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Analysis of Prediabetes Risk Factors at Primary Health Care Centers

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ABSTRACT
Background: The condition of prediabetes is still reversible whereas diabetes is irreversible. Prediabetes prevalence continues to increase rapidly worldwide. It is estimated that >470 million people will have prediabetes by 2030. The prevalence and risk factors for the cause of prediabetes in the Daerah Istimewa Yogyakarta (DIY) are not known because there was not enough research and data. Yogyakarta has a high risk of prediabetes because Yogyakarta has the highest level of sugar consumption in Indonesia (16.9%). **Objective:** This research aimed to analyze the risk factors for prediabetes and identify the most dominant risk factors for prediabetes in primary health care centers at DIY. **Methods:** This observational, analytical research used a cross-sectional study approach. The population of this research was the population in DIY. The subjects of the research were a group of individuals aged >25 years in Sleman and Bantul who met the inclusionand exclusion criteria. A sample size estimate of the study was a minimum of 312 patients. The data were analyzed by using chi square and multivariate logistic regression with significance set as $p<0.05$. **Results:** The research was conducted in two districts of Sleman and Bantul. The total number of study subjects was 346 and 67peoplewere excluded because they had diabetes. Subjects with hypertension and prediabetes were 20 people and statistically significant with the value of $p = 0.001$ (Prevalence Ratio (PR) = 3.16 95% CI: 2.85-3.46). Age was also associated with the incidence of prediabetes with $p = 0.029$. The results of the multivariate logistic regression analysis were $p>0.05$ was hypertension ($p = 0.022$, PR 4.239; 95% CI: 0.203-0.962) and central obesity ($p = 0.040$, PR 5.253; 95% CI: 0.163-0.868). **Conclusion:** Prediabetes prevalence was 11.1% in the study population. The risk factors associated with the incidence of prediabetes were age, central obesity and hypertension. The most dominant factor was central obesity.

Keywords: *prediabetes, risk factors, central obesity, diabetes, hypertension*

INTRODUCTION

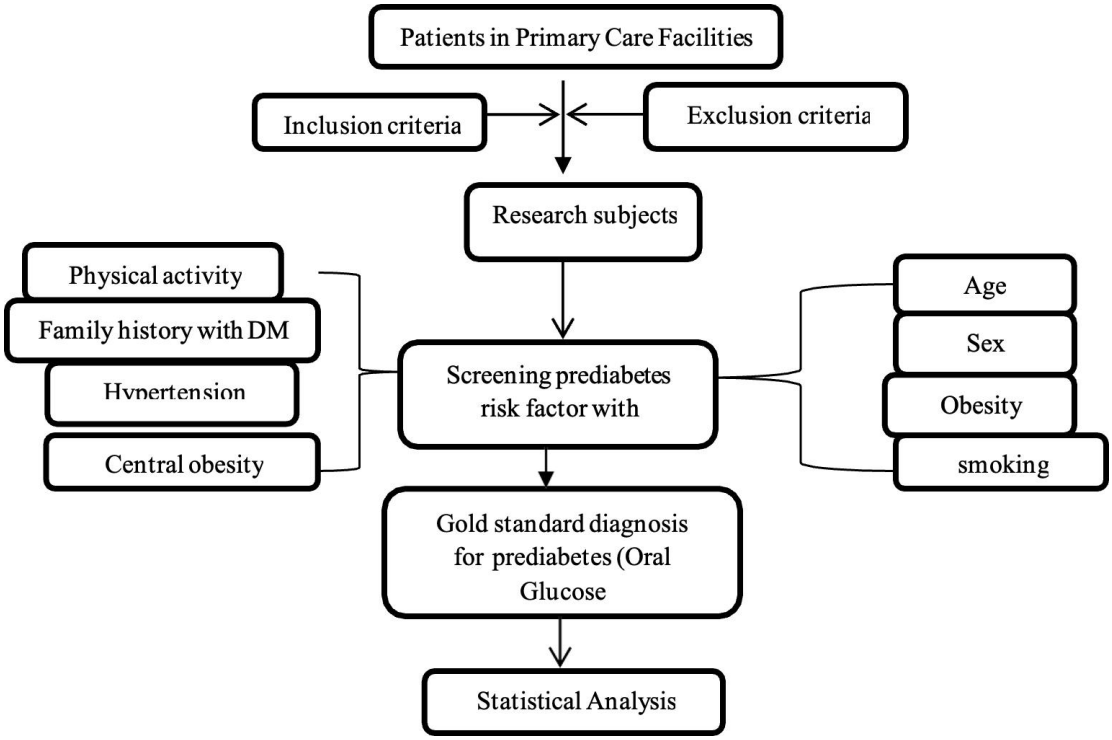
One way to prevent diabetes is to prevent the occurrence of prediabetes or glucose intolerance which will increase the risk of diabetes. Prediabetes is still a reversible condition whereas diabetes is irreversible[1]. Almost 4-9% of people with prediabetes each year will become patients with diabetes. Research of Sofitri[2] reported 5-14% per year of prediabetes would become diabetes, and it was also reported that ± 30% became diabetes mellitus (DM) after 5-6 years, while 30% became normal and 30% remained prediabetes. Prediabetes prevalence continues to increase rapidly worldwide and i t i s estimated that >470 million people will have prediabetes by 2030[3]. The results of research by Suwondo and Pramono[4] predicted that 10% of the population in Indonesia (33 provinces) already have prediabetes.

Risk factors which cause prediabetes are almost the same risk factors that cause diabetes. Based on data obtained from the European Society for Cardiology (ESC) and the European Association for the Study of Diabetes (EASD), prediabetes risk factors were associated with several conditions: old age, obesity, central obesity, lack of physical activity, lack of fruit and vegetable consumption, family history, and hypertension. Prediabetes Consensus by theAmerican College of Endocrinology (ACE) and the American Associationof Clinical Endocrinology (AACE) suggest that prediabetes risk factors include family history, coronary heart disease overweight and obesity, unhealthy lifestyles, and hypertension[5]. Behavioral factors that support the occurrence of prediabetes include high fat consumption, lack of fiber, less physical activity and smoking. High fat consumption ofmore than 30% of total calories cancause insulin resistance leading toprediabetes. Some research conducted in Depok city showed that high fat consumption (≥ 40 g/day) may increase the risk of prediabetes[6].

The prevalence and risk factors of prediabetes in Yogyakarta are not known because there is no research nor enough data yet. But Yogyakarta had high risk of prediabetes because according to Total Dietary Survey in 2014, Yogyakarta was the province with the highest level of sugar consumption in Indonesia with numbers reaching 16.9%[7]. Research about risk factors of prediabetes has been done in several countries and cities in Indonesia but the study did not specify the predominant risk factors for the cause of prediabetes. In addition, the study population has different characteristics with the population in Yogyakarta. This study aimed to analyze the risk factors and the most dominant factors for the occurrence of prediabetes in primary care in Yogyakarta.

RESEARCH METHOD

This observational research was conducted with a cross-sectional study approach. The population of this research was the population in DIY.The subjects of the research were a group of individuals aged >25 years in Sleman and Bantul who met the inclusion and exclusion criteria. A sample size estimate of the minimum respondents was 312 patients. The inclusion criteria were age >25 years, lived in Yogyakarta, communicate well with the Indonesian language. While the exclusion criteria were: diagnosed DM, pregnant, has history of routine diabetic medication. This study consists of two variables, dependent variable was prediabetes and there were some independent variables: age, gender, family history with DM, obesity, central obesity, physical activity, smoking, and hypertension. Statistical analysis was performed bychi square test for bivariate analysis and logistic regression analysis for multivariate analysis using SPSS program. This research was conducted in Puskesmas Kalasan and Puskesmas Tempel in Sleman, while in Bantul, it was in Puskesmas Kasihan I. After giving explanation about the research procedures and informed consent, there were 346 people willing to be research subjects. As many as 67 people were excluded from the study, based on the results of the history anamnesis 18 patients had a history of DM and 49 patients were diagnosed with DM from the results of fasting blood glucose and blood glucometer.



RESULTS

Table 1 shows the description of risk factors for prediabetes and its frequency and percentage consisting of sex, age, central obesity, obesity, family history of diabetes, hypertension, physical activity, and smoking status.

The results of bivariate analysis in Table 2 showed that there were three factors which were statistically related with prediabetes: age, central obesity and hypertension. Central obesity (men ≥ 90 cm and female ≥ 80 cm) was statistically significantly associated with prediabetes occurrence with (p = 0.001, PR 1.57; 95% CI: 2.14-2.56), whereas hypertension was also significant with (p= 0.001; PR 1.85, 95% CI: 2.85-3.46), and age with p = 0.006. Furthermore, other factors such as gender, obesity, family history with DM, smoking status and physical activity were not statistically significant (p> 0.05) and had no relationship to the incidence of prediabetes.

Furthermore, Table 3 shows that the three factors which were statistically significant with p < 0.05 were central obesity,hypertension, and age which were associated with the occurrence of prediabetes, and used in the multivariate logistic regression analysis. Multivariate logistic regression analysis results identified the most dominant factors or most significant with p <0.05 were central obesity with (p =

Table 1. Descriptive Table prediabetes risk factor

Characteristic	Frequency	Percentage
Sex		
Female	227	81.4 %
Male	52	18.6 %
Age		
< 40 years old	66	23.7 %
40-49 years old	61	21.9 %
50-59 years old	85	30.5 %
>=60 years old	67	24.0 %
Family history of DM		
No	191	68.5 %
Yes	88	31.5 %
Hypertension		
No	177	63.4 %
Yes	102	36.6 %
Physical activity scoring by GPAQ		
low (0-599 minutes/week)	243	87.1 %
moderate (600-2999 minutes/week)	34	12.2 %
vigorous (≥ 3000 minutes/week)	2	0.7 %
Obesity		
Yes (BMI ≥ 25 Kg/M^2)	147	52.7 %
No (BMI <25 Kg/M^2)	132	47.3 %
Central obesity		
Yes	184	65.9 %
No	95	34.1 %
Smoking		
No	242	86.7 %
Yes	37	13.3 %
Prediabetes diagnosed by OGTT		
Normal	248	88.9 %
Prediabetes	31	11.1 %

Table 2. Bivariate analysis

Risk factor		Prediabetes				*P* value	PR**	*Confidence Interval* 95%
		Yes		No				
		n	%	N	%			
Sex	Female	22	9.7	205	90.3	0.115	0.56	0.50-0.62
	Male	9	17.3	43	82.7			
Central obesity	**Yes**	**17**	**17.9**	**78**	**82.1**	**0.010***	**1.57**	**2.14-2.56**
	No	**14**	**7.6**	**170**	**92.4**			
Hypertension	**Yes**	**20**	**19.6**	**82**	**80.4**	**0.001***	**3.16**	**2.85-3.46**
	No	**11**	**6.2**	**166**	**93,8**			
Obesity (BMI ≥ 25 kg/m^2)	Yes	19	14,4	113	85,6	0.098	1.76	1.63-1.90
	No	12	8.2	135	91,8			
Family history with DM	Yes	12	13.6	76	86.4	0.362	1.37	1.29-1.45
	No	19	9.9	172	90.1			
Smoking	Yes	6	16.2	31	83.3	0.289	1.57	1.46-1.68
	No	25	10.3	217	89.7			
Physical inactivity	Yes	27	11.1	216	88.9	1.0	1.0	1.00-1.00
	No	4	11.1	32	88.9			
Age classification	**<40**	**4**	**6.1**	**62**	**93.9**	**0.029***		
	40-49	**6**	**9.8**	**55**	**90.2**			
	50-59	**7**	**8.2**	**78**	**91.8**			
	> 60	**14**	**20.9**	**53**	**79.1**			

PR: Prevalence Ratio

Table 3. Multivariate analysis

Variable	*P* value	PR	*Confidence Interval* (CI 95%)
Age	0.107	2.594	1.904 - 3.463
Hypertension	**0.022**	4.239	3.231-5.712
Central obesity	**0.040**	5.253	3.163- 6.868

0.040; PR = 5.253, 95% CI: 3.163-6.868) and hypertension with (p = 0.022; R = 4.239, 95% CI: 3.231-5.712).

DISCUSSION

Prevalence of diabetes in this study was 11.1% of 279 subjects. This result was almost the same as the results of research by Suwondo and Pramono[4] about the prevalence of prediabetes in Indonesia, which was 10%. That research was conducted in several provinces in Indonesia, namely in Aceh, Riau, Bengkulu, Riau Islands, Central Java, Banten, NTT, South Kalimantan, Central Sulawesi, Gorontalo and North Maluku.

From bivariate analysis, the results inthis study found that age has a significant relationship with the incidence of prediabetes with p = 0.029. The results of this study were also in line with the Hutabarat[8] study in their bivariate analysis with chi-square showing an association between age and prediabetes occurrence (p = 0.01;1PR = 3.720, 95% CI: 1.273-10.875). If age was classified with >60 years and <60 years then the results obtained will be more subject to those diagnosed with prediabetes under 60 years i.e. 17 subjects. This could happen because of other factors that also affect the cause of prediabetes. This process coincides with increased peripheral insulin resistance associated with obesity, low physical activity and poor diet. If this process occurs in individuals susceptible to prediabetes, it will cause hyperglycemia. The speed of development and when the occurrence is strongly influenced by the intensity of environmental exposure and lifestyle. There was a significant correlation between central obesity to prediabetes with (p = 0.010; PR 1,57, 95% CI: 2.14-2.56) and multivariate logisticregression analysis with (p = 0.040; PR = 5.253, 95% CI: 3.163-6.868). In the bivariate analysis, respondents with central obesity have 1.57-fold higher risk to develop prediabetes than respondents without central obesity. In the multivariate analysis, central obesity was also associated with the incidence of prediabetes.

Abdominal circumference ≧80 cm in women and ≧90cm in men increases the risk of prediabetes by 1.4 times compared with those who do not. Some research said the waist circumference ratio has a significant correlation with fasting blood sugar levels, which has a significant positive correlation with the incidence of DM. Similar results were obtained in a study conducted by Warren[9], that found women with abdominal circumference ≧88cm have increased risk of prediabetes (OR = 6.99; p < 0.001).

Abdominal fat accumulation has a stronger association with metabolic disorders compared with fataccumulation in the subcutaneous and whole body areas. This is because the free fatty acids released from the omentum and mesenteric enter first into the portal vein system before entering the systemic circulation. These conditions will have a major impact on glucose metabolism in the form of insulin metabolism disorders that can lead toinsulin resistance and prediabetes.

The prevalence of hypertension in this study was 36.6% and the results of the bivariate analysis showed a meaningful relationship with (p = 0.001; PR = 3.16, 95% CI: 2.85 to 3.46) and the results of logistic regression for hypertension with (p = 0.022; PR 4.239, 95% CI: 3.231-5.712). Several pathophysiological mechanisms may underlie the association between impaired glycemic control and the development of hypertension. Elevated fasting plasma glucose has been associated with arterial stiffness[10], most likely via oxidative stress and accumulation of glycation end products, and alterations in activities of vasoactive substances[11]. Furthermore, in patients with diabetes, the integrity of the vascular wall is more susceptible to damage, specifically in the presence of cardiovascular risk factor and these macrovascular changes are also evident in the prediabetic phase[12].

Most of the respondents of this study are female (22.4 (81.4%) and those diagnosed with prediabetes are 22 people (9.7%). The result of bivariate analysis showed that there was no significant correlationbetween sex with prediabetes occurrence (p = 0.115). The analysis between sex and prediabetes was less representative of the population. This can be seen from the unequal percentage of sexes in which there were more women (81.4%) while men were only 18.6%. This may cause bias due to lack of homogeneous data. The data collection of this research was mostly done during the morning and working hours when most of the men are working. Finally, people who can follow the measurements were mostly women.

In this study the association with obesity was not statistically significant with (p = 0.98; PR 1.76, 95% CI: 1.63-190). The results are in accordance withresearch which states that obesity based on Body Mass Index (BMI) does not increase the incidence of prediabetes. Similar results were also found in research conducted on subjects with overweight men aged 30-45 years which found no association between BMI with fasting blood sugar levels. BMI measurements have limitations in people with muscular physique and large bones who can have a high BMI but remain healthy, as well as in the elderly. It is known that elderly with low musclemass can have a normal BMI so that the use of BMI is less precise. Body fat distribution is more appropriate as predictors of prediabetes and diabetes than with general obesity as measured by BMI. BMI measurements cannot show the body fat distribution. Adipose of the upper body as measured by waist circumference ratio and the waist hip ratio has a closer correlation with diabetes mellitus.

Subjects with a family history ofdiabetes were 88 people (31.5%) and diagnosed with prediabetes were 12 (13.6%) but statistically, these were not significant with (p = 0.362; P R 1.37, 95% CI: 1.29- 1.45). A family history of DM disease increases the risk by 1.6-fold for prediabetes and diabetes compared with those who do not. In this study, family history was not significant because there was no valid and documented family history that could reflect past family history of disease. Many of the subjects' families are also not regularly checked blood sugar levels so that there was no previous history of diabetes.

Prevalence of physical inactivity in subjects diagnosed with prediabetes in this study was 11.1% with (p = 1.0;

PR 1.0, 95% CI: 1.00 to 1.00). This was not in line with the assertion that low levels of physical activity affect the occurrence of prediabetes anddiabetes. Exercise increases insulin sensitivity and helps to prevent obesity. Lack of physical activity in the study can increase the risk for the occurrence of prediabetes and diabetes compared with those who do exercise. In this study physical activity was measured only momentarily using questionnaires and most subjects are housewives whose activities were more at home and who do not calculate how long the physical activity was done so that the activity time data written by the subject were only presumed.

The results of bivariate analysis of the relationship between smoking with prediabetes stated that smoking was not statistically related to prediabeteswith (p = 0.289; PR 1.57, 95% CI: 1.46-1.68). Several studies examined the relationship between smoking and the incidence of glucose abnormalities and have shown that smoking is associated with glucose intolerance, fasting glucose, and type 2 DM. The results of a study conducted by Willi et al[13] showed that active smokers had a 44% higher risk of developing type 2 DM compared with nonsmokers. However, a cross -sectional study by Sakai et al[14] investigating the association between alcohol use and smoking on glucose intolerance showed that smoking was totally unrelated to glucose intolerance. Since the research method can influence the research results, to be able to determine whether smoking isa risk factor of prediabetes anddiabetes it is better to use the cohort method than cross-sectional design. Different doses and duration of smoking per subject should also be analyzed according to the group for more valid results. In this study the number of male subjects was small and not all smoking, while the analysis was also not differentiated based on the dose and duration of smoking each subject.

This is the first study conducted in two regions of Yogyakarta province (Sleman and Bantul) to observe the risk factors of prediabetes in the community. One of the main limitations of this study, is that it is not longitudinal study, so we cannot learn the causal effect of risk factors of prediabetes. Additionally, the female subjects were over-represented in this research and not representative of the general population.

CONCLUSIONS

Prediabetes prevalence was 11.1% in the study population. The risk factors associated with the incidence of prediabetes were age, central obesity and hypertension. The most dominant factor was central obesity.

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