

Behavior risk factors and lipid profiles of diabetes mellitus with hypertension among adult population in Indonesia

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Abstrak

Latar belakang: Penyakit Diabetes Mellitus (DM) yang disertai dengan Hipertensi dapat meningkatkan risiko terjadinya disabilitas dan kematian premature. Data besaran masalah DM yang disertai Hipertensi masih terbatas pada data dari fasilitas kesehatan sementara data berbasis populasi merupakan informasi penting untuk memberikan gambaran besaran masalah secara nasional di masyarakat. Studi ini bertujuan untuk mendapatkan gambaran besaran masalah DM dengan disertai Hipertensi serta hubungannya dengan faktor risiko PTM lainnya berdasarkan data RISKESDAS 2013 yang mencakup 34 Provinsi di Indonesia.

Metode: Studi ini merupakan analisis data sekunder dari RISKESDAS 2013 yang mencakup 33 provinsi di Indonesia. Data dikumpulkan menggunakan kuesioner terstruktur dan pengukuran tekanan darah dan pemeriksaan darah. Jumlah sampel yang dianalisis adalah 35, 931 individu usia 18 tahun ke atas. Pemilihan sampel dengan cara "four stages stratified sampling method".

Hasil: Hasil analisis menunjukkan bahwa prevalensi DM dengan disertai Hipertensi adalah sebesar 3,0%, dengan prevalensi tertinggi sebesar 14% pada laki-laki dan 8% pada perempuan. DM dan hipertensi mempunyai hubungan yang bermakna dengan indeks merokok (OR:2,94) pada laki-laki, dengan obesitas (OR: 2,35 pada laki-laki dan 2,19 pada perempuan), dan dengan kolesterol darah (OR: 1,86 pada laki-laki dan 3,45 pada perempuan).

Kesimpulan: Beberapa faktor risiko seperti indeks masa tubuh, profil lemak, konsumsi buah dan sayuran serta merokok dapat dijadikan indikator untuk pencegahan penyakit komplikasi DM dan hipertensi, risiko disabilitas dan kematian prematur. (*Health Science Journal of Indonesia* 2016;7(2):97-106)

Kata Kunci: diabetes mellitus, hipertensi, faktor risiko perilaku

Abstract

Background: Diabetes mellitus (DM) with hypertension increases risk of disability and premature death. Data on DM with hypertension is limited to hospital based data, while population-based data is important to provide problem magnitude in the population setting. This study aimed to describe issues magnitude of diabetes mellitus with hypertension and relationship with other NCD risk factors in Indonesia based on national population based survey.

Method: This is a data analysis from a cross sectional national health survey (RISKESDAS) in 2013 that covered 33 provinces in Indonesia. Data was collected using structured questionnaire and measurement. Sample was 35,931 people aged 18+ years. Sampling method used four stages stratified sampling method.

Results: This study showed prevalence of diabetes mellitus with hypertension was 3.0%, the highest prevalence was 14% for male and 8% in female. Diabetes mellitus with hypertension had significant relationship to smoking index in male (OR:2.94), obesity in male (OR: 2.35) and female (OR: 2.19) and blood cholesterol (OR: 3.45 in female and OR:1.86 in male).

Conclusion: Health risk monitoring on body mass index, lipid profile, fruits and vegetables consumption, and smoking, will be crucial as a secondary prevention among DM and Hypertension case towards further complication, and risk of disability and premature death. (*Health Science Journal of Indonesia* 2016;7(2):97-106)

Keywords : diabetes mellitus, hypertension, behaviour risk factors

Recently, diabetes mellitus (DM) and hypertension are major public health issues in most countries. In Indonesia, results of various National Health Surveys (NHS) between 1995 and 2013 showed a three-fold increase in prevalence of hypertension among those aged 15 years and above. Similarly, the prevalence of DM in Indonesian urban population aged 15 years and above increased from 5.7% in 2007 to 6.8% in 2013. Even though the prevalence of DM was not as high as hypertension, it led to greater risk of disability, nutrition related diseases and other metabolic syndrome as well as risk of its co-morbidity such as hypertension and other cardiovascular diseases. DM and hypertension are chronic conditions that appear to be closely related.¹ They share many common risk factors such as unhealthy diet, obesity, lack of physical activity and smoking.^{2,3}

Abnormal blood glucose is clinically related to hypertension with chronic insulin resistance leading to increased blood pressure.^{2,4} Patients with DM are twice as likely to have hypertension as compared to those without diabetes mellitus.³ It is postulated that genetic, environmental and physical factors interact with each other and contribute to insulin resistance which then leads to hyperglycaemia, dyslipidaemia and hyperinsulinemia. These cause vascular dysfunction resulting in hypertension in the long run.² In addition, a systematic review has shown that hypertension and/or diabetes mellitus is more likely to lead to signs of cognitive dysfunction, widespread structural atrophy, vascular damage and functional changes.⁵ A study in China (2009) described that ocular hypertension was significantly associated with the presence of diabetes mellitus.⁶ On the other hand, a study in England (2000) showed that hypertension and antihypertensive therapy may lead to risk of type 2 DM, although it is still required more supportive evidences.^{7,8}

The presence of DM and hypertension increases the risk of morbidity and mortality significantly. A study in Botswana (2007) described that DM with hypertension increased the risk of renal failure and cardiovascular death.⁹ Mortality rates among people with hypertension and diabetes were 2.5 times higher than those without either condition.¹⁰ Adverse effects of DM and hypertension relate to health-related quality of life.¹¹

Based on the above discussion, it was quite clear subjects with both hypertension and diabetes form an important group of population who were at increased

risk of disability and mortality and should be a priority for health system to prevent, identify and initiate treatment. Studies in Indonesia were not focused on this sub-group and very limited information on DM with hypertension and its association with behavior risk factors and lipid profile.

This study aimed to describe the epidemiology of DM and hypertension in Indonesian population. Particularly, it would describe the prevalence of DM with hypertension in Indonesia and its association with social demographic, behaviour and biochemical determinants.

METHODS

This study utilized data from the Indonesia NHS (National Health Survey) 2013 or in local term it is called RISKESDAS. This analysis consisted of 35,931 people (20,874 female and 15,057 male) aged 18 years and above. The Indonesia NHS used a four stage stratified sampling method. The first strata utilized systematic sampling of group of census blocks, the second strata used a Proportional to Enrolment Size design to identify two census blocks followed by systematic sampling of 25 census buildings, and finally random sampling was done to choose one household within the census buildings. All individuals above 18 years were included in the study.

Collected variables included social and demography data (sex, education background, occupation, residential areas, economic quintile), behaviour health risks (smoking, fruits and vegetables consumption), physical health risk (blood pressure and body mass index), biomedical risk factors (blood glucose, lipid profile). Data of behaviour risk factors were collected by face to face interview using structured questionnaire. Smoking index was calculated using Brinkman Index (number of cigarette per day and number of years smoking). Body mass index was measured by digital body scale and height measurement by aluminium height measurement tool. Obesity was defined as having BMI ≥ 25 kg/m² (WHO, 2004).

Blood pressure was measured by digital tool (Omron IA1). The blood pressure measurement was performed by trained health workers twice or three times for each respondents under the normal condition (sitting position after 10 minutes of rest, no smoking, coffee/tea consumption, exercise and stress at least

30 minutes before measurement). The range time between measurements was five minutes and the third measurement was done only if the differences between first and second measurement was 10 mmHg or higher. Two or three repeated readings were taken on the same arm and the mean of the two or three measures was used for the analysis. Hypertension was categorized by having systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or if they were taking medical treatment. Hypertension criteria was based on the Seven report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure.

Fasting blood tests for glucose and lipid were conducted in local government laboratory clinic. The measurement used venous blood with two hours postprandial method. Anhydrite Glucose load of 75 mg in 250 ml water for respondent with no diabetes history or 300 calorie liquid food (diabetasol) for those who had DM (fasting blood glucose ≥ 126 mg/dl) was given to respondents after the fasting venous blood was taken. Respondents were not allowed to do vigorous physical activity, smoking, eating or drinking (except plain water) during the two hours after the fasting blood was taken and finger capillary glucose blood test was performed after the two hours after glucose load. Blood glucose was measured by glucometer Accu-Check Performa. Diabetes was diagnosed if 2 hours post glucose load levels of blood glucose were 200 mg/dl or higher.¹²

Fasting lipid profile (cholesterol, HDL, LDL, Triglyceride) was measured by obtaining blood serum and used automatic device (Roche® COBAS 6000 c501 Analyzer) with enzymatic process (Jaffé-picric acid). Lipid profile reading was based on *National Cholesterol Education Program Adult Treatment Panel III* (NCEP ATP III) which used cut off for abnormal blood cholesterol level was ≥ 200 mg/dl. Cut off for other lipid profile were < 40 for HDL, ≥ 130 for LDL and ≥ 150 for Triglyceride.

All the measurement tools had been validated and calibrated prior to the data collection. The validation was conducted in term of sensitivity and specificity. The survey was conducted by National Institute of Health Research and Development and approved by a national ethical committee in Indonesia. Written consent was taken from respondents.

Point estimates of the prevalence by sex had been calculated and 95% confidence intervals were

used based on cluster sample analysis using SPSS package. A cross tabulation was used to describe the behaviour risk factors, anthropometry, biological and biochemical risk factors (fruits and vegetable consumption, smoking, obesity, hyperglycaemia, hypertension, hyperlipidaemia). Multivariate analysis was done to calculate Odds-ratio (with 95% CI) for the determinants with diabetes with hypertension as the outcome variable.

RESULTS

Results from this study describes relationship between behaviour risk factors (smoking; fruits and vegetable consumption), physical risk (body mass index), lipid profile and Diabetes (DM) with hypertension as well as DM and hypertension in single condition. From table 1, national prevalence of hypertension in the population was 25.8% (95% CI 25.6-26.0) and of DM was 6% (95% CI 5.6-6.4) among population above 18 years in Indonesia. The prevalence of DM with hypertension was 3.0% (95%CI 2.7-3.3) in which the prevalence is significantly higher among female (3.7%, 95%CI 3.4-4.1) than males (2.0%, 95% CI 1.7-2.3). The prevalence of DM and hypertension increased with age. Female had significantly higher prevalence of diabetes with hypertension than male. There were no major rural/urban or economic differentials in its prevalence.

Overall, the distribution of the prevalence of DM with hypertension across the 33 districts was different between male and female, whereas male had higher prevalence than female in general. The highest prevalence reached 14.3% in male (in Province of Sulawesi Tenggara) and was 8.3% in female (in Province of Bangka Belitung) and the lowest was in Province of Papua Barat (both male and female)

Among the male population, relationship of behaviour related determinants (body mass index and smoking index) shows significant differences (Table 2). Those with BMI ≥ 25 kg/m² (OR= 2.354) and smoking ≥ 200 cigarette sticks during lifetime (OR = 2.94) were related to higher risk of DM with hypertension (Table 2). The prevalence of DM with hypertension was 3.6% (CI 2.9%-4.5%) in BMI ≥ 25 kg/m² compare to lower BMI (1.6%, CI 1.3-1.9). Similarly, the prevalence of DM with hypertension was higher among those who were heavy smokers

(Brinkman Index ≥ 200 stick in life years) than light smokers, which was 2.5%, CI 2.0%-3.2% vs 0.9%, CI 0.6%-1.2% in male. Fruit and Vegetable intake was associated with presence of DM with hypertension and DM alone, but no association with the hypertension. In fact, the prevalence of hypertension was most likely higher among those with higher consumption of fruits and vegetable. It can be assumed that adequate fruit and vegetable may not necessary lead to lower blood pressure without controlling other high natrium source of food.

This study shows that prevalence of DM with hypertension in male was significantly higher

among those who had blood cholesterol ≥ 200 mgdL in comparison to lower blood cholesterol (3.0% vs 1.6%; OR=1.86) and among those who had LDL ≥ 130 in comparison to lower LDL (2.6% vs. 1.6%; OR=1.61). Other lipid profile (HDL and triglyceride) did not showed significant contribution to higher DM with hypertension prevalence among male population (Table 2). The relationship pattern is more likely similar with the single condition of hypertension and DM. Prevalence of DM with hypertension was higher among those with higher triglyceride, although the relationship was weak (2.4% vs. 1.8%; OR=1.29).

Table 1. Prevalence of Diabetes Mellitus with Hypertension by population characteristics, RISKESDAS 2013

Population characteristic		n	DM with hypertension (95% CI)	N	DM (95% CI)	n	Hypertension (95% CI)
Age group	18-24 years	3,586	0.01% (0.01% - 0.2%)	3,604	1.0% (0.7%-1.5%)	91,903	8.7% (8.3%-9.0%)
	25-34 years	6,762	0.7% (0.5%-1.0%)	6,781	2.3% (1.9%-2.8%)	141,991	14.7% (14.3%-15.0%)
	35-44 years	9,014	2.2% (1.9% - 2.6%)	9,042	5.3% (4.7%- 6.0%)	159,821	24.8% (24.4%-25.2%)
	45-54 years	7,839	4.3% (3.8% - 4.9%)	7,857	8.9% (8.1 - 9.8%)	130,295	35.6% (35.1%-36.0%)
	55-64 years	5,263	7.0% (6.1% - 8.1%)	5,280	12.0% (10.8%-13.3%)	81,376	45.9% (45.4%-46.5%)
	65-74 years	2,533	8.8% (7.4% - 10.3%)	2,542	12.3% (10.6%-14.1%)	38,976	57.6% (56.8%-58.3%)
	75+ years	934	7.9% (6.0% - 10.2%)	939	12.5% (10.0%-15.6%)	17,005	63.8% (62.8%-64.9%)
Sex	Male	15,057	2.0% (1.7% - 2.3%)	15,104	4.3% (3.9%-4.8%)	316,617	22.8% (22.5%-23.0%)
	Female	20,874	3.7% (3.4%-4.1%)	20,941	7.2% (6.7% - 7.8%)	344,750	28.8% (28.5%-29.1%)
Residential areas	Urban	16,253	2.9% (2.6%- 3.3%)	16,322	5.5% (5.0% - 6.1%)	305,156	26.1% (25.7%-26.6%)
	Rural	19,678	3.1% (2.7% - 3.5%)	19,723	6.5% (5.8% - 7.2%)	356,211	25.5% (25.2%-25.8%)
Economic status	Quintile 1	5,784	2.6% (2.1% - 3.1%)	5,795	5.7% (4.9%- 6.7%)	121,635	25.5 % (25.0%-26.0%)
	Quintile 2	7,605	3.0% (2.5% - 3.5%)	7,621	5.5% (4.8%-6.4%)	127,956	27.2% (26.8%-27.6%)
	Quintile 3	8,424	2.8% (2.3%- 3.2%)	8,453	5.7% (5.1%-6.4%)	134,570	25.9% (25.5% - 26.4%)
	Quintile 4	8,022	3.3% (2.8% - 3.8%)	8,053	6.5% (5.7%-7.3%)	138,624	25.1% (24.7% -25.6%)
	Quintile 5	6,096	3.3 % (2.8%-3.9%)	6,123	6.5% (5.6% - 7.5%)	138,582	25.4% (24.9% - 25.9%)
Total		35,931	3.0% (2.7% - 3.3%)	36,045	6.0% (5.6% - 6.4%)	661,367	25.8% (25.6%-26.0%)

Table 2. Prevalence of Diabetes Mellitus and Hypertension by health risks among **Male** population aged 18+ years in Indonesia

Health Risks		DM with hypertension					Hypertension					DM				
		OR	%	95%CI		N	OR	%	95%CI		N	OR	%	95%CI		N
				Lower	Upper				Lower	Upper				Lower	Upper	
Behaviour																
Smoking indeks	IB >=200	2.939*	2.5%	2.0%	3.2%	4,861	2.002*	29.9%	29.4%	30.4%	95,913	2.463*	5.1%	4.3%	6.1%	4,868
	IB < 200	ref	0.9%	0.6%	1.2%	3,659	reff	17.6%	17.1%	18.0%	73,992	reff	1.1%	.9%	1.4%	3,666
Fruits and vegetables consumption	< 5 porsi sehari	1.258*	2.2%	1.9%	2.6%	9,539	.827	24.8%	24.5%	25.1%	204,347	1.312*	4.90%	4.40%	5.30%	9,570
	>= 5 porsi sehari	ref	1.8%	0.7%	4.3%	377	reff	28.5%	26.9%	30.2%	7,002	reff	3.80%	2.20%	6.30%	379
Physical profile																
Obesity	BMI >= 25 kg/m2	2.354*	3.6%	2.9%	4.5%	2,845	2.566*	42.90%	42.00%	43.90%	63,266	2.138*	7.9%	6.4%	9.7%	2,850
	BMI < 25 kg/m2	ref	1.6%	1.3%	1.9%	12,115	reff	22.70%	22.40%	23.00%	251,212	reff	3.9%	3.4%	4.4%	12,133
Lipid profile																
Blood cholesterol	>=200	1.862*	3.0%	2.4%	3.6%	4297	1.767*	34.9%	33.0%	36.9%	4,338	1.971*	6.6%	5.8%	7.6%	4,314
	< 200		1.6%	1.3%	1.9%	9799		23.3%	22.1%	24.5%	9,885		3.5%	3.0%	4.0%	9,823
HDL	<40	1.037	2.0%	1.6%	2.5%	4726	1.098	27.7%	26.1%	29.5%	4,764	1.157	4.7%	4.1%	5.5%	4,736
	>= 40		2.0%	1.6%	2.3%	9370		25.9%	24.7%	27.2%	9,459		4.1%	3.6%	4.7%	9,401
LDL	>=130	1.616*	2.6%	2.1%	3.2%	5478	1.606*	32.6%	30.8%	34.4%	5,519	1.723*	5.9%	5.1%	6.7%	5,494
	< 130		1.6%	1.3%	2.0%	8618		23.1%	21.9%	24.4%	8,704		3.5%	3.0%	4.1%	8,643
Triglyceride	>=150	1.296	2.4%	1.9%	2.9%	4168	1.646*	33.7%	31.8%	35.5%	2,363	1.440*	5.5%	4.7%	6.4%	4,178
	< 150		1.8%	1.5%	2.2%	9928		23.6%	22.4%	24.8%	3,965		3.9%	3.4%	4.4%	9,959

Note: *) significant relationship based on 95% CI does not overlap between the two groups within each health risk.

Table 3. Prevalence of Diabetes Mellitus and Hypertension by health risks among **Female** population aged 18+ years in Indonesia

Health Risks		DM with hypertension					Hypertension					DM				
		OR	%	95%CI		N	OR	%	95%CI		N	OR	%	95%CI		N
				Lower	Upper				Lower	Upper				Lower	Upper	
Behaviour																
Smoking indeks	IB >=200	1.009	4.1%	1.6%	10.3%	121	1.475*	43.6%	40.1%	47.1%	1,933	1.242*	7.4%	3.7%	14.2%	121
	IB < 200	Ref	1.6%	1.9%	8.7%	233	reff	34.3%	31.8%	37.0%	3,259	reff	6.1%	3.3%	11.0%	234
Fruits and vegetables consumption	< 5 porsi sehari	0.896 (0.6 – 1.4)	3.8%	3.4%	4.3%	13,837	.973	31.5%	31.1%	31.8%	229,372	.870	7.4%	6.8%	8.0%	13,884
	>= 5 porsi sehari	ref	4.2%	2.8%	6.5%	543	reff	32.0%	30.5%	33.6%	8,291	reff	8.4%	5.9%	11.9%	544
Physical																
Obesity	BMI >= 25 kg/m2	2.190*	5.7%	5.0%	6.4%	7,486	2.404*	47.9%	47.3%	48.6%	112,826	1.559*	9.8%	8.7%	11.1%	7,509
	BMI< 25 kg/m2	Ref	2.7%	2.3%	3.0%	13,263	reff	27.7%	27.4%	28.0%	228,959	reff	6.5%	6.0%	7.1%	13,288
Lipid Profile																
Blood cholesterol	>=200	3.452*	6.8%	6.0%	6.0%	7697	2.072*	44.8%	43.3%	46.4%	7,758	2.332*	11.3%	10.3%	12.3%	7,724
	< 200		2.1%	1.8%	2.4%	11633		28.2%	27.0%	29.4%	11,708		5.2%	4.6%	5.8%	11,664
HDL	<40	1.377	4.9%	4.0%	5.9%	2937	0.984	33.9%	31.5%	36.4%	2,956	1.409*	9.6%	8.3%	11.1%	2,944
	>= 40		3.6%	3.2%	4.0%	16393		34.3%	33.2%	35.4%	16,510		7.0%	6.4%	7.6%	16,444
LDL	>=130	3.291*	6.3%	5.6%	7.0%	8734	2.076*	43.9%	42.4%	45.4%	8,793	2.329*	10.8%	9.9%	11.8%	8,763
	< 130		2.0%	1.7%	2.3%	10596		27.4%	26.2%	28.6%	10,673		5.0%	4.4%	5.6%	10,625
Triglyceride	>=150	2.896*	7.6%	6.6%	8.8%	4195	1.768*	44.8%	42.7%	47.0%	4,201	2.203*	12.5%	11.2%	13.9%	4,212
	< 150		2.8%	2.4%	3.1%	15135		31.5%	30.4%	32.6%	10,022		6.1%	5.5%	6.7%	15,176

Note: *) significant relationship based on 95% CI does not overlap between the two groups within each health risk.

Meanwhile among the female population, the DM with hypertension prevalence showed different pattern. No significant difference between female who smoke less and heavy smokers, neither between low and adequate fruit and vegetable consumption (Table 3). Prevalence of DM with hypertension was 5.7% (CI 5.0%-6.4%) vs 2.7% (CI 2.3%-3.0%) in female who had obesity and 4.1%, CI:1.6%-10.3% vs 1.6%, CI: 1.9%-8.7% in female who had smoking index ≥ 200 . The prevalence was higher but not significant among female who has higher smoking index and fruits and vegetable consumption. However, the prevalence was significantly higher among female who were heavy smokers in single condition of hypertension (OR= 1.48) or DM (OR= 1.24) compared to female with lower smoking index. Relationship between obesity (BMI ≥ 25 kg/m²) and DM with hypertension, hypertension and DM was strong (OR= 2.19 for DM with hypertension, 2.40 for hypertension, 1.56 for DM). The prevalence of DM with hypertension was significantly higher among female with obesity, as well as the prevalence of hypertension and DM in single condition.

The relationship between lipid profile and DM with hypertension was most likely strong among female, whereas the prevalence was higher among female who had higher lipid profile (6.8% vs 2.1% for blood cholesterol; 4.9% vs 3.6% for HDL; 6.3% vs 2.0% for LDL and 7.6% vs 2.8% for triglyceride). Similar pattern was shown for the relationship between lipid profile and hypertension. The prevalence of hypertension among females was significantly higher in female with high blood cholesterol, LDL, and triglyceride. Specifically for DM, the DM prevalence was significantly higher among female who have high in all the lipid profile (Cholesterol, HDL, LDL and triglyceride).

DISCUSSION

The prevalence of DM with hypertension in Indonesia tended to increase by age and among female. Most of NCD is most likely having linear positive relationship with aging due to metabolic pathway or biologic change during aging, which can be positively or negatively modified by life style risk factors such as diet, smoking, physical activity and alcohol consumption. These risk factors have been known to be related to socio demographic condition such as income and education background

as well as cultural aspects. In other Asian countries, such as in Thailand, the prevalence of DM with hypertension in 2008 was higher (8.1% in males and 10.3% in females)¹³ than in Indonesia during 2013. The prevalence in Indonesia was not much different between urban and rural population. This pattern was also seen in DM or hypertension alone.

More than half of DM cases in Indonesia were also having hypertension (50.8% in male and 56.5% in female). A study in Botswana in 2007 showed that about 67% of DM patients suffered hypertension.⁹ The study was done in 401 subjects and used a cross sectional design. The subject of the study was all of the DM patients who follow diabetic care in Gaborone City Council fourteen clinics.⁹

Female tended to have greater prevalence of DM with hypertension and also stronger relationship with behavior risk factors compared to male. These could be related to the general lifestyle differences between the genders which may be compounded by other special metabolic susceptibilities, like due to hormonal influences.

There were major geographical differences in the prevalence of DM with hypertension. It can be assumed that these differences were related to cultural factors which influence life style such as dietary habit. Indonesia has more than hundred of different ethnicities and food cultures across provinces. Sulawesi Tenggara is one of the provinces with good resources of seafood including salted fish which is commonly consumed in daily basis.

Similar pattern of relationship has been reported from other countries such as in Africa and Taiwan.⁹ The study in Botswana Africa also showed that overweight and obesity and hypertriglyceridemia have significant relationship with DM with hypertension.⁹ A cross sectional study in India, showed a correlation between hypertension and hyperglycemia among young adult aged 17 to 19 years.¹⁴ Different country may have different discrepancy of the problem magnitude of DM with hypertension. In Indonesia, this analysis have shown prevalence discrepancy across 33 provinces and the difference is as high as more than 10 times between the lowest and the highest.

This study highlighted three main areas that may contribute to policy implications: 1) prevention and controlling of co-morbidity among diabetes patients; 2) gender sensitive prevention and control strategies;

3) biological and biochemical risk factors screening among diabetes cases.

Prevention and controlling of co-morbidity of DM

This study showed that hypertension is one of the common co-morbidity of DM, as about fifty percent of diabetes cases had hypertension. Several studies also found that DM with hypertension lead to greater risk of cardiovascular death.¹⁰ In this case, a secondary prevention among DM case is crucial to avoid disability, case fatality and premature death. A longitudinal study done by Hassing L B et al in 2004 showed that DM with hypertension co-morbid lead to greater risk of having cognitive decline.¹⁵ A study in Turkey also found that combination of hypertension and obesity and DM lead to lower quality of life.¹⁶ The prevention may need to focus on medical treatment compliant and healthy life style practice in both facility and community based approaches. In term of health facility-based approaches several key interventions include adequate access to good quality health services in term of drug availability, devices, treatment and health education and counseling. It is also important to have adequate communication between patient and physician. A study among diabetes patients in DeBakey VA Medical Centre in Houston indicated that sufficient communication of patient-clinician had significant association with hypertension control.¹⁷ While in the community-based approaches, the intervention is directed towards public awareness and conducive living environments that allow community to practice healthy lifestyle.

Gender sensitive prevention and control strategies

In Indonesia context, prevention and control strategies non-communicable disease, in some extent, applied generic or common strategies for both gender except for the maternal related diseases. It is obvious that males and females have their own unique pattern and magnitude of NCD, including DM and hypertension and NCD risk factors association that lead to different needs and priority areas to be addressed. Females tend to have more issues on obesity, smoking and hyperlipidemia as risk factors while males have more problem on smoking and hyperlipidemia. Smoking seems to affecting towards higher risk of cardiovascular diseases and other diabetes co-morbidity. Although prevalence of smoking is much more lower among females than males aged 10 years and above in Indonesia (1.9% vs 56.7%)¹⁸, the

health impact is similarly crucial for both males and females. The smoking index (years and number of cigarettes) are higher in males than females (243 in males and 173.4 in females).¹⁸ Meanwhile, obesity tends to contribute more serious health impact on females. Body mass index control and monitoring can be more strengthened among females, which lead to more intervention focus on healthy diet and sufficient physical activity. Hyperlipidaemia is one of the health risk issues that correlate with diabetes co-morbidity for both males and females.

Physical and biochemical risk factors screening among diabetes cases

This study shows that biological risk factors such as body mass index and lipid profile are crucial to be monitored and controlled among the diabetes cases to prevent co-morbidity that may lead to premature death and diseases related disability. Maintaining normal body mass index is very challenging, particularly among productive age group. It is intervened by childbearing period among females and physical inactivity among working aged males, as well as aging effect. Particularly among those who have DM required strategy that enable them maintaining normal body mass index, blood pressure and in preventing central obesity. Similarly, monitoring and controlling lipid profile such as cholesterol, LDL, triglyceride and HDL, among DM case refers to applying healthy life style. In this case, routine monitoring and controlling of blood pressure, body weight and lipid profile should be included in the DM case manageable standard to avoid more complicated treatment which lead to more costly health expenditure. Evidences from other country, such in Canada also showed that the Canadian Hypertension Education Program has recommended to include hypertension monitoring among DM patients.¹⁹ It is also known that DM, hypertension and kidney disease are interrelated in which they lead to greater cardiovascular risk.^{20,21} A randomized trial among type 2 diabetes showed that controlling blood pressure to 135/80 mmHg provide intense benefits to prevent adverse outcome of type 2 diabetes patients.²² Reviews of benefits and risk of monitoring blood pressure among diabetes cases in Canada highlighted that treatment of hypertension in people with diabetes is highly effective strategy to reduce the risk of cardiovascular disease and diabetes complication.²³

Further studies are required to address more specific issues on DM with hypertension in specific geographical setting such as in province with the highest proportion of DM with hypertension in Sulawesi Tenggara. More specific intervention programs should consider areas or population with high, moderate and low proportion of DM with hypertension, hypertension as well as DM. The interventions should also put into account specific approached on different age groups such as adolescents, adult and elderly.

In conclusion, DM with hypertension has significant relationship to certain health risks (behavior, physical and biomedical) among Indonesian adult aged 18 years and above. Routine monitoring and controlling of body weight, blood pressure and lipid profile are crucial to prevent DM comorbidity and case fatality among DM cases. This study also suggested reducing and controlling the risk factors (quit smoking and healthy diet) to prevent co-morbidity of hypertension and diabetes mellitus.

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Conflict of Interest Statement

This study is not related to any matters that may cause conflict of interest. This study is supported by Ministry of Health Republic of Indonesia and authors have nothing to disclose

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