odds Ratio (OR:CI 95%)
	Men	Women	Total	n	(%)	-	-
Mother with T2DM	-	-	-	-	-	-	-
Yes	45	45	90	9	14.5	0.00*	0.27:0.13-0.57
No	68	112	180	53	85.5	-	-
Father and mother with T2DM	-	-	-	-	-	-	-
Yes	61	78	139	25	40.3	0.03*	0.56:0.31-0.99
No	52	79	131	37	59.7	-	-

Note: * significantly associated at $p<0.05$

n = frequency; % = percentage.

3.3. Family History

The prevalence of family history living with T2DM for fathers (25.8%), mothers (14.5%), and both mothers and fathers (48.3%). There is an association between mother variables with T2DM (p=0.00), and the risk factor for the father is OR: 1.42 (Cl 95%: 0.73 - 2.75), (Table **3**). Fathers, mothers, and both father and mother have significantly simultaneously influenced T2DM by approximately 77%.

4. DISCUSSION

4.1. Prevalence of Participants Living with T2DM

Women, age, urban residence, education level, history of hypertension, diastolic blood pressure, and lipid profiles were all associated with obesity among T2DM subjects in Indonesia. The higher prevalence of T2DM in females is related to variate risk factors such as early menopause caused by hormones [9]. Estrogen can affect insulin sensitivity and blood sugar metabolism. Apart from that, it is also influenced by diet, lack of physical activity, and genetic factors [10]. Results of the study showed the prevalence of T2DM tends to increase with age and occurs relatively higher for 46+ years (69.4%), and women living with T2DM reached 74.2%. The risk of diabetes increases with age for several reasons, such as decreased body sensitivity to insulin and difficulty maintaining weight and an active lifestyle. Respondents in the no education category reached 59.7% of T2DM. Low education causes limited access to information, healthy lifestyles, healthy food, and fitness facilities. The prevalence of T2DM for underweight (12.5%), normal (19.2%), overweight (38.2%), and obese (50.0%). It tends to increase with the BMI index. A high BMI reflects excess body fat, especially in the stomach. These fats can contribute to insulin resistance. Adherence to sweet food, vegetable, and poultry dietary patterns was favorably related to body weight, higher fasting blood glucose, and total cholesterol [11]. Family history of T2DM for the father (25.8%), mother (14.5%), and father and mother (40.3%), while a risk factor for the father 1.42, contributed to 42% for T2DM. Family history was more susceptible to the negative impact of being overweight or obese on dyslipidemia [12]. Monitoring and controlling related determinants are needed to prevent complications caused by the doubled burden of T2DM [13]. This information is important because of the strong association between being overweight/obese and several risk factors for T2DM

[14]. The BMI corrected to young height; obese subjects had an increased risk for developing pre-diabetes and diabetes, with a higher risk for females than males [15]. Bodyweight change was significantly associated with cardiovascular disease risk factor changes, and >5% bodyweight reduction was associated with improved glycated hemoglobin (Xu, 2023). In addition, body weight fluctuation leads to an increased risk of T2DM in adults aged >/= 60 years [16].

4.2. Lifestyle Drinking Tea/Coffee

The abundance of information and easy-to-access food via online media push dietary lifestyle change, and increasing in the incidence of T2DM in rural areas follows the trend of lifestyle in urban citizens [4]. This is also in line with the high prevalence of T2DM in respondents who consume sweet tea or coffee. The prevalence of T2DM with heavy drinking of sweet tea or coffee reached 77.5%). Indonesian people 40.7% consume fatty foods, 53.1% sweet foods, 93.5% less vegetables and fruit, and 26.1% lack physical activity [17]. This shows that, in general, Indonesian people like sweet food or drinks is relevant to the result of this study. According to a study [18], continuous glucose monitors are needed to provide high-frequency information regarding daily glucose variation and are recognized as effective for improving glycemic control [19]. It is important to note that each individual with diabetes may have a different response to food and glucose regulation. Therefore, it is important to work with a health professional or nutritionist to develop a meal plan that suits the individual's specific needs and health condition.

4.3. Lifestyle Physical Activity

This research shows that lack of physical activity is associated with a high prevalence of T2DM (87.1%). High-intensity workout is a key factor in increasing catabolism rate in middle-aged and older people [20]. Even mild and regular exercise such as walking, swimming, and bicycling contributed to glycemic control, preventing and treating overweight or obese, and T2DM [21]. Consistency in regular physical activity is also the key to getting maximum benefits in preventing diabetes and maintaining health in general.

4.4. Lifestyle Smoking

People in this area commonly use tobacco cigarettes.

Respondents have a habit of smoking and living with T2DM (22.6%), but no significant associated T2DM. In addition, there is no evidence to support an association between maternal cigarette smoking during pregnancy and the risk for gestational diabetes mellitus [22]. It is important to remember that quitting smoking can have direct health benefits, including reducing the risk of diabetes and improving blood sugar control for those who already have diabetes. Steps to managing diabetes involve a healthy lifestyle, including quitting smoking, maintaining a healthy weight, exercising regularly, and adhering to a treatment plan recommended by a health professional.

4.5. Family History

There was a strong association between patients with T2DM and those who have a family history of diabetes [10]. The prevalence of T2DM related to family history, namely father (25.8%), mother (14.5%), and both father and mother (40.3%), and variable mothers significantly associated with the incidence of T2DM at p<0.05. Other studies also show family history was significantly associated with diabetes, even in those with a low genetic risk and an ideal lifestyle [23]. A family history of T2DM is an important risk factor for gestational diabetes mellitus [24]. Families living with T2DM are not only required to maintain diet, physical activity and negative habits. Still, they are also expected to provide support for loneliness through a mediating role to relieve depression and the burden of self-perception [25]. The holistic approach acknowledges the multifaceted nature of lifestyle influences on diabetes and emphasizes the importance of comprehensive health promotion and disease prevention in Bahari Village.

Cross-sectional studies used to analyze associated factors with diabetes are only used to capture data at a single point in time, making them prone to certain limitations. Future research is important to use longitudinal designs to provide a more robust understanding of the causal relationships between lifestyle and T2DM.

CONCLUSION

The respondents' advanced age, obesity, lack of education, preference for sweet foods, and inactivity all contributed to their type 2 diabetes. These coastal communities living with T2DM need to make lifestyle changes to reduce the burden of diabetes.

LIST OF ABBREVIATIONS

BMT　=　Body Mass Index

T2DM　=　Type 2 Diabetes Mellitus

SPSS　=　Statistical Package for the Social Sciences

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This research has received approval from the National and Political Unity Agency, South Buton Regency Government -Indonesia, Number: 070/369-20/10/2022.

HUMAN AND ANIMAL RIGHTS

No animal were used that are the basis of this study. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committees and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

All participants were asked for verbal consent before the interview.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data and supportive information are available within the article.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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