MEDIA PENELITIAN DAN
PENGEMBANGAN KESEHATAN
Vol 35 No 3, September 2025

e-ISSN: 2338-3445
p-ISSN: 0853-9987

PREVALENCE AND RISK FACTORS OF PREDIABETES IN COASTAL COMMUNITIES: A CROSS-SECTIONAL STUDY IN CHC SABRANG

Prevalensi dan Faktor Risiko Prediabetes pada Masyarakat Pesisir: Studi Potong Melintang di Wilayah Kerja Puskesmas Sabrang

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ABSTRAK

Prediabetes merupakan kondisi metabolik kronis yang serius dimana kadar gula darah lebih tinggi dari normal dan memiliki risiko tinggi terkena diabetes dalam lima tahun. Berdasarkan IDF, pada tahun 2024, penderita prediabetes pada orang dewasa, jumlah IGT mencapai 16,3%, dan IFG mencapai 16,3%. Dari SKI 2023, prevalensi prediabetes di Indonesia, IGT mencapai 18,5% dan IGF mencapai 13,4%, dimana angka tersebut lebih tinggi dari prevalensi global. Prediabetes di pesisir juga cukup besar, untuk penelitian sebelumnya prevalensinya lebih dari 40%. Berdasarkan data profil kesehatan Jember tahun 2020-2023, PKM Sabrang mengalami peningkatan kasus pada tahun 2020 (593), 2021 (623), 2022 (627), dan (629). Terdapat perbedaan temuan antara faktor risiko sehingga perlu diketahui kondisi di wilayah Sabrang. Penelitian ini bertujuan untuk mengetahui prevalensi dan faktor risiko prediabetes di wilayah kerja Puskesmas Sabrang. Penelitian ini menggunakan desain penelitian cross-sectional dan menggunakan data primer. Sampel minimal dengan rumus Kelsey didapatkan sebanyak 104, namun pada penelitian ini didapatkan sebanyak 105 yang memenuhi kriteria penelitian dan menggunakan purposive sampling. Penelitian ini menemukan prevalensi prediabetes pada masyarakat pesisir mencapai 16,19%. Hasil uji Chi-square didapatkan hubungan yang signifikan antara pendidikan dan tempat tinggal dengan kejadian prediabetes (p-value < 0,05). Analisis multivariat didapatkan hubungan antara variabel obesitas sentral dan tempat tinggal dengan prediabetes setelah variabel IMT dikontrol. Responden yang lingkar pinggangnya masuk kategori obesitas sebesar 3,57 dan tinggal diperkotaan memiliki risiko 3,91 kali lebih tinggi untuk mengalami prediabetes setelah variabel IMT dikontrol. Masyarakat dan pemerintah berperan aktif dalam program Gerakan Nusantara Tekan Angka Obesitas (GENTAS). Perlu skrining kesehatan rutin dan sosialisasi terkait prediabetes.

Keywords: *faktor risiko, prediabetes, prevalensi, pesisir, potong melintang*

ABSTRACT

Prediabetes is a serious chronic metabolic condition where blood sugar levels higher than normal and have a high risk of developing diabetes in five years. Based on IDF, in 2024, prediabetics in adults, the number of IGT reached 16.3%, dan IFG reached. From SKI 2023, prevalence of prediabetes in Indonesia, IGT reached 18,5% and IGF reached 13,4%, where the number higher than global prevalence. Prediabetes on the coast is also quite large, for previously research prevalence more than 40%. Based on Jember health profile data from 2020-2023, CHC Sabrang had an increase in cases in 2020 (593), 2021 (623), 2022 (627), and (629). These studies are in line, and some are not in line; it is necessary to know the conditions in the Sabrang area. This study aimed to

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

know the prevalence and risk factors of prediabetes in the Sabrang Health Center work area. This study used a cross-sectional study design and used primary data. The minimum sample with the Kelsey formula was found to be 103, but in this study, 105 were found to meet the research criteria and were used purposive sampling. This study found that the prevalence of prediabetes in coastal communities reached 16.19%. The results of the Chi-square test revealed a significant relationship between education and place of residence with the incidence of prediabetes (p-value <0.05). Multivariate analysis found a relationship between central obesity variables and place of residence with prediabetes after the BMI variable was controlled. Respondent who waist circumference in the obesity category had 3.57 and rural had 3.91 times higher risk of developing prediabetes after the BMI variable is controlled. The community and government play an active role in the *Gerakan Nusantara Tekan Angka Obesitas (GENTAS)* program. Routine health screening and socialization related to prediabetes.

Keywords: coastal, cross-sectional, risk factors, prediabetes, prevalence

INTRODUCTION

Prediabetes is a serious chronic metabolic condition where also known as intermediate hyperglycemia with blood sugar levels higher than normal but not enough to be diagnosed as type 2 diabetes mellitus but have high risk of developing diabetes[1], [2], [3]. There are various categories of prediabetes, in Indonesia Impaired Fasting Glucose (IFG) and Impaired Glucose Tolerance (IGT). After the diagnosis of IGT or IFG, 26% and 50% will develop into new cases of type 2 diabetes over five years[1].

Globally, the number of IGT in 2021 reached 541 million adults (20-79 years) (10.6%), increased in 2024 reached 634.8 milion adulth (12.0%), and it is predicted in 2050 the number will reach 846.5 million adults or 12.9% of all adults. Meanwhile, IFG in 2021 reached 319 million (6.2%), increased in 2024 reached 48.7 milion (9.2%) and will reach 647.5 million adults or 9.8% of the adult population in 2050. After the diagnosis of IGT or IFG, 26% and 50% will develop into new cases of type 2 diabetes over five years. The Western Pacific has the region with the second highest prevalence of IGT at 13.5% in 2024 after South East Asian, where Indonesia is one of the countries contributing cases in Western pasific area based on International Diabetes Federation region [4], [5].

Based on International Diabetes Federation (IDF), in 2024 prediabates in adults, the number of IGT reached 16.3%, dan IFG reached 7.7%. From other data, Indonesian Health Survei (SKI) 2023, prevalence prediabetes in Indonesia, IGT reach 18,5% and IGF reached 13,4% where the number more than prevalence global. Theres was no prevalence prediabetes in East Java but prevalence diabetes based on doctor diagnoses for age ≥ 15 years reached 2.7% er DKI Jakarta (3.8%), DI Yogyakarta (3.6%), East Kalimantan (3.1%), Bangka Belitung (2.8%), and South Sulawesi (2.7%). The prevalence of prediabetes in 2018 in Indonesia reached 26.3% of the adult population, where the prevalence rate is 2 times of type 2 diabetes in Indonesia[6], [7], [8]. East Java Province is one of the 10 provinces in Indonesia with the highest prevalence of diabetes cases and the second most common non-communicable disease after hypertension. Where Jember Regency is one of the contributors to diabetes cases.

A study related to the prevalence of prediabetes divided into urban, plantation, and coastal areas revealed that the highest prevalence of prediabetes is in urban areas, although not as high as in urban areas but the number of prediabetes on the coast is also quite large, for previously reasech prevalence more than 40%.[9] In Jember Regency, there are several CHC that have coastal areas, namely, CHC Cakru, CHC Gumukmas, CHC Puger, CHC Wuluhan, CHC Sabrang, CHC, and CHC Curahnongko. Based on Jember health profile data from 2020-2023, PKM Sabrang had an increase

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

in cases in 2020 (593), 2021 (623), 2022 (627), and (629). In five years were 593 cases, increasing to 645 cases in 2023 and as many as 35% were new cases that could return to normal if handled properly during the prediabetes phase [10], [11], [12], [13].

Several previous studies have discussed the determinants or risk factors for prediabetes, namely being overweight, age over 45 years old, having a family history of type 2 diabetes, lack of activity, being diagnosed with diabetes during pregnancy (gestational diabetes), and having Polycystic Ovary Syndrome (PCOS). Some studies found no relationship between age, family history, BMI, Central obesity, giving birth > 4Kg, and history of PCOS with prediabetes. However, other studies found a relationship between age, gender, smoking behavior, nutritional status, physical activity, genetics, and cholesterol with prediabetes [14], [15], [16], [17],[18].

Knowing prediabetes can help with early identification so that rapid intervention can be obtained and the number of individuals with diabetes cases can be reduced [2]. There are differences in findings regarding risk factors for prediabetes. In addition, until this study was conducted, there had been no research related to prevalence and risk factors of prediabetes in the Sabrang Health Center work area so this research aimed to know the prevalence and risk factors of prediabetes in the Sabrang Health Center work area.

METHODS

This study used a cross-sectional study design because independent and dependent variable measured one time because prediabetes and diabetes were cronic disease so need long time to see disease progress [19], [20]. This study was conducted from April to November 2024. This study was located in a coastal area in Jember Regency, namely the Sabrang Health Center Work Area, Ambulu District. The population in this study were all residents in the Sabrang Health Center work area aged ≥ 18 years. A minimum sample formula Kelsey for cross-sectional studies, formula Kelsey :[21]

$$N_{Kelsey} = \frac{(Z_{\alpha/2} + Z_{\beta})^2 p(1-p)(r+1)}{r(p_0 + p_1)^2}$$

Notes : α = probability of type I error (5%), β = probability of type II error (80%), p_0 = proportion of disease population 1 (43.3%), p_1= proportion of disease population 2, calculated for p_0, r= Ratio of population 2 to population 1, OR = Odds ratio 3.16 So, a minimum sample of 104 people was obtained. We used epi info 7 for calculated the minimum sampling [14], [17], [22], [23]. Sampling in this study used a purposive sampling technique because because did not have a sampling frame and respondents must meet the research criteria [24]. The inclusion criteria for research subjects were that respondents lived or were domiciled in the Sabrang Health Center Work Area, respondents had never been diagnosed with diabetes mellitus, and respondents were willing to fast for at least 8 hours. The exclusion criteria were subjects who had incomplete data.

The dependent variable in this study was the incidence of prediabetes. For this research we used glucometer, automatic blood pressure monitiring, body weight scale, waist ruler, and stature. Before used, the instrument was calibrated to ensure valid results. In addition, measurements were also carried out by medical personnel from the community health center. The instrument used is a glucometer using fasting blood levels. Prediabetes was categorized if fasting blood sugar was between 100 - 125 mg / dL, and not prediabetes if fasting blood sugar was <100 mg / dL [25], [26], [27]. The independent variables of this study are gender, age, Body Mass Index (BMI), central obesity, hypertension, family history of diabetes, history of cholesterol, history of gestational diabetes, history of giving birth to a baby weighing more than 4 kg, physical activity, education level, smoking status, alcohol consumption, place of residence, and employment status.

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Gender was categorized as male and female. Age was divided ≥ 45 years and <45 years. BMI was categorized as obesity (≥ 25 Kg/m²) and normal (< 25 Kg/m²) [28]. Central obesity was classified as central obesity if the waist circumference of men is ≥ 90 cm or women ≥ 80 cm), less than that categorized as No [29]. For hypertension if the blood pressure measurement results during the study are ≥ 140/90 mmHg [30]. Family history of diabetes was categorized into yes and no, categorized as yes if a family member, either father, mother, sister, or brother has been diagnosed with diabetes, and the rest are classified as no. History of cholesterol, history of gestational diabetes, and history of giving birth to more than 4 kg are categorized as yes and no based on the results of interviews with respondents. For Physical activity we used Global Physical Activity Questionnaire (GPAQ) where has passed the validity and reliability test will be classified into 3, namely low activity (<600 MET), moderate activity (≥600 – 3000 MET), and heavy activity (>3000 MET) [31]. Respondents' education will be categorized as low (Not Finished Elementary School – High School/High School equivalent) and high education (Diploma to S1/S2/S3). Smoking status, alcohol consumption, and employment status will be categorized as yes or no. Place of residence will be grouped into urban, and rural/coastal.

The data collected will be analyzed univariately, bivariate, and multivariate. Univariate analysis to determine the prevalence of prediabetes. Bivariate analysis was seen from the Chi-square test to determine whether there is a relationship between the independent variable and the dependent variable, with a significance level of alpha <0.05 [32]. The strength of the relationship between risk factors and prediabetes in bivariate analysis was measured through the Prevalence Ratio (PR) with a 95% confidence interval [33]. Mutivariat analysis used regression logistic, variable with p-value <0.25 enter to analysis with backward step [34], [35]. The PR measure is used because the study design in this study uses a cross-sectional study. This study has passed the ethical feasibility of research with the number No.2588 / UN25.8 / KEPK / DL / 2024 aand respondents are aware of the purpose of the research and health examination as indicated by signing the informed consent.

RESULT

Table 1. Frequency Distribution of Risk Factors and Blood Sugar Status in Coastal Communities (Study in CHC Sabrang, Ambulu)

Variable	Category	n	%
Blood Glucose Status	Prediabetes	17	16.19
	Normal	88	83.81
Sex	Female	97	92.38
	Male	8	7.62
Age (years)	≥ 45	42	40.00
	< 45	63	60.00
BMI (Kg/m²)	≥ 25	60	57.14
	< 25	45	42.86
Waist Circumference (cm)	Obesity Central	70	66.67
	Normal	36	34.29
Blood Pressure	High	30	28.57
	No	75	71.43
History of High Cholesterol	Yes	16	15.24
	No	89	84.76
Diabetes Family History	Yes	26	24.76
	No	79	75.24
Gestational Diabetes	Ever	0	0.00
	Never	97	100.00

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Variable	Category	n	%
Giving birth baby > 4 kg	Ever	3	3.09
	Never	94	96.91
Physical Activity	Low	20	19.05
	Moderate	36	34.29
	High	49	46.67
Education	Higher Education	24	22.86
	Low - Moderate Education	81	77.14
Smoking Status	Ever	3	2.86
	Never	102	97.14
Alcohol Use	Ever	0	0.00
	Never	105	100.00
Residence	Urban	49	46.67
	Rural/Coastal	56	53.33
Working Status	Yes	46	43.81
	No	59	56.19

In the coastal community, namely the Sabrang Health Center working area. Prevalence of prediabetes reached 16.19%. Respondents in this study were mostly women (92.38%). More than half of the respondents were had central obesity (68.29%), had low education (77.24%), aged <45 years (77.14%), had a BMI ≥ 25 Kg/m² (57.14%), were unemployed (56.19%) and lived on the coast (53.33). Found that 28.57% had hypertension, 15.24% had a history of high cholesterol, 24.76% had a family who had been diagnosed with diabetes mellitus, and 19.05% had low physical activity. In the entire study, none consumed alcohol. For female respondents, it was known that none had gestational diabetes and 3.09% had given birth to a baby ≥ 4 kg (table 1).

Table 2. Analysis Bivariate Determinants in Coastal Communities (Study in CHC Sabrang, Ambulu)

Variable	Prediabetes (n=17)		Normal (n=88)		Total		PR	95% CI	p-value
	n	%	n	%	n	%			
Sex									
Female	15	15.46	82	84.54	97	92.38	0.62	0.17 - 2.24	0.4816
Male	2	25.00	6	75.00	8	7.62			
Age (years)									
≥ 45	7	16.67	35	83.33	42	40.00	1.05	0.43 - 2.54	0.9139
< 45	10	15.87	53	84.13	63	60.00			
BMI (Kg/m²)									
≥ 25	10	16.67	50	83.33	60	57.14	1.07	0.44 - 2.59	0.8784
< 25	7	15.56	38	84.44	45	42.86			
Waist Circumference									
Obecity Central	14	20.00	56	80.00	70	66.67	2.33	0.17 - 7.58	0.134
Normal	4	11.11	32	88.89	36	34.29			
Blood Pressure									
High	4	13.33	26	86.67	30	28.57	0.77	0.27 - 2.17	0.6152
Normal	13	17.33	62	82.67	75	71.43			
History of High Cholesterol									
Yes	4	25.00	12	75.00	16	15.24	1.71	0.64 – 4.59	0.6911
No	13	14.61	76	85.39	89	84.66			
Diabetes Family History									
Yes	5	19.23	21	80.77	26	24.76	1.33	0.52 - 3.42	0.5536
No	12	15.19	67	84.81	79	75.24			

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Variable	Prediabetes (n=17)		Normal (n=88)		Total		PR	95% CI	p-value
	n	%	n	%	n	%			
Gestational Diabetes									
Ever	0	0.00	0	0.00	0	0.00	[redacted]		
Never	15	15.46	82	84.54	97	100.00			
Giving birth baby > 4 kg									
Ever	1	33.33	2	66.67	3	3.09	2.23	0.42 - 11.91	0.3845
Never	13	13.83	81	86.17	94	96.91			
Physical Activity									
Low	5	25.00	15	75.00	20	19.05	1.75	0.63 - 4.87	0.284
Moderate	5	13.89	31	86.11	36	34.29	0.97	0.33 - 2.82	0.959
High	7	14.29	42	85.71	49	46.67			
Education									
Higher Education	8	33.33	16	66.67	24	22.86	3	1.29 - 6.93	0.0094 *
Low - Moderate Education	9	11.11	72	88.89	81	77.14			
Smoking Status									
Ever	1	33.33	2	66.67	3	2.86	2.13	0.40 - 11.20	0.4135
Never	16	15.69	86	84.31	102	97.14			
Alcohol Use									
Ever	0	0.00	0	0.00	0	0.00	[redacted]		
Never	17	16.19	88	83.81	105	100.00			
Residence									
Urban	13	26.53	36	73.47	49	46.67	3.71	1.29 - 10.64	0.015*
Rural	4	7.14	52	92.86	56	53.33			
Working Status									
Yes	10	21.74	36	78.26	46	43.81	1.83	0.75-4.44	0.1729
No	7	11.86	52	88.14	56	56.19			

- There is a significant relationship between risk factors and prediabetes (p-value<0.05)

Bivariate analysis showed that education and residence were significant determinants of prediabetes in coastal communities at the Sabrang Health Center. Respondents with lower education had a threefold higher risk of prediabetes (OR = 3; 95% CI 1.29–6.93; p = 0.0094). Female respondents living in urban areas had a 3.71 times greater risk compared to those in coastal areas (OR = 3.71; 95% CI 1.29–10.64; p = 0.015). No associations were found between other risk factors—such as gender, age, BMI, waist circumference, blood pressure, hypertension, high cholesterol, family history of diabetes, gestational pregnancy, physical activity, smoking, alcohol use, or employment status—and prediabetes incidence (Table 2).

Table 3. Multivariate Analysis Determinants Prediabetes in Coastal Communities

Variable	Model 1			Model 2		
	PR	95% CI	p-value	PR	95% CI	p-value
Age						
BMI	0.67	0.28 - 1.58	0.361	0.67	0.27 - 1.64	0.386
Waist Circumference	3.57	1.02 -12.51	0.046	3.54	1.01- 12.41	0.048
Education	2.31	0.58 - 9.16	0.235			
Residence	2.96	0.87 - 10.03	0.081	3.93	1.38 -11.21	0.01
Working Status	0.75	0.17 - 3.22	0.699			
Gestasi						
Baby Born Weigh > 4 Kg/m3						

Note: Model 1, the first model contains variable with p-value <0.25, for the prediabetes model add BMI because effect of obesity central; Model 2, the final model

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Multivariate analysis by entering variables with p-value <0.25.[34], [35] For prediabetes, it is known that there is a relationship between central obesity and residence with prediabetes in coastal communities after the BMI variable is controlled. Where respondent who waist circumference in the obesity category (more than 90 cm for male an 80 cm for female) had 3.57 times higher risk of developing prediabetes compared waist circumference in normal after residence and the BMI variable is controlled (OR = 3.57; 95% CI 1.01-12.41; p-value 0.048). Respondent who living in urban (Sabrang Village) had 3.91 times higher risk of developing prediabetes compared lived inrural/coastal (Sumberejo Village) after waist circumference and the BMI variable is controlled (OR = 3.91; 95% CI 1.38 - 11.21; p-value 0.001) (Table 3).

DISSCUSION

The results of the study showed that the prevalence of prediabetes in coastal communities, namely the Sabrang Health Center work area, was found to be quite high (16.19%). The determinants of prediabetes in coastal communities were education and place of residence. The results of the bivariate analysis found that higher education was a higher risk of developing prediabetes. Different from previous findings which revealed that there was an educational gradient in prediabetes, which showed an inverse relationship between educational attainment and the prevalence of prediabetes. The higher the education, the lower the prevalence of prediabetes. This is related to better preventive measures [36]. In addition to education, it was found that place of residence was related to prediabetes. This study is in line with Dany et al (2020) who stated that place of residence was related to prediabetes. This is related to lifestyle and environmental conditions which play an important role in prediabetes. Previous studies have shown that urbanization and loss of greenness are beneficial to the health of urban residents and affect the risk of diabetes and markers of glucose homeostasis [37].

In this study, there was no relationship between risk factors (gender, age, BMI, waist circumference, blood pressure, history of high cholesterol, family history of diabetes, physical activity, smoking status, and employment status) with prediabetes in coastal communities. There was no relationship between gestational diabetes and alcohol. There was no relationship between gender and prediabetes, in line with Budiastutik (2022) and Kautzky-Willer (2023) studies which revealed that men appear to have a greater risk of developing diabetes at a younger age and a lower body mass index (BMI) compared to women but women have a dramatic increase in the risk of diabetes-related cardiovascular disease after menopause so that both men and women have a chance of developing prediabetes [38], [39]. This also supports that age was not related to prediabetes because the proportion of men and women is not balanced.

The absence of a relationship between BMI and central obesity with prediabetes. This contradicts Rezavitawanti (2024) who revealed a significant relationship between BMI and central obesity with prediabetes with p-values of 0.017 and <0.001, respectively.[40] The difference in findings may be due to the different study designs used, the cohort study design revealed that BMI and WC were associated with Prediabetes. Weight gain is a recognized risk factor for glycemic metabolic disorders, especially visceral fat, which poses a greater risk[16]. Several studies have reported that there is no relationship between BMI and the obesity paradox, and BMI acts as a simple indicator to evaluate the risk of blood glucose and lipid metabolism [15], [41].

In this study, there was no relationship between blood pressure and a history of high cholesterol with prediabetes. This study was in line with Budiastutik (2022) which found no relationship between blood pressure and prediabetes and a history of high cholesterol with prediabetes [39]. Goals and agents for blood pressure and lipid management should be the same for patients with prediabetes as those for patients with overt diabetes. People with high blood pressure are also at risk for developing prediabetes and type 2 diabetes. This risk stems from the damage caused to blood vessels by high blood

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

pressure, which impairs insulin sensitivity and reduces glucose tolerance [42]. The impact of cholesterol was hyperlipidemia general or central and leads to obesity or obesity central that leads to insulin resistance and development of both T2D and prediabetes [43]. Different from Okado (2015) in Alijanvand (2020) found that increased within-visit blood pressure variability is particularly associated with the prevalence of prediabetes [44], [45].

A family history of diabetes was not associated with prediabetes, but a previous study found that a family history of diabetes was independently associated with glucose dysfunction and diabetes [46]. This research found no relationship between physical activity and prediabetes. This finding is supported by previous research that says about risk factors in coastal communities are the eating habits of coastal communities consume a lot of shrimp, squid, and sea fish that high fat consumption of more than 30% of total calories can cause insulin resistance which leading to pre-diabetes conditions [14]. In this study, we did not examine this. In theory, physical activity was related to the absorption of glucose into the active muscle skeleton through a pathway that is not dependent on insulin. Inactivity causes fat accumulation, especially in the abdomen, which is closely related to insulin resistance [40], [47], [48]. Besides that, it found that there was no relationship between smoking status and prediabetes. This result in line with Budistutik in 2022, but different from the theory by Aeschbacher (2014) in Durlach (2022) said there was evidence showing that smoking increases the risk of pre-diabetes and diabetes in the general population [39]. These data suggest that smoking can accelerate progression from normoglycemia to impaired glucose tolerance or impaired fasting glucose, thus increasing the risk of developing diabetes among smokers [49], [50]. Last, not found a relationship between weighing baby > 4 Kg and prediabetes. There was studied about macrosomia (defined as the history of women who ever birthweight greater than 9 lbs or approximately 4000 g) and diabetes. One such hypothesis was found that maternal hyperlipidemia leads to increased birth weight, even in the absence of maternal hyperglycemia. Maternal hyperlipidemia may be a contributing factor to macrosomic offspring, and this risk factor is also known to be associated with the development of diabetes mellitus later in life [51].

Analysis multivariate, in the final model it was found that central obesity and residence had an association with prediabetes after the BMI variable was controlled. The study was in line with Kulkarni (2023) who revealed a higher percentage of overall body fat (BMI) and percentage of visceral fat (waist circumference) observed in the prediabetes group compared to the age-matched and sex-matched control group. Visceral fat, which is stored in the abdominal cavity and around vital organs, has been known to be a significant contributor to metabolic disorders. This type of fat was metabolically active and has a higher potential to release free fatty acids and inflammatory cytokines, both of which are associated with insulin resistance and inflammation. These findings suggest that combining BMI and central obesity measurements may be better than either index alone in assessing adverse effects on individuals, such as prediabetes and diabetes [48]. Other studies supported that obesity, especially central obesity, was associated with the aging process and one of the factors that influences insulin resistance. Central fat cells are more resistant to the metabolic effects of insulin and are more sensitive to lytic hormones. With insulin resistance, the body tries to overcome the existing consequences (relative insulin deficiency) by increasing insulin secretion so that hyperinsulinemia occurs. As long as the pancreas is still able to meet the body's needs for insulin (compensation stage), the body's metabolism can still be maintained within normal limits. If the pancreas can no longer meet the body's needs for insulin, the metabolic status will change to hyperglycemia-hyperinsulinemia (impaired glucose tolerance) [40].

Previously, research by Wulandari (2023) found that unhealthy lifestyles of coastal communities, such as a lack of physical activity, consumption of foods and drinks high in

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

sugar, and processed seafood and vegetables that are often fried/stir-fried or cooked with coconut milk excessively, are some of the risk factors for disease. Most coastal communities like to consume seafood such as skipjack tuna, tuna, snapper, sardines, anchovies, shrimp, squid, crab, shellfish, and other ingredients, because the food ingredients are abundant and easy to obtain [52], [53]. While the mechanism linking deep-frying and stir-frying methods for cooking fish to impaired glucose metabolism is unclear, there are several possible explanations. Absorption of fat during frying produces more energy-dense foods and may contribute to higher overall fat intake. Moreover, the fatty acid composition of foods changes with frying, and frying fish may lead to a loss of long-chain omega-3 fatty acids and an increase in other fatty acids, depending on the type of fat used for frying. Further, high-temperature cooking, such as frying, induces the formation of advanced glycation end products, which may contribute to insulin resistance [54].

A growing body of evidence from intervention trials and animal studies suggests that a frequent intake of lean seafood, as compared with intake of terrestrial meats, reduces energy intake typically in the range of 4–9 %, a reduction sufficient to prevent a positive energy balance and obesity. Regarding the intake of fatty fish, observational data from one study indicate that the intake of fatty fish was associated with increased body weight. As with obesity, the development of insulin resistance and T2D normally occurs over many years [55]. The findings of this study revealed that the prevalence of prediabetes in the Sabrang CHC work area is quite high. This supports that although not as high as in urban areas, coastal areas also have opportunities. There are findings that BMI, WC and residence are related to Prediabetes. These findings can be used as a basis for making health policies to prevent prediabetes and reduce the number of new diabetes, expecially in coastal area.

Limitation In this study, the respondent criteria are respondents who want to do fasting at least 8 hours so is difficult to used random sampling so we used purposive sampling, because we need respondent who fasting so the respondents of this study involve people who care about health such as kader so that the prevalence results found can be smaller than the actual ones in the field and less representative so that it is expected in the future to use random sampling techniques. In addition, fasting time was recommended not to be more than 12 hours because it will affect blood sugar levels which tend to be lower. After all, the body needs to be active. For cholesterol, measurements need to be taken, not based on history. For future research need focus behavior and eating patterns or food process between urban and rural areas that have not been studied in this research but effect prediabetes. For activity more detail about lack activity in coastal area maybe can not cannot be measured using the gpaq instrument used in this research.

CONCLUSION

This study found that the prevalence of prediabetes in coastal communities reached 16.19%. The bivariate analysis found significant relationship between education and residence with the incidence of prediabetes. Multivariate analysis found a relationship between central obesity variables and residence with prediabetes after the BMI variable was controlled. Respondents whose waist circumference was categorized as obese at 3.57 and lived in urban areas had a 3.91 times higher risk of experiencing prediabetes after the BMI variable was controlled. Central fat cells are more resistant to the metabolic effects of insulin. Year by years, the metabolic status will change to hyperglycemia-hyperinsulinemia (impaired glucose tolerance) or prediabetes, and over five year will develop diabetes.

Prediabetes was reversible to normal, but diabetes was irreversible. We recommend that respondents pay attention to waist circumference and BMI by maintaining a diet and activity. For those who live in urban areas, it is also expected to maintain lifestyle and environment. The community and government actively participate in the *Gerakan*

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Nusantara Tekan Angka Obesitas (GENTAS) program. Routine health screening and socialization related to prediabetes. Based on limitation studies, for future research we recommend using random sampling and adding more variables cholesterol test for more accurate result about risk factor prediabetes, dailly comsumtion food, food process, and detail of lack activity.

ACKNOWLEDGEMENTS

The researcher would like to thank the Institute for Research and Community Service of Jember University for funding this research activity. The researcher would like to thank the respondents in this study and the Sabrang Health Center for helping to carry out this research well. The researcher would also like to thank the enumerators, namely Elya Rahmawati, Falistya Idriani, Kharima Novia Ardana, and Nurul Khotimah. Funding for the research comes from internal funds of the University of Jember, namely from the 2024 Beginner Lecturer Research Grant Program.

REFERENCES

[1] M. R. Rooney *et al.*, "Global Prevalence of Prediabetes," *Diabetes Care*, vol. 46, no. 7, pp. 1388–1394, 2023, doi: 10.2337/dc22-2376.
[2] U. Hostalek, "Global epidemiology of prediabetes - present and future perspectives," *Clin. Diabetes Endocrinol.*, vol. 5, no. 1, pp. 1–5, 2019, doi: 10.1186/s40842-019-0080-0.
[3] U.S.Centers for Disease Control and Prevention, "Prediabetes – Your Chance to Prevent Type 2 Diabetes." [Online]. Available: https://www.cdc.gov/diabetes/prevention-type-2/prediabetes-prevent-type-2.html
[4] International Diabetes Federation, *IDF Diabetes Atlas*, 10th Editi. 2021. doi: 10.1016/j.diabres.2013.10.013.
[5] International Diabetes Federation, *Diabetes Atlas 11th Edition*. 2025.
[6] A. Pramono, D. Y. Fitranti, E. R. Rahmawati, and F. Ayustaningwarno, "Efek Pemberian Susu Kedela-Jahe Terhadap Kadar Glukosa Darah Puasa Wanita Pre-Menoupouse Prediabetes," *Asian J. Chem.*, vol. 26, no. 12, pp. 70–73, 2014.
[7] Kemenkes RI, "Laporan Nasional Riskesdas 2018," 2018.
[8] Kementrian Kesehatan RI, "Survei Kesehatan Indonesia 2023," Jakarta, 2024.
[9] I. Noventi, Rusdianingseh, and M. Khafid, "Prevalensi, Karakteristik dan Faktor Resiko Prediabetes di Wilayah Pesisir, Pegunungan dan Perkotaan," *J. ners dan kebidanan*, vol. 6, no. 3, pp. 371–381, 2019, doi: 10.26699/jnk.v6i2.ART.p.
[10] Dinkes Kab. Jember, "Profil Kesehatan Kabupaten Jember Tahun 2022," Jember, 2023.
[11] Dinas Kesehatan Kabupaten Jember, "Laporan 15 Besar Kesakitan," 2023.
[12] Dinkes Kab. Jember, "Profil Kesehatan Kabupaten Jember Tahun 2023," Jember, 2024.
[13] Dinkes Kab. Jember, "Profil Kesehatan Kabupaten Jember Tahun 2021," Jember, 2022.
[14] I. Noventi, R. Rusdianingseh, and M. Khafid, "Prevalensi, Karakteristik dan Faktor Resiko Prediabetes di Wilayah Pesisir, Pegunungan dan Perkotaan," *J. Ners dan Kebidanan (Journal Ners Midwifery)*, vol. 6, no. 3, pp. 371–381, 2019, doi: 10.26699/jnk.v6i3.art.p371-381.
[15] R. Amelia, J. Harahap, H. Wijaya, M. A. Pase, S. Suryani Widjaja, and S. Saktioto, "Prevalence, Characteristics and Risk Factors Analysis of Prediabetes: A Cross-Sectional Study," *F1000Research*, vol. 13, no. 13:843, pp. 1–21, 2024, doi: 10.12688/f1000research.150600.1.
[16] Y. Chai, Y. Liu, R. Yang, M. Kuang, J. Qiu, and Y. Zou, "Association of body mass index with risk of prediabetes in Chinese adults: A population-based cohort study," *J. Diabetes Investig.*, vol. 13, no. 7, pp. 1235–1244, 2022, doi: 10.1111/jdi.13783.
[17] S. Sovia, N. Damayantie, and N. Insani, "Determinan Faktor Prediabetes di Kota Jambi Tahun 2019," *J. Ilm. Univ. Batanghari Jambi*, vol. 20, no. 3, pp. 983–989, 2020, doi: 10.33087/jiubj.v20i3.1088.
[18] K. Muhamad Ali and R. Muhammad, "Diabetes Self Management Terhadap Hba1c Dan

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Kadar Gula Darah Pada Kelompok Prediabetes Sebelum Dan Sesudah Intervensi," *Media Penelit. dan Pengemb. Kesehat.*, vol. 34, no. 1, p. 58, 2024.

[19] H. Brink, C. Van der Walt, and G. H. Van Rensburg, *Fundamentals of research methodology for health care professionals*. South Africa: Ltd., Cape Town, 2018.

[20] D. D. Celentano, M. Szklo, and Y. Farag, *Gordis Epidemiology*. Philadelphia: Elsavier, 2023.

[21] K. M. Sullivan and M. M. Soe, "Sample Size for a Cross-Sectional , Cohort , or Clinical Trial Studies Sample Size for Cross-Sectional & Cohort Studies & Clinical Trials," 2007.

[22] T. D. Simanjuntak, C. A. Kinanthi, and A. E. Noveyani, *Manajemen dan Analisis Data Epidemiologi*. Jember: UPA Penerbitan, 2024.

[23] N. Fauziyah, *Sampling dan Besar Sampel Bidang Kesehatan Masyarakat dan Klinis*. Bandung: Politeknik kesehatan Kementerian Bandung, 2019.

[24] R. H. Friis and T. A. Sellers, *Epidemiology for Public Health Practice*, Sixth. Jones & Barlett Learning, 2020.

[25] Perkeni, *Pedoman Pemantauan Glukosa Darah Mandiri*. Jakarta: PB Perkeni, 2021.

[26] Kemenkes, *Buku Pedoman Pengendalian Hipertensi di Fasilitas Tingkat Pertama Tahun 2024*. Jakarta: Kementerian Kesehatan RI, 2023.

[27] S. Dagogo-Jack, *Prediabetes: A Fundamental Text*. United States of America: American Diabetes Association, 2022.

[28] Kementrian Kesehatan RI, "Klasifikasi Obesitas Setelah Pengukuran IMT."

[29] J. Q. Purnell, *Definitions, Classification, and Epidemiology of Obesity*. South Dartmouth (MA): MDText.com, 2023.

[30] Perhimpunan Dokter Hipertensi Indonesia (PERHI), *Konsensus Penatalaksanaan Hipertensi 2021: Update Konsensus PERHI 2019*. 2021.

[31] WHO, "Global Physical Activity Questionnaire (GPAQ) Analysis Guide," *Geneva World Heal. Organ.*, pp. 1–22, 2012.

[32] Y. P. Utomo, *Analisis Chi Square untuk Penelitian Sosial (dan Medik)*, Edisi Ke-2. Yogyakarta: Pandiva Buku, 2020.

[33] L. K. Alexander, B. Lopes, K. Ricchetti-Masterson, and K. B. Yeatts, *Second Edition of the ERIC Notebook: Cross-sectional Studies*. 2015.

[34] M. M. Kebalepile and P. M. Chakane, "Regression analysis basics: making the right choice of type of regression analysis to model clinical data.," *South. African J. Anaesth. Analg.*, vol. 29, no. 5, pp. S136–S142, 2023.

[35] S. W. Grant, G. L. Hickey, and S. J. Head, "Statistical primer: multivariable regression considerations and pitfalls†," *Eur. J. Cardio-Thoracic Surg.*, vol. 55, no. 2, pp. 179–185, Feb. 2019, doi: 10.1093/ejcts/ezy403.

[36] T. Formagini *et al.*, "Prediabetes prevalence and awareness by race, ethnicity, and educational attainment among U.S. adults," *Front. Public Heal.*, vol. 11, no. December, pp. 1–12, 2023, doi: 10.3389/fpubh.2023.1277657.

[37] W. Yu *et al.*, "Rural-urban disparities in the associations of residential greenness with diabetes and prediabetes among adults in southeastern China," *Sci. Total Environ.*, vol. 860, p. 160492, 2023, doi: https://doi.org/10.1016/j.scitotenv.2022.160492.

[38] A. Kautzky-Willer *et al.*, "Sex and gender-specific aspects in prediabetes and diabetes mellitus-clinical recommendations," *Wien. Klin. Wochenschr.*, vol. 135, no. Suppl 1, pp. 275–285, Jan. 2023, doi: 10.1007/s00508-023-02185-5.

[39] I. Budiastutik, M. I. Kartasurya, H. W. Subagio, and B. Widjanarko, "High Prevalence of Prediabetes and Associated Risk Factors in Urban Areas of Pontianak, Indonesia: A Cross-Sectional Study," *J. Obes.*, vol. 2022, no. Article ID 4851044, pp. 1–9, 2022, doi: 10.1155/2022/4851044.

[40] Rezavitawanti and Helda, "Central Obesity as A Risk Factor For Prediabetes," *Asian J. Soc. Humanit.*, vol. 2, no. 9, pp. 2068–2078, 2024, doi: 10.59888/ajosh.v2i9.347.

[41] L. Lipscombe *et al.*, "Pharmacologic Glycemic Management of Type 2 Diabetes in

https://doi.org/10.34011/jmp2k.v35i3.2826

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Adults," *Can. J. Diabetes*, vol. 42, pp. S88–S103, 2018, doi: 10.1016/j.jcjd.2017.10.034.

[42] B. Gilta, *Prediabetes Diet : A Beginner's Step by Step Guide to Reversing Prediabetes*. United States of America: mindplusfood, 2020.

[43] J. S. Neves *et al.*, "Management of dyslipidemia and atherosclerotic cardiovascular risk in prediabetes," *Diabetes Res. Clin. Pract.*, vol. 190, no. 2022, pp. 1–8, Aug. 2022, doi: 10.1016/j.diabres.2022.109980.

[44] M. H. Alijanvand, A. Aminorroaya, I. Kazemi, M. Amini, S. Aminorroaya Yamini, and M. Mansourian, "Prevalence and predictors of prediabetes and its coexistence with high blood pressure in first-degree relatives of patients with type 2 diabetes: A 9-year cohort study.," *J. Res. Med. Sci.*, vol. 25, no. 31, pp. 1–12, 2020, doi: 10.4103/jrms.JRMS_472_18.

[45] R. Okada, Y. Yasuda, K. Tsushita, K. Wakai, N. Hamajima, and S. Matsuo, "Within-visit blood pressure variability is associated with prediabetes and diabetes.," *Sci. Rep.*, vol. 5, no. 7964, pp. 1–5, Jan. 2015, doi: 10.1038/srep07964.

[46] Z. He, H. Yamana, H. Yasunaga, H. Li, and X. Wang, "Analysis of risk factors and clinical implications for diabetes in first-degree relatives in the northeastern region of China," *Front. Endocrinol. (Lausanne).*, vol. 15, pp. 1–10, 2024.

[47] J. A. Kanaley *et al.*, "Exercise/Physical Activity in Individuals with Type 2 Diabetes: A Consensus Statement from the American College of Sports Medicine.," *Med. Sci. Sports Exerc.*, vol. 54, no. 2, pp. 353–368, Feb. 2022, doi: 10.1249/MSS.0000000000002800.

[48] A. Kulkarni, M. Jain, and S. Bhalerao, "General and central obesity in adult pre-diabetics: A metabolic derangement to consider," *Natl. J. Physiol. Pharm. Pharmacol.*, vol. 14, no. 1, pp. 123–126, 2024, doi: 10.5455/njppp.2023.13.11545202321122023.

[49] S. Aeschbacher *et al.*, "Association of smoking and nicotine dependence with pre-diabetes in young and healthy adults.," *Swiss Med. Wkly.*, vol. 144, no. w14019, pp. 1–10, 2014, doi: 10.4414/smw.2014.14019.

[50] V. Durlach *et al.*, "Smoking and diabetes interplay: A comprehensive review and joint statement," *Diabetes Metab.*, vol. 48, no. 6, 2022, doi: 10.1016/j.diabet.2022.101370.

[51] C. Miller and E. Lim, "The risk of diabetes after giving birth to a macrosomic infant: data from the NHANES cohort.," *Matern. Heal. Neonatol. Perinatol.*, vol. 7, no. 1, p. 12, May 2021, doi: 10.1186/s40748-021-00132-8.

[52] H. T. Widyananda and Y. A. Romadhon, "The Effect of Residence in Coastal Areas and Industrial Area on the Occurrence of Type 2 Diabetes Mellitus," *J. La Medihealtico*, vol. 05, no. 06, pp. 1181–1188, 2024, doi: 10.37899/journallamedihealtico.v5i6.1672.

[53] C. Wulandari, M. A. F. Akbar, and R. F. Maulida, "Hubungan Kebiasaan Masyarakat Pesisir dengan Penyakit Diabetes Melitus dan Asam Urat," *J. Pengabdian, Riset, Kreat. Inovasi, dan Teknol. Tepat Guna*, vol. 1, no. 2, pp. 172–180, 2023, doi: 10.22146/parikesit.v1i2.9550.

[54] A. Nanri, A. Takazaki, T. Kochi, M. Eguchi, I. Kabe, and T. Mizoue, "Fish cooking methods and impaired glucose metabolism among japanese workers: The furukawa nutrition and health study," *Nutrients*, vol. 12, no. 6, pp. 1–11, 2020, doi: 10.3390/nu12061775.

[55] B. Liaset, J. Oyen, H. Jacques, K. Kristiansen, and L. Madsen, "Seafood intake and the development of obesity, insulin resistance and type 2 diabetes," *Nutr. Res. Rev.*, vol. 32, no. 1, pp. 146–167, 2019, doi: 10.1017/S0954422418000240.

https://doi.org/10.34011/jmp2k.v35i3.2826