Prevalence and Determinants of Diabetes Mellitus and Impaired Glucose Tolerance in Indonesia (A Part of Basic Health Research/Riskesdas)

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ABSTRACT

Aim: *to estimate the prevalence of diagnosed and undiagnosed diabetes mellitus (DM) and impaired glucose tolerance (IGT) in 15 year old and over in urban Indonesia and their association with risk factors such as age, smoking, physical inactivity, obesity, hypertension.*

Methods: *a national sample involving 24,417 participants living in urban Indonesia aged >15 years were examined for 2 hours of plasma glucose concentrations in a cross sectional survey using the 75-g oral glucose. Diagnostic criteria of the World Health Organization 1999 and American Diabetes Association (ADA) 2003 were used to determine the prevalence of abnormal glucose tolerance. Data on age, smoking, physical activity were obtained from the personal interview, and obesity included body mass index and waist circumference and blood pressure were measured.*

Results: *the prevalences of diabetes in urban Indonesia was 5.7%, consisting of diagnosed diabetes mellitus (DDM) 1.5%, undiagnosed diabetes mellitus (UDDM) 4.2% and IGT 10.2%. The prevalence of DM was 6.4% in women and 4.9% in men. In the youngest group (15-24 years) 5.3% had IGT. Prevalence increases with age with a sharp rise from middle age (35 – 54 years). Determinant factors for IGT and diabetes were age, smoking, obesity, central obesity and hypertension.*

Conclusion: *these results indicate that diabetes has become a major publich health problem in Indonesia and needs national strategies to screen, prevent and treat the disease.*

Key words: *diabetes mellitus, impaired glucose tolerance, prevalence, determinant factors, Riskesdas.*

INTRODUCTION

Diabetes mellitus (DM) is a global health problem. Recent estimate showed that there were 171 million people in the world with diabetes in the year 2000 and this is projected to increase to 366 million by 2030.[1] Environmental risk factors such as smoking, lack of physical activity and obesity are the main determinants of the disease. Diabetes and its complications can increase morbidity, mortality and decrease quality of life. The prevalence of type 2 diabetes increases by age with a sharp rise from middle age.[2,3] Diabetes is a strong risk factor for cardiovascular disease. Type 2 diabetes often remains undetected for a long time, and many patients with newly detected diabetes have complications at the time of diagnosis. Several studies have indicated that the prevalence of undetected diabetes is about 50% of all patients with diabetes, an observation that underlines the importance of detecting type 2 diabetes as early as possible.[4] Impaired glucose tolerance (IGT) as pre diabetes is related to increased body masss index (BMI), hypertension and central obesity, which are major risk factors for the future development of type 2 diabetes. Lifestyle modifications or pharmacological treatment may prevent or postpone conversion to diabetes in subjects with IGT, emphasizing the importance of identifying subjects at risk.[5,6]

Indonesia is the biggest archipelago country in Asia, located between Indian Ocean and Pacific Ocean. It consists of 206.3 million people in the year 2003 with similar proportion between men and women. International Diabetes Federation (IDF) estimated that the prevalence of DM in Indonesia will increase from 5.1% in the year 2000 to 6.3% in 2030.[7] Based on the national

household survey, prevalence of fasting hyperglycemia ≥ 110 mg% of capillary blood among ≥ 25 years old were 7.5% in Bali Java (2001) and 11.2% in Sumatera, Java Bali and Eastern Indonesia (2004). The aim of this study is to determine the prevalence of diabetes and IGT in a cross sectional survey of 15 year old and over in urban Indonesia that has not been reported yet.[8,9]

METHODS

The survey for collecting blood glucose data was conducted in 33 provinces in Indonesia among population who lived in urban Indonesia. Samples were 10% of total households of urban areas from a large survey sample of Susenas Kor (National Sosioeconomic Survey Core) 2007 urban and rural from Central Bureau of Statistics (277.630 households), but with consideration that there might be drop out, 15% total households were selected by systematic random sampling. The samples were all family members of 15 year old and over from selective households in 294 subdistrics urban area (15,536 households).

Riskesdas Kesmas (Population Health Basic Health Research) samples were the same with Susenas Kor 2007. Riskesdas Kesmas collected many data using questionnaire by interviewing subjects about sociodemographic factors, previous diseases, smoking habits, physical activities, history of diabetes and other diseases. Anthropometric data (weight, height and waist circumference) and blood pressure were measured. Height (to the nearest millimeter) was recorded in all subjects without shoes using microtoise, and body weight was measured in light clothing to the nearest 0,1 kg by digital scale. Waist circumference was measured in the middle between the last arcus costae and spina iliaca anterior superior. Blood pressure was measured using digital tensimeter in the right arm with sitting position using a cuff of appropriate size after at least 5 min of rest. There were two readings of blood pressure and three readings if a difference of more than 10% was found. The mean of two or three recordings was used.

After the interview and measurement, particularly for collecting blood glucose all family members of 15 year old and over from selective households were motivated to fast overnight (10 – 14 hours) by healthcare worker. The participants had been asked to avoid heavy physical activity and smoking during the previous day before the test. The next day participants came to the selected laboratory. All subjects except those with diagnosed diabetes were given an Oral Glucose Tolerance Test (OGTT). OGTT were given after subjects did overnight fasting about 10 - 14 hours. A 75g glucose anhidrous in 200 mL water was given in the morning to the respondents (before 11 AM) and a 2-hour postload venous plasma glucose was measured.[1] Chemical clinic automatic or spectrophotometry were used as measurement. Every morning, quality control was done before measurement (maximally 40 respondents/day). Respondent with known diabetes were examined without preceding oral glucose but given liquid food containing 300 calories.

Diagnosed diabetes (DDM) was determined by a medical doctor based on whether the subjects regularly take oral antidiabetic drugs /injection insulin or they have previously a history of DM with classic symptoms criteria of polyuria, polydipsia and polyphagia + venous plasma glucose anytime ≥ 200 mg/dL or + fasting venous plasma glucose ≥ 126 mg/dL.

Undiagnosed diabetes (new diabetes) was determined by measurement post loading venous plasma glucose ≥ 200 mg/dL.

Data were analyzed using SPSS 15 software by complex samples. Binary logistic regression was used to analyze the variable determinants.

All participants received both written and oral information before they gave their consent to take part in the survey. The protocol was approved by the Ethics Committee of the National Institute of Health Research and Development.

The World Health Organization (WHO 1999) and ADA 2003 criteria for venous blood glucose cut off values were used. Diabetes is defined as 2 hours after glucose load ≥11.1 mmol/L (≥200 mg/dL) and IGT is defined as 2 hours after glucose load measured ≥7.8mmol/L (≥140 mg/dL) and <11.1 mmol/L (<200 mg/dL).[1] Sufficient physical activity is defined as MET >600 (WHO step).

Obesity is defined as body mass indeks (BMI) (weight (kg)/height^2 (m) ≥23, normal as BMI 18,5-<23. Central obesity as waist circumference ≥80 cm in women and ≥90 cm in men. Hypertension as systolic blood pressure ≥140 mmHg and or diastolic ≥90 mmHg.

RESULTS

The overall response rate of participants for collecting blood glucose was 82% (24,417 respondents).

Prevalence of known diabetes (DDM) was 1.5% and undiagnosed diabetes mellitus (UDDM) 4.2%, so the prevalence of DM in Indonesia is 5.7%. The prevalence of IGT was 10.2% (Table 1).

Of the previously diagnosed subjects with diabetes, only 47% used diabetic medicines, 50% diet and sufficient physical activity 65%. Prevalence of DDM

Table 1. Prevalence of IGT, DDM, UDDM and Total DM in Urban Indonesia, Riskesdas 2007

	IGT	DDM*	UDDM**	Total DM***
Urban Population Indonesia	10.2%	1.5%	4.2%	5.7%

*DDM = *Diagnosed Diabetes Meliltus,*
**UDDM = *Undiagnosed Diabetes Mellitus,*
***Total DM = DDM + UDDM

those who had plasma glucose ≥140 mg/dL after two hours postload 300 calories liquid food was 75,9%.

To analyze the associations of blood glucose with demographic, habitual and biologic data only 19,791 respondents could be linked to data from Kesmas caused by lack of identification number.

Tabel 2. Prevalence of IGT and DM Based on Demographic Characteristics

Characteristics	IGT (%)	Total DM (%)
Sex		
Men	8.7	4.9
Women	11.5	6.4
Age Group (year)		
15 – 24	5.3	0.6
25 – 34	6.9	1.8
35 – 44	11.5	5.0
45 – 54	12.8	10.5
55 – 64	15.3	13.5
65 – 74	17.8	14.0
75 and over	21.7	12.5
Education level		
Has no education	13.9	8.9
Not graduated from primary school	12.3	8.0
Primary School	10.4	5.5
Junior High School	9.6	4.4
Senior High School	8.9	4.9
High education / University Graduate	9.8	5.6
Occupation		
Jobless	12.6	6.9
Student	6.5	1.0
Housewife	11.7	7.0
Employee	10.6	5.9
Private business	9.9	5.9
Farmer//Fishermen/ Labourers	6.0	2.8
Others	10.3	9.0
Household Outcome per capita per month		
Quintil-1	8.8	4.1
Quintil-2	8.9	4.0
Quintil-3	10.4	5.3
Quintil-4	10.1	5.3
Quintil-5	10.5	7.1

In table 2 we can see that IGT and DM affected more women than men, increased by age with a sharp rise in 35 – 44 years age group. The highest prevalence was in the 65 – 74 age group (14%). In the youngest group (15 – 24 years) 5.3% had IGT. Those who have no education and not graduated from primary school, jobless and house wives were the highest prevalence group in IGT and DM. Prevalence of IGT and DM was higher among high socioeconomic group.

Tabel 3 shows that the prevalence of IGT and DM was not different in those with intake ≥5 portions fruit and vegetables per day compared to <5 portions/day. Prevalence of IGT and DM tended to increase with increasing smoking and alcohol consumption. Prevalence of IGT and DM was higher among those who lack physical activity as compared to sufficient physical activity group.

Prevalence of IGT and DM gradually increased with body masss index (BMI). Prevalence of IGT and DM in central obesity was higher than in no central obesity. Prevalence of DM in people with central obesity was

Table 3. Prevalence of IGT and DM Based on Habitual and Biologic Variables in Indonesia

Variables	IGT (%)	DM (%)
Habits		
Fruit Vegetables		
• ≥ 5 portions/day	10.3	4.9
• < 5 portions/day	10.5	5.0
Smoking every day (sticks)		
• 1-12 sticks	3.3	8.3
• 13 -24	3.2	7.0
• 25- 36	10.3	6.2
• 37– 48	6.7	13.3
• ≥ 49	8.0	9.6
Alcohol (1 unit = 8 – 13 g etanol)		
• 1 – 2 units	3.8	7.9
• ≥ 3 units	7.4	9.2
Physical activity		
• sufficient	10.1	4.7
• lacking	11.2	5.7
Biologic		
BMI		
• Thin	10.3	3.7
• Normal	9.1	4.4
• Overweight	12.3	7.3
• Obesity	16.3	9.1
Obesity		
• Central	15.9	9.7
• No central obesity	9.1	4.0
Hipertension		
• Hipertension	15.1	9.0
• No Hypertension	8.4	3.4

9.7%. Hipertension was related with IGT and DM.

To know about the determinant factors for hyperglycemia, in the analysis of data, DDM was excluded because DDM might be influenced by diet, more physical activity or antidiabetes medicine.

Table 4 shows that 35 – 54 year old had 2.8 times the risk of hyperglycemia (CI 2.5 – 3.1, p 0.0001) compared to 15 – 34 year old, while 55 year old and over had 4,9 times risk (CI 4.3 – 5.4, p 0.0001) vs 15 -34 year old. Women had greater hyperglycemia risk than men with OR 1.3 x (CI 1.2 – 1.4, p 0.0001). Those with no education or not graduated from primary school had 1.6 times the risk of hyperglycemia (CI 1.4 – 1.8, p 0.0001) compared to those with primary school or more education.

Jobless persons, housewives and student had hyperglycemia risk of 1.1 times (CI 1.0 – 1.2, p 0.003) compared to employees. High economic status had hyperglycemia risk of 1.2 times (CI 1.0 – 1.4, p 0.001) compared to low economic status.

There was no significant difference of hyperglycemia among respondents who ate vegetables and fruits ≥ 5 portions/day vs < 5 portions/day, so was with alcohol 3 units vs 1- 2 units. Smoking ≥ 25 sticks/day had 1.6 times risk of hyperglycemia compared to < 25 sticks/day. (CI 1.1 – 2.3, p 0.012). Lack of activity had 1.1 times risk for hyperglycemia compared to sufficient activity (CI 1.0 – 1.3, p 0.007).

Hypertension had 2.4 times risk of hyperglycemia compared to no hypertension. (CI 2.2 – 2.6. p 0.0001). Obesity had the risk 1.9 times compared to normal (CI 1.7 – 2.1, p 0.0001). Central obesity had 2.3 times the risk of hyperglycemia (CI 2.1 – 2.5, p 0.0001) compared to no central obesity.

Tabel 4. Associations of Charasteristics, Habits and Biologic Variables with Hyperglycemia

Variables	P value	OR	95% CI
Characteristics			
Age (years)			
• 15 - 34		1	
• 35 - 54	0.0001	2.8	2.5 – 3.1
• ≥55 - 97	0.0001	4.9	4.3 - 5.4
Sex			
• Women vs men	0.0001	1.3	1.2 – 1.4
Education level			
• Graduated from primary school or more		1	
• No education, not graduated primary school	0.0001	1.6	1.4 – 1.8
Occupation			
• Employee etc		1	
• Jobless, house wife, student	0.003	1.1	1.0 – 1.2
Economic status			
• 3,4,5 vs 1,2	0.001	1.2	1.0 – 1.4
Habits			
Vegetables and Fruits			
• ≥ 5 portion/day vs < 5 portions/day	0.630	1.0	0.9 – 1.2
Smoking every day			
• ≥ 25 sticks/day vs 1- 24 sticks/day	0.012	1.6	1.1 – 2.3
Alcohol every day			
• ≥ 3 units/day vs 1 – 2 units/day	0.210	1.3	0.9 – 1.9
Activity			
• lacking vs sufficient	0.007	1.1	1.0 – 1.3
Biologic			
Hipertension			
Hipertension vs no hipertension	0.0001	2.4	2.2 – 2.6
Obesity			
• Obesity vs Normal	0.0001	1.9	1.7 – 2.1
• Central Obesity vs no central obesity	0.0001	2.3	2.1- 2.5

Table 5 shows that age ≥ 55 year increased the risk of hyperglycemia 3.1 times (CI 2.4 – 3.1, p 0.0001) compared to 15 – 34 year old, 35 – 54 year old 2.3 times (CI 1.8 – 2.9, p 0.0001). Central obesity increased the risk 1.9 times (CI 1.5 – 2.4. p 0.0001) compared to no central obesity. Hypertension had 1.6 times risk of hyperglycemia (CI 1.2 – 1.8, p 0.0001) compared to no hypertension. Heavy smoking > 25 sticks/day had risk 1.7 times (CI 1.1 – 2.6, p 0.013) compared to < 25 sticks/day. Obesity increased the risk 1.2 times (CI 1.0 – 1.5, p 0.026) compared to normal. Those who are employee had 0.7 times risk of hyperglycemia (CI 0.5 – 0.9, p 0.006) compared to jobless persons, housewives and students.

Tabel 5. Association of Risk Factors with Hyperglycemia (Multivariate)

Variabel	Significant	OR	95% CI
Age (year)			
• 55 – 97 vs 15 -34	0.0001	3.1	2.4 – 4.1
• 35 – 54 vs 15 - 34	0.0001	2.3	1.8 – 2.9
Employee vs jobless, house wife, student	0.006	0.7	0.5 – 0.9
Hipertension vs no hypertension	0.0001	1.6	1.2 – 1.8
Obesity vs Normal	0.026	1.2	1.0 – 1.5
Central Obesity vs no central Obesity	0.0001	1.9	1.5 – 2.4
Smoking every day ≥25 sticks/day vs 1 – 24 sticks/day	0.013	1.7	1.1 – 2.6

DISCUSSION

The prevalence of Diabetes was 5.7%, almost similar to the estimate by International Diabetes Federation 2003. Wild S et al estimated that Indonesia was the fourth highest numbers of people with diabetes in 2000 and 2030 after India, China and U.S.[10] If we compare to Singapore the prevalence of DM aged 18 – 69 years in 1992 was 8.1% and in Malay national survey in 1997 indicated the prevalence exceeds 8 % of the adult people. The prevalence of DM in Vietnam (Ho Chi Minh City) in 1992 was 2.5% and in Cina (19 provinces, aged 25 - 64) in 1994 was 2.5%. Singapore and Malay had more rapid economical growth than Indonesia, and it was known that high socioeconomic level group had higher prevalence of diabetes than the low one.[11] Prevalence of impaired glucose tolerance (IGT) was 10.2% and many researchers found that nearly one third of the IGT population was likely to get converted to diabetes in five years.[12]

The prevalence of UDDM (4.2%) is higher than DDM (1.5%). The health care provider should be active to screen high risk people in publich health centre. The prevalence of IGT was 10.2%. Research shows that about 30% IGT will progress to Diabetes, so the prevalence of diabetes in Indonesia will increase in the future. IGT is at high risk of progressing to cardiovascular disease.[13]

The prevalence of IGT and DM increased with age. The older have more risk for hyperglycemia, because the pancreas begins to pump insulin less effectively. Prevalence IGT In the youngest group (15 – 24 years) was 5.3%, so that it is important to give intervention to diet, exercise in order to prevent progressing to diabetes.

Prevalence of IGT and DM was not different among those with intake ≥5 portions fruit and vegetables per day compared to <5 portions/day. This may be caused only by the small number of respondents who ate ≥ 5 portions/day. Females were at greater risk for hyperglycemia than males, that might be caused by obesity in females which was higher than males.[14] Obesity had impact on resistance of insulin. Central obesity had 2.3 times the risk of hyperglycemia compared to no central obesity.

There was a relationship between hyperglycemia with age, smoking, obesity, and hypertension. Life style intervention such as more physical activity, diet, stopping smoking is effective in the prevention of type 2 diabetes in individuals with impaired glucose tolerance and to prevent complications in diabetes.

Limitation: This is a cross sectional study which does not explain about causal relationships; cohort study is needed for further study.

CONCLUSION

The prevalence of Diabetes was 5.7%, UDDM 4.2%, DDM 1.5% and IGT 10.2%. Age, central obesity, hypertension, smoking and obesity were determinant factors for IGT and DM.

Effective management of diet, stopping smoking, exercise program and education are needed in society to face the challenge of diabetes.

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