Prevalence of Diabetes Among Suburban Population of Ternate - A Small Remote Island in The Eastern Part of Indonesia

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ABSTRACT

Aim: *to study the prevalence of diabetes in a sub-urban population of one of the less developed provinces in eastern part of Indonesia and its associated risk factors.*

Methods: *a cross-sectional survey was conducted in 2008 in adult population of TernateCityof North Moluccas Province, Indonesia, aged 20 years or more. Subjects were interviewed regarding diabetes risk factors by a standard questionnaire.Anthropometric (height, weight, waist and hip circumference) and blood pressure measurements were also taken. Diagnosis of diabetes was established by measuring overnight fasting capillary blood glucose with a glucose meter. Venous blood was also drawn for blood lipid profiling.*

Results: *495 subjects consisted of 187 (37.8%) men and 308 (62.2%) women aged 20 to 84 years (mean age 47.30±12.78)were enrolled. Prevalence of diabetes (fasting blood glucose >126 mg/dL) was 19.6%. Four independent risk factors were identified, i.e. age at 45 years or older (OR=4.1, 95% CI = 2.4-7.1), having a positive family history (OR=2.4, 95% CI = 1.5-4.0), a body mass index more than 23 kg/m^2(OR=1.8, 95% CI = 1.02 – 3.3) and triglycerides levels more than 200 mg/dL (OR=2.6, 95% CI = 1.2 – 5.6).*

Conclusion: *the prevalence of diabetes in Ternate City, a sub-urban population in the eastern part of Indonesia is high. Having a family history of diabetes and being older are major risk factors of developing the disease. Metabolic factors are identified as the potential modifiable risk factors requiring intervention in the future.*

Key words: *diabetes mellitus, prevalence, sub-urban population, risk factors.*

INTRODUCTION

The number of people with diabetes will be increasing in the future as a consequence of population aging and urbanization. Improved survival may also contribute to increasing prevalence of diabetes especially in developed countries.[1] The World Health Organization (WHO) has projected that people with diabetes mellitus (DM) in Indonesia will increase from 8.4 million in 2000 to about 21.3 million in 2030 and ranked Indonesia the fourth highest number of estimated cases.[2] Studies in Jakarta and Makassar showed increasing prevalence from less than 2% in 1980s to about 12.5% in the 2000s.[3] These high prevalence rates put diabetes as one of the potentially major public health problems in Indonesia.

For this reason, the Indonesian Diabetes Association initiates a national project intending to establish diabetes clinics nationwide. Ternate City has been attractive to start such program because North Moluccas Province ranked the second highest prevalence of diabetes based on the Basic Health Research run by the Ministry of Health, Republic of Indonesia in 2007.[4] However, the exact prevalence of diabetes in this city and its associated risk factors are largely unknown. Ternate is unique because it has 40-times larger sea than the land areas. It comprises the Ternate Island and 7 other remote islands in the North Moluccas Province, eastern Indonesia, in a very active seismic region where active volcanic activity and earthquakes are common.This beautiful city has been known as the dominant "Spice Island" in the pre-colonial era and currently has an important role as the economic hub in North Moluccas. It is inhabited by more than 179,000 people based on 2007 census with various

ethnicities and different lifestyles.[5] Traditional marriage between close relatives is still commonly practiced today which could possibly cause the diabeticinheritance. This study was aimed to know the prevalence of diabetes in Ternate City and its associated risk factors.

METHODS

Study Design and Subjects

This was a descriptive, population-based, cross-sectional study in Ternate City in May 2008. The target population was the people living in three districts, i.e. North, Central, and South Ternate. Subjects were enrolled if they were adults aged 20 years or more, who are the core family member in the house. Other adults living in the same home or household were excluded.The minimum number of subjects was calculated by using the formula of estimating a population proportion with specified relative precision. With a confidence level of 95%, an anticipated proportion (p) of 45% and relative precision(ε) of 0.1, the required minimum number of subjects was 470 people.

Data Collection

Primary data was generated during this study.Data were obtained by a team consisted of ten trained nurses as enumerators, two nurses as physical examiners and two laboratory technicians provided by the local private laboratory. A standard questionnaire has been developed specifically for this study consisting of demographic characteristics, lifestyle and eating habits. Interview was done by visiting all subjects at their home. Before interviewing, the enumerator asked consent from each subject and if they were willing to participate, they were asked to fast overnight until the blood test was done. Subjects gave their consent by signing an informed consent form.

Diagnosis of Diabetes Mellitus

Fasting blood glucose test was done by a nurse to each subject using a blood glucose meter (Accu-Chek® Advantage, Roche Diagnostics GmBH, Mannheim, Germany). Previous study in Jakarta has shown that this method showed a 100% accuracy compared to the standard method of plasma blood glucose obtained from cubital vein and Clarke's error grid analyses.[6] Diagnosis of diabetes was established if fasting blood glucose level was 126 mg/dL or more according to the 2006 Indonesian Society for Endocrinologist Consensus of Diabetes Management.[3]

Data Analyses

Demographic data and risk factors of all subjects were presented descriptively. Bivariate analyses were performed to test the association of diabetes and several risk factors using the Chi-square test. A p value below 0.05 was considered statistically significant. For multivariate analyses, variables were selected from bivariate analyses which give a p value less than 0.25. All statistical analyses were done by using the statistical software SPSS version 13 for Windows PC (SPSS Inc., Chicago, Illinois, USA).

RESULTS

A total of 502 subjects were enrolled in this study; seven of them do not have complete laboratory data and were excluded from analyses. The final total number of subjects eligible for analyses was 495 people; 308 (62.2%) of them were women. Their mean age was 47.3 $\pm$ 12.78 years, ranging from 20 to 84 years. Other characteristics were presented in **Table 1**.

Based on fasting blood glucose level, diabetes was present in 97 (19.2%) subjects. The prevalence was slightly higher in men (21.9% vs. 18.2%). The mean age of subjects with diabetes was 52.1 $\pm$ 9.96 years. The peak age group was 50-59 years (38.1%) followed by 40-49 years (29.9%) and 60-69 years (20.6%).

Bivariate analyses showed that several risk factors were significantly associated with diabetes, i.e. being at 45 years old or more, a family history of diabetes, body mass index higher than 23 kg/m^2, high total cholesterol, LDL-cholesterol and triglyceride levels **(Table 2)**. After multivariate adjustment, four variables could be identified as independent risk factors for diabetes, i.e. age 45 years or more, positive family history, body mass index more than 23 kg/m^2 and triglycerides level 200 mg/dL or more **(Table 3)**.

DISCUSSION

Population-based studies on diabetes have been done in many parts of Indonesia, but this study is the first to be held in the eastern part of the country. Many believe that the eastern part of Indonesia is not as much developed as the western part of Indonesia (mainly Java, Bali and Sumatra islands). Furthermore, people are still living their traditional ways despite lifestyle changes due to urbanization. Unfortunately, we found that the prevalence of diabetes in Ternate City is so far the highest compared to other parts of Indonesia and close

Table 1. Demographic and risk factors characteristics (n=495)

Variables	N	%
Gender		
• Men	187	37.8
• Women	308	62.2
Mean age (years): 47.3 + 12.78		
Age group (years)		
• 20-29	47	9.5
• 30-39	97	19.6
• 40-49	134	27.1
• 50-59	124	25.1
• 60-69	75	15.2
• > 70	18	3.6
Mean body weight (kg): 63.2 + 12.88		
Mean body mass index (kg/m^2): 26.13		
Mean waist circumference (cm)		
• Men: 84.7 + 11.67		
• Women: 84.5 + 11.57		
Mean hip circumference (cm)		
• Men: 94.0 + 10.20		
• Women: 97.7 + 10.5		
Mean blood pressure (mmHg)		
• Systolic: 127 + 29.3		
• Diastolic: 78 + 13.4		
Mean fasting blood glucose (mg/dL): 117.7 + 67.3		
Fasting blood glucose (mg/dL)		
• <100	288	58.2
• 100 – 125.9	110	22.2
• > 126	97	19.6
Mean cholesterol levels (mg/dL)		
• Total: 215.6 + 44.38		
• HDL-cholesterol: 44.7 + 10.08		
• LDL-cholesterol: 142.5 + 36.50		
Mean triglycerides levels (mg/dL): 114.7 + 65.97		

Table 2. Bivariate analyses of diabetes risk factors (n=495)

Risk factors	Diabetes		Odds Ratio (OR)	95% CI
	No (n=398)	Yes (n=97)		
Sex				
• Male	146 (78.1)	41 (21.9)	0.79	0.50-1.24
• Female	252 (81.8)	56 (18.2)		
Age				
• < 45 years	196 (91.2)	19 (8.8)	3.98	**2.33-6.83**
• > 45 years	202 (72.1)	78 (27.9)		
History of hypertension				
• No	324 (82.0)	71 (18.0)	1.63	0.97-2.72
• Yes	73 (73.7)	26 (26.3)		
Routine exercise				
• No	299 (80.8)	71 (19.2)	1.14	0.69-1.89
• Yes	96 (78.7)	26 (21.3)		
Family history of DM				
• No	316 (84.0)	60 (16.0)	2.38	**1.48-3.83**
• Yes	82 (68.9)	37 (31.1)		
Current smoker				
• No	298 (81.0)	70 (19.0)	1.11	0.67-1.83
• Yes	100 (79.4)	26 (20.6)		

Risk factors	Diabetes		Odds Ratio (OR)	95% CI
	No (n=398)	Yes (n=97)		
Close-relatives spouse				
• No	353 (80.2)	87 (19.8)	1.11	0.51-2.40
• Yes	33 (78.6)	9 (21.4)		
Body mass index (BMI)				
• < 23 kg/m2	116 (87.2)	17 (12.8)	1.94	**1.10-3.42**
• >23 kg/m2	281 (77.8)	80 (22.2)		
Total cholesterol				
• < 240 mg/dL	302 (83.9)	58 (16.1)	2.15	**1.34-3.44**
• > 240 mg/dL	92 (70.8)	38 (29.2)		
HDL cholesterol level				
• Low	244 (82.2)	53 (17.8)	1.32	0.84-2.07
• High	150 (77.7)	43 (22.3)		
LDL cholesterol level				
• <130 mg/dL	156 (85.2)	27 (14.8)	1.68	**1.03-2.73**
• > 130 mg/dL	238 (77.5)	69 (22.5)		
Triglycerides level				
• <200 mg/dL	372 (81.9)	82 (18.1)	2.89	**1.42-5.88**
• > 200 mg/dL	22 (61.1)	14 (38.9)		

Table 3. Multivariate analyses of risk factors for diabetes mellitus

Risk factors	OR	95% CI	p
Age > 45 years	4.10	2.36 – 7.14	<0.001
Positive family history	2.43	1.46 – 4.03	0.001
BMI >23 kg/m^2	1.84	1.02 – 3.32	0.044
Triglycerides > 200 mg/dL	2.61	1.22 – 5.59	0.014

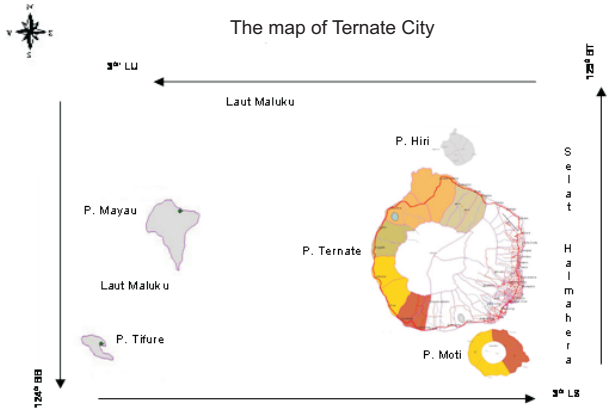

Figure 1. The map of Ternate city. Ternate city is located in the island of Ternate (P. Ternate) surrounded by deep sea water and small islands, which partly inhabited by human. It lies between 0-20 North and 126-1280 East.

to the prevalence of diabetes in urban areas in developed countries. For comparison, a recent study in suburban Beijing found that the prevalence of diabetes was 6.1%, which was higher than the general Chinese population, but lower than in the urban Beijing population[7]. Other studies among sub- or semiurban population found a prevalence rate between 2.0-10.4%.[8, 9, 10] An increasing prevalence of diabetes is also seen in urban areas in developing countries which range between 6.6-10.1%.[11, 12, 13]

Suburban areas are usually experiencing rapid industrialization and urbanization which might change individual lifestyles. Changes in lifestyle and eating habits are major contributors to metabolic syndrome and pre-diabetic state. Therefore, the high prevalence of diabetes may be not surprising. From our study, we learned that high body mass index and hyperlipidemia have significant association with the presence of diabetes in our subjects. A large, population-based epidemiology study in Jakarta found that dyslipidemia was a significant risk factor for newly diagnosed DM patients with an odds ratio (OR) of 3.02 for hypertriglyceridemia, OR 2.28 for hypercholesterolemia and OR 2.27 for low high-density lipoprotein cholesterol with the normal subjects as the reference standard.[14] Another epidemiology study in Balinese population, recently concluded that triglyceride was the most important risk factor for metabolic syndrome.[15] As a matter of fact, the prevalence of metabolic syndrome in Indonesia is high, but the most prominent feature was hypertension in men and central obesity in women.[16] Unwise eating habit and lack of exercise could contribute to this metabolic changes. However, these two risk factors failed to show direct contribution to diabetes. It may be the role of family history that differentiate which people that will eventually develop the disease.

It should be noted that our current study included adults as young as 20 years. The American Diabetic Association (ADA) has recommended diabetes screening in individuals >45 years of age, particularly in those with a BMI >25 kg/m^2.[17] In fact, our study showed that people aged 45 years or more have 4.1 times risk to develop diabetes compared to the younger ones. A recent study in Bali Island, Indonesia, also found that elderly people have higher prevalence of pre-diabetes and diabetes compared to the younger ones. The prevalence of diabetes was 21.4% in people aged 60 years or more versus 11.7% in the younger group. [18]

ADA also recommended screening in people less than 45 years old whenever diabetic risk factors are identified. Among risk factors identified by ADA they are habitually physically inactive, have a first-degree relative with diabetes, are hypertensive, have an HDL-cholesterol less than 35 mg/dL and/or a triglyceride level more than 250 mg/dL. Consistently, we identified family history and high triglyceride level as independent risk factors of diabetes.

One limitation of our study is that this is not a prospective study. Individual blood glucose levels might change and vary from time to time. However, we have minimized the potential over diagnosis by asking subjects to fast overnight before doing the test. We also noticed that the majority of our subjects were women since the data were collected at home and men most likely were not at home when the study team arrived. Globally, diabetes prevalence is similar in men and women, but it is slightly higher in men less than 60 years and in elderly women.[2] We do not know whether sex distribution has influenced the overall prevalence of diabetes in our study.

CONCLUSION

We have shown that the prevalence of diabetes in Ternate City is unexpectedly high.As North Moluccas was also considered a less-developed area, this result should raise awareness about the emergence of a potentially public health problem in suburban population. Despite having a family history of diabetes and being older as risk factors of developing the disease, metabolic factors are important as they are potentially modifiable for future intervention program.

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