

# Prevalence and clinical profile of diabetes mellitus in productive aged urban Indonesians

Laurentia Mihardja<sup>1\*</sup>, Uken Soetrisno<sup>1</sup>, Sidartawan Soegondo<sup>2</sup>

<sup>1</sup>National Institute Health Research and Development of Indonesia, and <sup>2</sup>Department of Internal Medicine, Medical Faculty, University of Indonesia, Jakarta, Indonesia

## Keywords

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## \*Correspondence

Laurentia Mihardja  
Tel.: +62-21-8164824173  
Fax: +62-21-4244693  
E-mail address: laurentialitbang@yahoo.com

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## ABSTRACT

**Aims/Introduction:** To estimate the prevalence and clinical profile of diabetes mellitus in productive aged urban Indonesians based on the National Basic Health Research 2007.

**Materials and Methods:** The statistical analyses of a cross-sectional survey included the data of 15,332 adults, aged 18–55 years, living in an urban area. Blood glucose was measured by an automatic clinical chemistry analyzer by 2-h, 75-g post glucose load after an overnight fast. Weight, height, waist circumference and blood pressure data were measured and recorded, whereas the sociodemographic and prior illness data were collected by interviewing the participants.

**Results:** The prevalence of diabetes mellitus in productive age urban Indonesians was 4.6%, consisting of 1.1% previously diagnosed diabetes mellitus and 3.5% undiagnosed diabetes mellitus. Diabetes mellitus affected more women than men, which increased with age, was higher among the high socioeconomic group and increased with increasing body mass index. The prevalence of diabetes mellitus was higher in centrally obese people. Hypertension was highly related with diabetes mellitus occurrence. The prevalence of previously diagnosed diabetes mellitus with overweight or obese was 68.4%, with central obesity 41.7%, with hypertension 41.4% and with dyslipidemia more than 50%. The prevalence of undiagnosed diabetes respondents with overweight or obese was 68.7%, with central obesity 43.8%, with hypertension 49.4% and with dyslipidemia more than 50%.

**Conclusions:** These results show that comprehensive strategies for the prevention and control of the problem of diabetes are urgently required.

## INTRODUCTION

Diabetes mellitus is a chronic disease that through its complications can seriously impact the quality of life of individuals. The World Health Organization (WHO) is warning that the number of people with diabetes is rapidly increasing. Shaw *et al.*<sup>1</sup> estimated that the world prevalence of diabetes among adults aged 20–79 years was 6.4% (285 million) in 2010, and will increase to 7.7% (439 million) by 2030. Predictions compiled by Dr Hilary King of the WHO before 1999 showed that this figure will rise to 300 million by the year 2025, and more than 150 million will be in Asia. Diabetes is an important health problem because of its high morbidity and mortality<sup>2</sup>, Indonesia is one of 10 countries with the largest numbers of people

with diabetes<sup>1–3</sup>. The prevalence of diabetes mellitus in urban Indonesia is 5.7%, and impaired glucose tolerance 10.2%<sup>4</sup>.

The incidence of diabetes mellitus is starting to rise at a younger age<sup>5</sup>. What about diabetes mellitus in productive aged urban Indonesians? Those of the productive age group are dynamic and productive; and are expected to have be in optimal health condition, so they can work optimally in life. The “Definition of Productive Age is a range of age when people can work for paid employment optimally”. People should work during their productive age for paid employment. Indonesia has a specific range of productive age that is from 18 years-of-age until 55 years-of-age<sup>6</sup>.

The aim of the present study was to estimate the prevalence and clinical profile of diabetes mellitus in productive aged urban Indonesians based on the National Basic Health Research (RisqueDas) 2007. If the data show there are health

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problems among productive aged people, these can serve as early warning tools for all stakeholders to develop a system and management program for diabetes mellitus for younger age groups earlier.

## MATERIALS AND METHODS

The data used in the present study were obtained from the 2007 National Basic Health Research (Riskesdas) of the National Institute Health Research and Development, Ministry of Health. The cross-sectional study was carried out in 33 provinces in Indonesia among a population that lived in urban Indonesia. Samples were all family members aged 15 years and over from 10% of total households of urban areas from a large survey sample of Susenas Kor (National Socioeconomic Survei Core) 2007 urban.

Data were collected by trained local enumerators with at least a bachelor graduate degree. Data about sociodemographic factors, lifestyle and prior illness were collected by interviewing participants using questionnaires. Anthropometric data (weight, height, waist circumference) and blood pressure were measured by trained surveyors, height by microtoise, weight by digital scale, waist circumference by centimeter scale and blood pressure by using a digital tensimeter. After overnight fasting (10–14 h), all participants except those who were previously diagnosed with diabetes mellitus were given an oral glucose tolerance test (OGTT). A solution of 75-g glucose in 200 mL of water was given to the respondent, then a 2-h postload, venous plasma glucose was measured using an automatic clinical chemistry analyzer (Roche, Cobas 6000, Germany). Diagnosed diabetes respondents were examined after drinking liquid food containing 300 calories. Blood lipids were measured by chemical clinic automatic too.

The data in the present study came from 8,470 female and 6,862 male participants aged 18–55 years, who live in urban areas. All participants received both written and oral information about the purpose of the research, so they gave their consent to take part in the survey.

Data were analyzed using SPSS 15 software (SPSS, Chicago, IL, USA) for complex samples. Binary logistic regression was used to analyze the determinant variables.

## Ethics Statement

The research protocol was approved by the ethics committee of the National Institute of Health Research and Development. Written informed consent was obtained from all participants.

## Definitions

Overweight and obese were determined using the Asia-Pacific WHO criteria: underweight if body mass index (BMI) <18.5, normal if BMI 18.5–22.9, overweight if BMI 23–24.9 and obese if BMI  $\geq 25$ <sup>7</sup>.

Central obesity is waist circumference (WC)  $\geq 80$  cm in women and  $\geq 90$  cm in men. Hypertension was defined according to Joint National Committee-VII criteria or history of intake of antihypertensive medicines.

Diabetes mellitus was defined as blood glucose level  $\geq 200$  mg/dL 2 h after a glucose load. Impaired glucose tolerance was defined as a glucose level between 140–200 mg/dL 2 h after glucose load<sup>8</sup>.

Diagnosed diabetes mellitus is previously diagnosed diabetes mellitus.

## RESULTS

As shown in Table 1, the prevalence of diabetes mellitus in productive aged urban Indonesian was 4.6%, consisting of 1.1% previously diagnosed diabetes mellitus and 3.5% undiagnosed diabetes mellitus. The prevalence of impaired glucose tolerance was 9.1%. Diabetes mellitus and impaired glucose tolerance affected more females than males; females had 1.6-fold (95% confidence interval [CI] 1.4–1.7) the risk of hyperglycemia compared with males. The prevalence of diabetes mellitus and impaired glucose tolerance increased with age, which was higher among the high socioeconomic group.

**Table 1** | Prevalence of diagnosed diabetes mellitus, undiagnosed diabetes mellitus and impaired glucose tolerance based on demographic and biological variables in productive aged urban Indonesians

Variables	DDM (%)	UDDM (%)	IGT (%)	(DDM, UDDM, IGT) vs (not hyperglycemia)		
				Significant	OR	95% CI
Sex:						
Male	0.9	2.9	6.9	0.0001	1	1.4–1.7
Female	1.2	3.9	10.8		1.6	
Total	1.1	3.5	9.1			
Age (years):						
18–24	0.2	0.8	4.9	0.0001	1	1.2–1.8
25–34	0.3	1.4	6.8	0.0001	1.5	2.6–3.7
35–44	1	4	11.4	0.0001	3.1	3.9–5.7
45–55	2.9	7.5	12.7		4.7	
Per capita expenses:						
Poor	0.6	3.1	8.4	0.0001	1	1.1–1.3
Non-poor	1.3	3.6	9.4		1.2	
BMI						
Underweight	0.5	1.4	7.4	0.9	0.9	0.8–1.1
Normal	0.6	2.1	6.7	0.0001	1	1.5–1.9
Overweight	1.4	3.8	9.6	0.0001	1.7	2.3–2.9
Obesity	1.7	6.3	13.2		2.6	
Obesity						
No central obesity	0.8	2.5	7.5	0.0001	1	2.1–2.6
Central obesity	1.9	6.5	14.1		2.4	
Hypertension						
No hypertension	0.8	2.4	7.7	0.0001	1	2.0–2.4
Hypertension	1.7	6.7	12.9		2.2	

BMI, body mass index; DDM, diagnosed diabetes mellitus; IGT, impaired glucose tolerance; UDDM, undiagnosed diabetes mellitus.

The prevalence of diagnosed diabetes mellitus, undiagnosed diabetes mellitus and impaired glucose tolerance gradually increased with increasing BMI. Overweight participants had 1.7-fold (95% CI 1.5–1.9) the risk of hyperglycemia compared with normal participants, and obese participants had 2.6-fold (95% CI 2.3–2.9) the risk. The prevalence of diabetes mellitus and impaired glucose tolerance was higher in centrally obese people. Participants with central obesity had 2.4-fold (95% CI 2.1–2.6) the risk of hyperglycemia compared with participants with no central obesity. Hypertension was highly related to diabetes mellitus or impaired glucose tolerance occurrence. Hypertension had 2.2-fold (95% CI 2.0–2.4) the risk of hyperglycemia compared with no hypertension.

Table 2 shows the prevalence of diagnosed diabetes mellitus in underweight participants was 5.7%, for overweight or obese participants it was 68.4% (22.8 + 45.6%) and for participants with central obesity it was 41.7%. The prevalence of undiagnosed diabetes respondents with underweight was 4.6%, for overweight or obese participants it was 68.7% (18.2 + 50.5%) and for participants with central obesity it was 43.8%.

Table 3 shows the prevalence of hypertension in the diabetes mellitus group was higher than that of the non-diabetes

**Table 2** | Clinical Profiles of diagnosed diabetes mellitus, undiagnosed diabetes mellitus and impaired glucose tolerance with body mass index in productive aged urban Indonesians

Blood glucose Category	BMI				Central obesity (%)
	Underweight (%)	Normal (%)	Overweight (%)	Obesity (%)	
DDM	5.7	25.9	22.8	45.6	41.7
UDDM	4.6	26.7	18.2	50.5	43.8
IGT	9.0	32.5	17.9	40.6	36.5
Non DM or Non IGT	11.6	46.4	16.6	25.4	21.1

BMI, body mass index; DDM, diagnosed diabetes mellitus; DM, diabetes mellitus; IGT, impaired glucose tolerance; UDDM, undiagnosed diabetes mellitus.

**Table 3** | Clinical profiles of diagnosed diabetes mellitus, undiagnosed diabetes mellitus and impaired glucose tolerance with hypertension and stroke in productive aged urban Indonesians

Blood glucose category	Hypertension* (%)	Stroke† (%)
DDM	41.4	1.8
UDDM	49.4	0.8
IGT	36.9	0.7
Non DM or non-IGT	23.7	0.4

\*By digital measurement. †By questionnaire: Have you ever been diagnosed with stroke in the last 12 months by a medical professional? BMI, body mass index; DDM, diagnosed diabetes mellitus; DM, diabetes mellitus; IGT, impaired glucose tolerance; UDDM, undiagnosed diabetes mellitus.

mellitus group. The highest was in the undiagnosed diabetes mellitus group (49.4%), followed by the diagnosed diabetes mellitus (41.4%), impaired glucose tolerance group (36.9%) and non-diabetes mellitus group (23.7%). Stroke started to rise in the productive age groups, and was the highest in the diagnosed diabetes mellitus (1.8%), followed by the undiagnosed diabetes mellitus (0.8%) and impaired glucose tolerance (0.7%) groups.

Table 4 shows that the prevalence of dyslipidemia was more than 50% among undiagnosed diabetes mellitus and diagnosed diabetes mellitus. The prevalence of dyslipidemia among the impaired glucose tolerance and no hyperglycemia groups was lower in comparison with diabetes mellitus (diagnosed diabetes mellitus and undiagnosed diabetes mellitus). The prevalence of hypercholesterolemia was 54.8% in the diagnosed diabetes mellitus groups, 56.8% in the undiagnosed diabetes mellitus group and 48.3% in the impaired glucose tolerance group. The prevalence of low high-density lipoprotein and high small dense low-density lipoprotein was higher in the diabetes mellitus groups in comparison with the impaired glucose tolerance and non-diabetes mellitus groups.

Table 5 shows that the prevalence of tuberculosis was 1.2% among the diagnosed diabetes mellitus group and 1.7% among the undiagnosed diabetes mellitus group. Tuberculosis is higher among the diagnosed diabetes mellitus and undiagnosed diabetes mellitus groups in comparison with the impaired glucose tolerance and non-diabetes mellitus groups.

## DISCUSSION

The prevalence of previously diagnosed diabetes mellitus was 1.1% and undiagnosed diabetes mellitus was 3.5%, so the prevalence of undiagnosed diabetes mellitus was higher than diagnosed diabetes mellitus. This was difference from other countries, such as the USA and Turkey, where previously diagnosed was higher than undiagnosed diabetes mellitus<sup>9,10</sup>. The healthcare program for early detection of diabetes mellitus must be increased in Indonesia. The prevalence of diabetes mellitus might be more than what was found in the present results if we measured fasting glucose and glycated hemoglobin<sup>8,11</sup>.

The prevalence of diabetes mellitus and impaired glucose tolerance were higher among women than men. These results were different from China and Japan, where males had higher prevalences than females<sup>12,13</sup>. This could be caused by differences in food intake, activity and other behaviors.

The prevalence of diabetes mellitus and impaired glucose tolerance increased with age. Older participants had more risk for hyperglycemia, which is related to the decrease of pancreatic function because the pancreas begins to pump insulin with less effectively as we age. The prevalence of diabetes mellitus and impaired glucose tolerance was higher among the high socioeconomic group. Some studies reported that low economic groups had a higher prevalence<sup>14</sup>.

Overweight, obesity and central obesity participants had a 1.7–2.6-fold risk of hyperglycemia compared with normal

**Table 4** | Chemical blood profile of diagnosed diabetes mellitus, undiagnosed diabetes mellitus and impaired glucose tolerance in productive aged urban Indonesians

Blood glucose category	Total cholesterol $\geq$ 200 mg/dL (%)	HDL-C male $<$ 40 mg/dL, female $<$ 50 mg/dL (%)	LDL-C $\geq$ 100 mg/dL (%)	Apo B male $>$ 109 mg/dL female mg/dL (%) $>$ 101	Lp (a) $\geq$ 20 mg/dL (%)	Small dense LDL (LDL direct/ApoB) $<$ 1.2 (%)
DDM	54.8	55.9	80.8	32.6	37.2	23.2
UDDM	56.8	63.4	76.3	34.6	32.0	20.4
IGT	48.3	56.0	76.0	22.7	30.5	15.4
Non DM or Non IGT	43.0	52.1	72.8	19.1	30.5	13.3

ApoB, apolipoprotein B; BMI, body mass index; DDM, diagnosed diabetes mellitus; DM, diabetes mellitus; HDL-C, high density lipoprotein cholesterol; IGT, impaired glucose tolerance; LDL-C, low density lipoprotein cholesterol; Lp (a), lipoprotein (a); UDDM, undiagnosed diabetes mellitus.

**Table 5** | Clinical profiles of diagnosed diabetes mellitus, undiagnosed diabetes mellitus and impaired glucose tolerance with tuberculosis in productive aged urban Indonesians

Blood glucose category	Tuberculosis* (%)
DDM	1.2
UDDM	1.7
IGT	0.3
Non DM or Non IGT	0.3

\*By questionnaire: Have you ever been diagnosed with tuberculosis in the last 12 months by a medical professional? DDM, diagnosed diabetes mellitus; DM, diabetes mellitus; HDL-C, high density lipoprotein cholesterol; IGT, impaired glucose tolerance; UDDM, undiagnosed diabetes mellitus.

weight participants. Obesity had an impact on insulin resistance<sup>15</sup>. Bays *et al.*<sup>16</sup> reported that an increased BMI was associated with an increased prevalence of diabetes mellitus, hypertension and dyslipidemia. Cockram<sup>17</sup> reported that all studies consistently showed a strong relationship between obesity and type 2 diabetes.

There was a relationship between hyperglycemia and hypertension. Participants with hypertension had a 2.2-fold risk of hyperglycemia compared with participants without hypertension. Some studies reported increased hypertension with increased hyperglycemia<sup>18</sup>. The prevalence of hypertension was high in the diagnosed diabetes mellitus and undiagnosed diabetes mellitus groups. The present study showed a prevalence of hypertension of  $>$ 40% in the diabetes mellitus groups. Ferrannin *et al.*<sup>19</sup> reported that high blood pressure was present in over two-thirds of patients with type 2 diabetes, and the increase coincides with the development of hyperglycemia<sup>19</sup>.

The prevalence of underweight was lower among the diagnosed diabetes mellitus and among undiagnosed diabetes mellitus groups, but the prevalence of overweight and obese was 68.4% among diagnosed diabetes mellitus group and 68.7% among the undiagnosed diabetes mellitus group. These results are different in certain parts of India. Prabhu *et al.*<sup>20</sup> found that the majority of diabetics had normal weight (65%); 24% belonged to the overweight group and just 2.6% of diabetics

were obese. In Western countries, the majority of the diabetes mellitus cases are obese.

The prevalence of stroke was higher among the diabetes mellitus group than the non-diabetes mellitus group. Zhang and He<sup>18</sup> reported that the most common risk factors of stroke were hypertension, smoking and hypertriglyceridemia. A review from McFarlane *et al.*<sup>21</sup> showed that the modifiable risk factors for stroke include hypertension, diabetes, dyslipidemia, smoking and alcohol, highlighting the intervention to decrease stroke in diabetic and hypertensive populations<sup>21</sup>.

The prevalence of previously diagnosed diabetes and undiagnosed diabetes respondents with dyslipidemia was more than 50%. Some studies reported higher results. Harris<sup>22</sup> reported that high or borderline high total cholesterol was common in diabetes, and is present in 70% of adults with diagnosed diabetes and 77% with undiagnosed diabetes in the USA population. Of these individuals, 95% showed evidence of coronary heart disease or two or more risk factors for heart disease<sup>22</sup>. Abdel-Aal *et al.*<sup>23</sup> found over 90% of patients with diabetes mellitus type 2 had one or more types of dyslipidemia<sup>23</sup>. Patients with dyslipidemia and diabetes mellitus have increased risk of cardiovascular disease. Epidemiological studies have shown that diabetes mellitus is an independent risk factor for cardiovascular disease, and that it amplifies the effects of other common risk factors, such as smoking, hypertension and hypercholesterolemia<sup>24–26</sup>. The prevalence of low high-density lipoprotein and high small dense low-density lipoprotein was higher in diabetes mellitus group in comparison with impaired glucose tolerance and non-diabetes mellitus groups. A review from Mooradian<sup>24</sup> showed that the characteristic features of diabetic dyslipidemia are a high plasma triglyceride concentration, low high-density lipoprotein cholesterol concentration and increased concentration of small dense low-density lipoprotein-cholesterol particles<sup>24</sup>. In the present study we did not measure triglyceride, because it required fasting for 12–14 h<sup>8</sup>.

The prevalence of tuberculosis was 1.7% among the undiagnosed diabetes mellitus group and 1.2% among the diagnosed diabetes mellitus group. Diabetes mellitus is a metabolic disorder that weakens the immune system. Diabetes mellitus is a known risk factor for tuberculosis. The prevalence of tuberculosis is

higher in patients with diabetes mellitus in comparison with non-diabetes mellitus and impaired glucose tolerance. Anand *et al.*<sup>27</sup> found 14.7% of diabetes mellitus patients with tuberculosis<sup>28</sup>. In the present study, the proportion was lower because the diagnosis of tuberculosis is based on a questionnaire.

Farouq Al-Zurba *et al.*<sup>27</sup> found the working productivity of the majority of participants with diabetes mellitus in the productive age group was less than non-diabetes mellitus participants<sup>27</sup>.

From the results presented, we showed that diabetes mellitus respondents in the productive age group have many risk factors and complications. They had many risk factors; that is, obesity, hypertension, dyslipidemia, and complications such as stroke and tuberculosis. Diabetic patients require special care, and a multidisciplinary approach for treatment and prevention of complications. Besides that, comprehensive strategies for the prevention of diabetes and to control the problems of diabetes are urgently required in this community of Indonesians. It should be emphasized that the national preventive programs need to combat obesity, hypertension and dyslipidemia. Development of a sustainable and effective lifestyle program in the community are required for those of productive age, and preferably in the younger group. Education, healthy eating, physical activity programs, drug management and counseling must be promoted in the community.

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