

Analysis of Diabetes Mellitus Determinants in Indonesia: A Study from the Indonesian Basic Health Research 2013

Haerawati Idris, Hamzah Hasyim, Feranita Utama

Faculty of Public Health, Universitas Sriwijaya, Indralaya, South Sumatera, Indonesia.

Corresponding Author:

Haerawati Idris. Faculty of Public health, Universitas Sriwijaya. Jl. Raya Palembang - Prabumulih Km. 32 Indralaya, OI, Sumatera Selatan 30662, Indonesia. email: haera@fkm.unsri.ac.id.

ABSTRAK

Latar belakang: diabetes mellitus adalah penyakit silent-killer. Prevalensi dan dampaknya terhadap kenaikan biaya kesehatan meningkat dari tahun ke tahun. Penelitian ini bertujuan untuk mengetahui karakteristik dan faktor risiko yang mempengaruhi diabetes mellitus di Indonesia. **Metode:** studi ini merupakan studi potong lintang. Data diperoleh dari Riset Kesehatan Dasar (RISKESDAS) pada tahun 2013. Subyek penelitian berasal dari individu berusia ≥ 15 tahun yang diukur glukosa darah puasa dan glukosa darah 2 jam setelah puasa. 38.052 subyek diikutsertakan dalam penelitian ini. Variabel usia, jenis kelamin, status perkawinan, tingkat pendidikan, status pekerjaan, status region, daerah tempat tinggal, hipertensi, obesitas, kebiasaan merokok, dan dislipidemia dianalisis sebagai faktor risiko diabetes mellitus. Analisis bivariat menggunakan uji chi kuadrat dengan tingkat signifikansi $p < 0,05$ dan interval kepercayaan (IK) sebesar 95%. Analisis multivariat menggunakan uji regresi logistik berganda. **Hasil:** penelitian kami menunjukkan bahwa 13% individu memiliki diabetes melitus pada tahun 2013. Faktor yang mempengaruhi diabetes melitus adalah usia > 55 tahun (OR=5,10; 95% IK 4,42-5,89; $p < 0,001$), perempuan (OR=1,37; 95% IK 1,26-1,49; $p < 0,001$), pedesaan (OR=1,16; 95% IK 1,08-1,26; $p < 0,001$), menikah (OR=1,31; 95% IK 1,07-1,58; $p < 0,05$), pengangguran (OR=1,14; 96% IK 1,05-1,23; $p < 0,05$), obesitas (OR=1,46; 95% IK 1,35-1,58; $p < 0,001$), hipertensi (OR=1,68; 95% IK 1,55-1,81; $p < 0,001$) dan dislipidemia (OR=1,53; 95% IK 1,39-1,68; $p < 0,001$). **Kesimpulan:** sebanyak 13% individu memiliki diabetes melitus pada tahun 2013. Hasilnya menunjukkan bahwa usia, jenis kelamin, status status, status pekerjaan, obesitas, hipertensi, dan dislipidemia merupakan faktor penyebab yang berkontribusi terhadap terjadinya diabetes mellitus.

Kata kunci: diabetes melitus, faktor risiko, gula darah.

ABSTRACT

Background: diabetes mellitus is a silent-killer. Its prevalence and impact on health expenses increase from year to year. This study aims to investigate the characteristics and the risk factors that affect diabetes mellitus in Indonesia. **Methods:** this is a cross sectional study. Data were obtained from the Basic Health Research (RISKESDAS) in 2013. The samples were individuals aged ≥ 15 years, whose fasting blood glucose and 2 hours blood glucose after the imposition have been measured. 38.052 individuals were selected for this study. The variables of age, sex, marital status, level of education, employment status, living area, regional status, hypertension, obesity, smoking habit, and dyslipidemia are analyzed as risk factors for diabetes mellitus. Bivariate analysis was using chi-square test with significance level of $p < 0.05$ and confidence interval (CI) of 95%, and multivariate analysis using multiple logistic regression test. **Results:** our study showed that 13% have diabetes mellitus in 2013. Factors affecting diabetes mellitus were age > 55 years (OR=5.10; 95%CI 4.42 to 5.89; $p < 0.001$), female (OR=1.37; 95%CI 1.26 to 1.49; $p < 0.001$), rural (OR=1.16; 95%CI 1.08 to 1.26; $p < 0.001$), married (OR=1.31; 95%CI 1.07 to 1.58; $p < 0.05$), unemployed (OR=1.14; 96%CI 1.05 to 1.23; $p < 0.05$), obesity (OR=1.46; 95%CI 1.35 to 1.58; $p < 0.001$), hypertension (OR=1.68; 95%CI 1.55 to 1.81; $p < 0.001$) and dyslipidemia (OR=1.53; 95%CI 1.39 to 1.68; $p < 0.001$).

obesity ($OR=1.46$; $95\%CI$ 1.35 to 1.58; $p<0.001$), hypertension ($OR=1.68$; $95\%CI$ 1.55 to 1.81; $p<0.001$) and dyslipidemia ($OR=1.53$; $95\%CI$ 1.39- 1.68; $P<0.001$). **Conclusion:** as many as 13% of individuals have diabetes mellitus in 2013. Age, gender, living area, employment status, obesity, hypertension, and dyslipidemia are the contributing factors to diabetes mellitus.

Keywords: diabetes mellitus, determinant factors, blood glucose.

INTRODUCTION

Diabetes mellitus is a syndrome of impairment of the carbohydrate metabolism characterized by chronic hyperglycemia due to a defect in the insulin secretion and/or an inadequate in the hormone's function.¹ Elevated blood glucose level as the main feature of this disease is caused by failure of the pancreas in maintaining its function as the producer of insulin.²

Diabetes mellitus is classified into type-1 diabetes mellitus which is also known as insulin-dependent or childhood-onset diabetes, characterized by the lack of insulin production and type-2 diabetes mellitus which is also known as non-insulin-dependent or adult-onset diabetes, caused by the inability of the body to effectively use insulin that leads to the increase of body weight and the decrease of physical activity, while gestational diabetes is defined as hyperglycemia that is found for the first time during a pregnancy.³ Diabetes mellitus is a health problem that needs proper attention. About 5% of the total global deaths are caused by this disease.⁴ Its prevalence is 4% and projected to reach 5.4% by 2025. WHO predicts that in China and India, the number will reach 50 million.⁵ According to International Diabetes Federation (IDF) in 2011, no less than 366 million people were suffering from this disease and 80% of them lived in countries with low and moderate income. The financial burden of this disease is as high as US\$ 465 billion.⁶

Many empirical studies related to the causes of this disease have been conducted. A study by Irawan found that demography, behavioral factors, and lifestyle, as well as clinical or mental condition affect the prevalence of type-2 diabetes mellitus.⁷ In accordance with this finding, Wicaksono discovered that the factors affecting type-2 diabetes mellitus include age, physical inactivity, and family history.⁸ A study

by Trisnawati and Setyorogo showed that age, family history, physical activity, blood pressure, stress, and cholesterol levels are related to type-2 diabetes mellitus.⁹ Meanwhile, Nainggolan, et al.⁴ found that age, hypertension, body mass index, high level of LDL-cholesterol, high level of triglyceride, and history of diabetes mellitus in the family are the determinants of diabetes mellitus.

Diabetes mellitus can affect people of any age and socio-economic class. Not only does it lead to complication, diabetes mellitus also decreases quality of life and therefore, needs to be prevented and controlled. In order to tackle the disease, we need to determine the risk factors that may increase the prevalence of diabetes mellitus. The objective of this study is to determine the characteristics and the risk factors that affect diabetes mellitus in Indonesia.

METHODS

The data used in this study were taken from Basic Health Research of the Ministry of Health or *Riset Kesehatan Dasar* (Riskesdas) 2013. The type of study was quantitative with cross-sectional design. Independent variable consisted of age, sex, marital status, levels of education, employment status, living area, regional status, hypertension, obesity, smoking habit, and dyslipidemia. Meanwhile, diabetes mellitus status served as a dependent variable and was divided further into dummy variables: 1 if the respondent fulfilled the criteria of diabetes mellitus that include fasting blood glucose levels of ≥ 126 mg/dl or postprandial blood glucose levels of ≥ 200 mg/dl and 0 if fasting blood glucose was < 126 mg/dl or postprandial blood glucose levels was < 200 mg/dl.

The subjects of this study were individuals who participated as respondents in Riskesdas 2013. Biomedical data from collections of blood

samples were done to the selected responders aged >15 years old from all 33 provinces in Indonesia. Selected respondents received a load of 75 g oral glucose after fasting for 10-14 hours. For those who had been diagnosed with diabetes mellitus (as confirmed by the doctors), the load was limited to 300 calories (for medical and ethical reasons). Venous blood collections were performed 2 hours after the administration of the load. The sample size in this study was 38.052 subjects.

Data analysis was done using STATA 12. Data were analyzed descriptively and analytically. Methods of analysis include univariate/descriptive analysis, bivariate analysis using chi-square test with significance levels of $p < 0.05$ and confidence interval (CI) of 95%, and multivariate analysis using multiple logistic regression test.

RESULTS

The descriptive analysis showed the characteristics of respondents in this study. Proportion of respondents with diabetes mellitus was 13%. The 35-44 years old group of age was the most frequent (23.73%) among the age groups. There were more female respondents (57.74%) than male (42.26%). There were more married respondents (75.94%) than those who had never married (15.07%) and those who were divorced (8.98%). Levels of education was mostly low (55.80%), while the percentages of moderate and high levels of education were 39.18% and 5.02%, respectively. Most respondents were employed (58.58%), only 41.42% of them were unemployed. The majority of these respondents lived in rural areas (54.60%), only 45.40% of them lived in urban areas. Region with the highest frequency at subjects was Java-Bali (63.11%) while the lowest was found in Sumatra (18.20%). Most respondents did not smoke (72.67%) and only a very small proportion was known to have heavy smoking habit (2.69%). Most respondents suffer from hypertension (33.47%), obesity (27.64%), and severe dyslipidemia (3.43%).

Bivariate Analysis

Bivariate analysis showed the relationships between diabetes mellitus and independent

variables (**Table 1**). The proportion of diabetes mellitus increased with age. The majority of diabetic respondents were found in the 65-74 years old age group. Proportion of diabetes mellitus in females was significantly higher than in males. Divorced respondents had significantly highest proportion of diabetes mellitus, the compared those who were married and had never married. The highest proportion of diabetes mellitus was also found in low education group. Proportion of diabetes mellitus was significantly higher in those who are unemployed than in those who are employed, in those who live in rural areas than in those who live in urban areas, and in those who do not smoke than in those who smoke. The highest proportion of diabetes mellitus was found in Java-Bali region. Results from bivariate analysis showed that age, sex, marital status, levels of education, employment status, living area, regional status, hypertension, obesity, smoking habit, and dyslipidemia were all related to the prevalence of diabetes mellitus significantly (p value < 0.05).

Multivariate Analysis

Results from multivariate analysis revealing the determinant factors associated with diabetes mellitus were shown in **Table 2**. Individuals aged 35-54 years old were 3 times more at risk than those aged 15-34 years old (OR=3.03; $p < 0.001$). This likelihood increases with age. Individuals aged >55 years old were 5 times more at risk than those aged 15-34 years old (OR=5.10; $p < 0.001$). Females were 1.37 times more likely to develop this disease than males (OR=1.37; $p < 0.001$). Individuals who were married were 1.31 times more likely to develop this disease than those who have never married (OR=1.31; $p < 0.005$). Meanwhile, those who were divorced have 1.30 times higher chance to develop the disease than those who have never married (OR=1.30; $p < 0.05$). Unemployed individuals were at 1.14 times higher risk than employed ones (OR=1.14; $p \leq 0.05$). Individuals living in rural areas were 1.16 times more at risk than those living in urban areas (OR=1.16; $p < 0.05$). Individuals with hypertension were 1.68 times more likely to develop diabetes mellitus than those without hypertension (OR=1.68; $p < 0.001$). Individuals with obesity had 1.46 times higher risk

Table 1. Bivariate analysis between diabetes melitus and related factors

Variables	Diabetes mellitus				p value
	Yes		No		
	n	%	n	%	
Age group (year)					
- 15- 24	98	1.72	5,615	98.28	0.00
- 25-34	246	3.63	6,538	96.37	
- 35-44	712	7.88	8,319	92.12	
- 45-54	954	12.15	6,899	87.85	
- 55-64	814	15.47	4,449	84.53	
- 65-74	436	17.34	2,078	82.66	
- ≥75	136	15.20	759	84.80	
Sex					
- Male	1,175	7.31	14,906	92.69	0.00
- Female	2,221	10.11	19,751	89.89	
Marital status					
- have never married	143	2.49	5,592	97.51	0.00
- Married	2,758	9.54	26,141	90.46	
- Divorced	495	14.48	2,924	85.52	
Level of education					
- Low	2,279	10.73	2,279	10.73	0.00
- Moderate	984	6.60	984	6.60	
- High	133	6.96	133	6.96	
Employment status					
- Unemployed	1,488	9.44	14,274	90.56	0.00
- Employed	1,908	8.56	20,383	91.44	
Living area					
- Urban	1,471	8.51	15,806	91.49	0.01
- Rural	1,925	9.27	18,851	90.73	
Regional status					
- Sumatera	565	8.16	6,359	91.84	0.03
- Jawa-Bali	2,202	9.17	21,813	90.83	
- East region	629	8.84	6,485	91.16	
Hypertension					
- Yes	1,861	14.61	10,874	85.39	0.00
- No	1,535	6.06	23,783	93.94	
Obesity					
- Yes	1,326	12.61	9,191	87.39	0.00
- No	2,070	7.52	25,466	92.48	
Smoking habit					
- Mild	252	7.34	3,183	92.66	0.00
- Moderate	408	6.87	5,528	93.13	
- Severe	86	8.40	938	91.60	
- None	2,650	9.58	25,008	90.42	
Dyslipidemia					
- High	612	12.32	4,357	87.68	0.00
- Normal	2,784	8.41	30,300	91.59	

Table 2. Multivariate analysis among related factors

Variable	characteristics	OR	CI	p value
Age group (year)	15-34 (ref)			
	35-54	3.03	2.64- 3.46	0.000
	>55	5.10	4.42- 5.89	0.000
Sex	Male (ref)			
	Female	1.37	1.26- 1.49	0.000
Marital status	have never married (ref)			
	Married	1.31	1.07- 1.58	0.007
	Divorced	1.30	1.05- 1.65	0.021
Employment status	Employee (ref)			
	Unemployed	1.14	1.05- 1.23	0.002
Living area	Urban (ref)			
	Rural	1.16	1.08- 1.26	0.000
Hypertension	No(ref)			
	Yes	1.68	1.55- 1.811	0.000
Hypertension	No (ref)			
	Yes	1.46	1.35- 1.58	0.000
Obesity	Normal (ref)			
	High	1.53	1.39- 1.68	0.000

than those without obesity (OR=1.46; $p<0.001$). Individuals with severe dyslipidemia were 1.53 times more at risk than those with normal lipid profile (OR=1.53; $p\leq 0.001$).

DISCUSSION

The aim of this study was to describe the determinants of diabetes mellitus in Indonesia. The results show that in 2013, 13% of the population in this country had diabetes mellitus. According to previous studies, there has been an increasing trend in the prevalence of diabetes mellitus from time to time.⁹ Report from *Survey Kesehatan Rumah Tangga* (SKRT) in 2004 found that 0.4% of the population in Indonesia were suffering from this disease. Similarly, a study by Mihardja, et al.¹⁰ using data from Riskesdas 2007 found that the prevalence of diagnosed diabetes mellitus (DDM) was 5.7% in urban areas of Indonesia.

Diabetes mellitus had become a global health problem. The highest prevalence of this disease is found in developing countries, especially in Asia. Among these Asian countries, India and China have the largest number of people suffering from diabetes.¹¹ Meanwhile, in developed countries

such as the USA, more than 95% of 25 million individuals were suffering from this disease in 2010 and 79 million individuals were predicted to be in pre-diabetic state.¹²

Age is significantly related to the prevalence of diabetes mellitus. According to our bivariate analysis, the proportion of respondents with diabetes mellitus increased with age. Several researches studied the variations of age in diabetes mellitus patients among Asian population. In India, the prevalence of diabetes mellitus peaked among those age 60-69 years old, whereas in China, among 70-89 years of age.¹³ A study by Sujaya¹⁴ found that the 45-52 years old age group had the largest number of diabetic patients. The increase of diabetes mellitus prevalence with age, especially in population over 40 years of age, is due to the development of glucose intolerance. Age was found to be associated significantly with diabetes mellitus and those age 55-64 years old had the highest chance to develop the disease. The older the age, the higher the risk to develop diabetes mellitus.⁴ Our bivariate analysis shows that individuals aged 35-54 years old was more at risk than those aged 15-34 years old. This association increases with age. Individuals aged

>55 years old had more risk than those aged 15-34 years old. This finding is in line with a study conducted by Das¹⁵ that found a positive association between age and diabetes mellitus.

Both males and females have the same levels of risk of developing diabetes mellitus until early adulthood. However, after the age of 30 years old, females are more at risk than males.^{16,17} Results from bivariate analysis showed that the proportion of diabetes mellitus among females was higher than among males. These findings are in line with some studies that found that females have a higher risk of developing type-2 diabetes mellitus than males.^{18,19} This is because physically, females have higher chance of gaining greater increase of body mass index. Post-menopausal monthly cycle syndrome allows the distribution of body fat to accumulate more easily due to various hormonal processes and therefore, leads to a higher risk of type-2 diabetes mellitus in females.⁷

Marital status is related to a person's health status. Marriage protection theory states that by getting married, an individual may gain additional income that will help fund their healthcare expenses. Moreover, marriage can help reduce stress due to the love and sharing between the couples. Marriage also encourages couples to pay more attention to the health condition of each other, allowing them to have more control in their lifestyle.²⁰ This is very different to the circumstances of the divorced. Divorced individuals are prone to the negative impacts of the experience that may affect their health, i.e. depression and drug consumption.^{20,21} Results from our bivariate analysis show that the highest proportion of diabetes mellitus was found among divorced respondents, compared to those who were married and have never married. Furthermore, our multivariate analysis showed an association between marital status and the development of diabetes mellitus. Divorced individuals were more likely to develop the disease than those who had never married. Similarly, married individuals were more likely to develop the disease than those who had never married.

Levels of education is one of the factors determining a person's behavior. Education can mature a person and cultivate proper attitude.

Our bivariate analysis showed that diabetes mellitus mostly affected those with low levels of education compared to people with moderate and high levels of education. However, multivariate analysis found no significant association between levels of education and the prevalence of diabetes mellitus. This finding is in line with a study conducted by Trisnawati, et al.⁹ in which no significant association was found between levels of education and the development of diabetes mellitus.²²

Employment status is related to the development of this disease. According to our bivariate analysis, the proportion of diabetes mellitus was higher among the unemployed respondents than among the employed ones. However, according to our multivariate analysis, there was no significant association between employment status and the development of diabetes mellitus, meaning that there was no difference between those who employed with who unemployed on the prevalence of diabetes mellitus.

Environmental factors play a role in the development of diabetes mellitus, the prevalence of the disease is expected to be lower in rural areas due to the traditional lifestyle of those who live in these areas. In several countries, there are differences in the prevalence of diabetes mellitus in urban and rural areas.¹¹ The burden caused by the disease tends to be higher in urban areas than in rural areas. However, our bivariate analysis showed that the proportion of diabetic individuals was higher in rural areas than in urban areas. This contrast the results of previous studies that found greater number of diabetes cases in urban areas. A study in India showed that socio-economic differences cause great differences between the prevalence of diabetes mellitus in urban areas and in rural areas.¹⁵ This trend is also found in Philippines and Cambodia. Meanwhile, in Thailand, the prevalence of diabetes mellitus in urban areas is similar to that in rural areas. Similar to our study, in Korea, the prevalence is higher in rural areas. This study shows that the prevalence of diabetes mellitus was higher in rural areas due to migration or urbanization.¹¹ Our statistical analysis found a significant association between living area and

the development of diabetes mellitus. Those who live in rural areas had higher chance to develop diabetes mellitus than those who live in urban areas.

Based on regional status, the highest proportion of diabetes mellitus was found in Java-Bali than in Sumatera and eastern regions. Multivariate analysis shows no significant association between regional status and the prevalence of diabetes mellitus.

Obesity is one of the precipitating factors in the development of diabetes mellitus. Obesity was associated significantly with the development of diabetes mellitus. This condition was found in 80-85% of patients with type-2 diabetes. Although not everyone with obesity has diabetes, diabetes is very likely to develop after 10-20 years among obese people. In older age groups (41-64 years old), obesity plays an important role in accelerating the development of type-2 diabetes mellitus.^{18,19} Our bivariate analysis found that the proportion of respondents with diabetes mellitus was higher among those who were obese. Obesity had a positive association with diabetes mellitus. This finding is in line with a study conducted by Das.¹⁵ Our multivariate analysis showed that individuals with obesity was more likely to develop diabetes mellitus than those without obesity. This is in line with a study by Trisnawati⁹ in which obese group was more at risk of diabetes mellitus than normal BMI group. Similarly, Sujaya¹⁴ found that individuals with obesity was more likely to develop diabetes mellitus than those without obesity.

Hypertension is an important risk factor for diabetes mellitus. Chung et al²² stated that hypertension as a part of metabolic syndrome is an important risk factor in type-2 diabetes. Our bivariate analysis found that the proportion of diabetes mellitus was high among subjects with hypertension. This is in line with studies conducted by Benner, et al.¹⁸ in which hypertension accounted for the prevalence of diabetes mellitus by 20%. The prevalence of diabetes mellitus was higher among people with hypertension than among those without hypertension. Hypertension was also associated significantly with the development of diabetes mellitus. Based on our multivariate analysis, respondents with

hypertension was more likely to develop diabetes mellitus than those without hypertension. These findings are in line with a study by Trisnawati⁹ where individuals with hypertension had greater an odds ratio for diabetes mellitus than those without hypertension. Sujaya¹⁴ also found that individuals with hypertension had higher chance to develop diabetes mellitus than those without hypertension. Similarly, a previous study in America showed that type-2 diabetes is found more frequently among people with hypertension than among those with normotension.¹⁹

Smoking habit is one of the known risk factors for various diseases, including cancer, coronary heart disease, diabetes mellitus, hypertension, cataract, and more.²³ However, our bivariate analysis showed that the proportion of diabetes mellitus was higher among respondents who do not smoke. This finding is also supported by the results of our multivariate analysis that show no significant association between smoking habit and the development of diabetes mellitus, meaning that this disease can affect all individuals, both smoker or non-smoker.

Dyslipidemia was associated with the development of diabetes mellitus. People with excessive fat in their torso, especially when it is accumulated around the abdomen, is more likely to develop non-insulin-dependent diabetes mellitus. This is because fat in the abdomen seems to be easier to be processed into energy. When fat is processed into energy, fatty acid levels in blood increases insulin resistance through its action on the liver and muscles of the body.¹⁷ Bivariate analysis shows that individuals with severe dyslipidemia had higher chance of developing diabetes mellitus than those with normal lipid profile. Similarly, another study found a significant relationship between dyslipidemia and diabetes mellitus.¹⁸

CONCLUSION

The prevalence of diabetes mellitus in Indonesia tends to increase every year. As many as 13% of the population were diagnosed with diabetes mellitus in 2013. The result showed that age, gender, area status, employment status, obesity, hypertension, and dyslipidemia are the contributing factors in the development of

diabetes mellitus. Therefore, the individuals need to constantly control their blood glucose, blood pressure, and cholesterol levels, as well as exercise regularly. The government needs to design a preventive program to control the prevalence of diabetes mellitus through early prevention by considering the risk factors that may lead to the development of the disease.

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REFERENCES

1. Tjekyan S. Risiko penyakit diabetes mellitus tipe 2 di kalangan peminum kopi di kotamadya Palembang tahun 2006-2007. *Makara Seri Kesehatan*. 2007;11(2):54-60.
2. Handelsman Y, Mechanick J, Blonde L, Grunberger G, Bloomgarden Z, Bray G, Dagogo-Jack S, Davidson J, Einhorn D, Ganda O, Garber A. American association of clinical endocrinologists medical guidelines for clinical practice for developing a diabetes mellitus comprehensive care plan. *Endocrin Pract*. 2011;(7).
3. World Health Organization. Diabetes mellitus. Available online on http://www.who.int/topics/diabetes_mellitus/en/. Sited on October 3rd, 2014.
4. Nainggolan O, Kristanto Y, Edison H. Determinan diabetes mellitus analisis baseline data studi kohort penyakit tidak menular Bogor 2011. *Buletin Penelitian Sistem Kesehatan*. 2013;3(16):331-9.
5. Adnyana L, Gde Budhiarta AA. Penatalaksanaan pasien diabetes melitus di Poliklinik Rumah Sakit Sanglah Denpasar. *J Intern Med*. 2006;7(3).
6. International Diabetes Federation. Diabetes evidence demands real action from the UN summit on non-communicable disease. Available online on <http://www.idf.org/diabetes-evidence-demands-real-action-un-summit-non-communicable-disease>. Sited on October 3rd, 2014.
7. Irawan D. Prevalensi dan faktor risiko kejadian diabetes melitus tipe 2 di daerah urban Indonesia (analisa data sekunder RISKESDAS 2007). Universitas Indonesia., Fakultas Kesehatan Masyarakat. Depok (Tesis). 2010.
8. Wicaksono RP. Faktor-faktor yang berhubungan dengan kejadian diabetes melitus tipe 2 (studi kasus di poliklinik penyakit dalam rumah sakit dr. kariadi (Doctoral dissertation, Faculty of Medicine). 2011.
9. Trisnawati SK, Setyorogo S. Faktor risiko kejadian diabetes melitus tipe II di puskesmas kecamatan cengkareng Jakarta Barat Tahun 2012. *Jurnal Ilmiah Kesehatan*. 2013;5(1):6-11.
10. Mihardja L, Manz HS, Ghani L, Soegondo S. Prevalence and determinants of diabetes mellitus and impaired glucose tolerance in Indonesia (a part of basic health research/Riskesdas). *Acta Med Indones-Indones J Intern Med*. 2009;41(4):169-74.
11. Yoon KH, Lee JH, Kim JW, et al. Epidemic obesity and type 2 diabetes in Asia. *Lancet*. 2006;368(9548):1681-8.
12. Hill J, Nielsen M, Fox MH. Understanding the social factors that contribute to diabetes: a means to informing health care and social policies for the chronically ill. *Permanente J*. 2013;17(2):67.
13. Ramachandran A, Ma RC, Snehalatha C. Diabetes in Asia. *Lancet*. 2010;375(9712):408-18.
14. Sujaya IN. Pola konsumsi makanan tradisional Bali sebagai faktor risiko diabetes melitus tipe 2 di Tabanan. *Jurnal Skala Husada*. 2009;6(1):75-81.
15. Das RN. Determinants of diabetes melitus in Pima Indian mothers and Indian medical students. *Diabetes J*. 2014;7:5-13.
16. Departemen Kesehatan RI. *Pharmaceutical care untuk penyakit diabetes mellitus*. Jakarta: Departemen Kesehatan RI; 2005. p. 7.
17. Ramaiah S. *Diabetes: cara mengetahui gejala diabetes dan mendeteksinya sejak dini*. Jakarta: PT. Bhuana Ilmu Populer; 2008.
18. Bener A, Zirie M, Janahi IM, Al-Hamaq AO, Musallam M, Wareham NJ. Prevalence of diagnosed and undiagnosed diabetes mellitus and its risk factors in a population-based study of Qatar. *Diab Res Clin Pract*. 2009;84(1):99-106.
19. Darmono ST, Pemayun TG, Padmomartono FS. *Naskah lengkap diabetes melitus ditinjau dari berbagai aspek penyakit dalam*. Semarang: Badan Penerbit Universitas Diponegoro; 2007.
20. Pandey MK. Association between marital status and health: examining the role of age and gender. Munich Personal Repec Archive paper; No.15923. 2008.
21. Yamamura E. Different effects of social capital on health status among residents: Evidence from modern Japan. *J Socio-Economics*. 2011;40(5):475-9.
22. Pramono LA. *Prevalensi dan faktor-faktor prediksi diabetes melitus tidak terdiagnosa pada penduduk usia dewasa di Indonesia (Doctoral dissertation, Tesis FKMUI. Jakarta)*. 2010.
23. Rohmah M. *Hubungan merokok dengan terjadinya katarak: studi kasus pada pasien Rumah Sakit Mata Undaan tahun 2006*. Available online on <http://www.adln.lib.unair.ac.id/go.php?id=gdlhub-gdl-sl-2006-rohmahmuji>. Sited on October 3rd, 2014.