Higher body mass index may increase prehypertension risk

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Abstrak

Latar belakang: *Kegemukan dapat berimplikasi terhadap berbagai masalah kesehatan, salah satunya adalah hipertensi. Banyak penelitian telah membuktikan kaitan erat antara kelebihan berat badan dengan hipertensi. Penelitian ini bertujuan untuk menganalisis besarnya risiko kegemukan berdasarkan indeks massa tubuh (IMT) dan lingkar perut terhadap prahipertensi di Indonesia.*
Metode: *Data berasal dari penelitian potong lintang Riskesdas 2007. Analisis dilakukan terhadap subjek berusia 18-60 tahun. Kriteria prahipertensi merujuk pada Joint National Committee on Prevention, Detection, Evaluation, And Treatment of High Blood Pressure, USA (JNC 7), sedangkan kelebihan berat badan dan obesitas berdasarkan Western Pacific Region of WHO (WPRO) 2000.*
Hasil: *Dari total 2884 responden yang dianalisis, 1660 (57,6%) adalah kelompok tekanan darah prahipertensi dan 1224 (42,4%) kelompok tekanan darah normal. Subjek yang kelebihan berat badan dibandingkan dengan normal berisiko 15% lebih besar menderita prahipertensi [risiko relatif suaian (RRa)=1,15; 95% interval kepercayaan (CI)=1,06-1,24], sedangan yang obes berisiko 25% lebih besar menderita prahipertensi (RRa =1,25; 95% CI=1,16-1,34). Selain itu subjek dengan kadar LDL tinggi dibandingkan dengan yang normal 11% menderita prahipertensi (RRa=1,11; 95% CI=0,99-1,24).*
Kesimpulan: *Kelebihan berat badan, obesitas, dan kadar LDL tinggi meningkatkan risiko prahipertensi. Pemantauan berat badan oleh diri sendiri supaya tetap dalam kategori normal sebaiknya rutin dilakukan.* ***(Health Science Indones 2011;2:21-7)***

Kata kunci*: kelebihan berat badan, obesitas, prahipertensi*

Abstract

Background: Obesity can create various health problems, one of which is hypertension. Many studies show a relationship between obesity and hypertension, however few reports on Indonesia. This paper assessed the risk of obesity based on body mass index (BMI) and abdominal circumference against the prehypertension in Indonesia.
Methods: For this analysis we used data from a cross sectional of Basic Health Research in Indonesia (*Riskesdas*) 2007. Analysis was carried out among 18-60 years old subjects. Criteria for prehypertension refers to Joint National Committee on Prevention, Detection, Evaluation, And Treatment of High Blood Pressure, USA (JNC 7), whereas the overweight and obesity criteria refer to the Western Pacific Region of WHO (WPRO) 2000.
Results: Of the total 2884 subjects, consisted of 57.6% prehypertension and 42.4% normal blood pressure. Overweight than normal BMI subjects had 15% higher risk of prehypertension [adjusted relative risk (RRa)=1.15; 95% confidence interval (CI)=1.06-1.24], while obese than normal subjects had 25% increase risk of prehypertension (RRa=1.25; 95% CI=1; 16-1.34). Furthermore, those who had high than normal level of LDL had 11% more prehypertension risk (RRa=1.11; 95% CI=0.99-1.24).
Conclusion: Higher body mass index, and higher LDL may increase prehypertension risk. Monitoring of body weight and LDL level control routinely recommended. ***(Health Science Indones 2011;2:21-7)***

Key words: overweight, obesity, prehypertension

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Obesity may create various health problems, among other, is hypertension. The latest data from the Health Research Association in 2007 showed that hypertension prevalence rate in Indonesia is quite high, at 31.7%. In Indonesia, hypertension is the number 3 cause of death from all categories of disease, after stroke and tuberculosis. The prevalence of overweight at age 15 years and over was 8.8% and obesity was 19.1%.[1]

Many studies have shown an association between overweight and increased blood pressure.[2,3,4] There are few reports linking overweight and obesity to the risk of prehypertension in Indonesia. In the framework of prevention before becoming hypertension, an analysis of obesity risk against prehypertension becomes important.

This paper presents an assessment risk of overweight and obesity based on body mass index (BMI), abdominal circumference and several other factors to on prehypertension risk in Indonesia.

METHODS

The study was cross-sectional study using data sources from the Basic Health Research (*Riskesdas*) in 2007. *Riskesdas* performed basic health data collection that includes the data of disease, risk factors, and measurement, physical examination and biomedical examination.

Riskesdas is a national scale survey. The sample represents the population of Indonesia, from 33 provinces and 440 districts (from total 456 districts). Calculation of samples was done by two stage sampling method. Stage 1 was to determine households which subsequently selects from a simple random sampling. Stage 2 determined all household members in selected households to do interview and physical measured. Total sample of *Riskesdas* 2007 which interviewed were 972 989 samples.

Biomedical measurement sample were members of households living in census blocks with urban classification. Blood sampling was done on all household members aged > 1 year, from selected households in selected urban census blocks in accordance *SUSENAS* 2007. The series of sample collection were: from the urban census blocks were selected on *SUSENAS* 2007, selected some 15% of the total urban census blocks. Blood samples were taken from all households members (except infants) who signed informed consent. Blood sampling was not performed in a sick household member, history of bleeding and the use of blood thinning medications regularly. Total biomedical samples aged > 1 year was 26 919. The examination of blood glucose levels was done on household members aged > 15 years and a pregnant woman was excluded. Total samples of blood glucose examination was 19 114.

Of the total sample available, the selection was conducted based on the inclusion criteria of aged 18 to 60 years, had never been diagnosed with hypertension by health professional or based on the measurement of blood pressure, were not taking antihypertensive drugs, not being pregnant, do not suffer from heart disease and not suffer a stroke. The number of samples which ready to analyze was 2884.

Criteria for prehypertension refers to Joint National Committee on Prevention, Detection, Evaluation, And Treatment of High Blood Pressure, USA (JNC 7),[5] whereas the overweight and obesity criteria refer to the Western Pacific Region of HO (WPRO) 2000.[6] In *Riskesdas* 2007, blood pressure was measured using a digital pressure meter validated by standard measurement of a mercury sphygmomanometer.

Blood pressure measurement is performed at least 2 times. If the results of these two measurements differ by more than 10 mmHg compared to the first measurement, the third measurement was carried out. Two measurements with the smallest difference is calculated as the average blood pressure measurement results. Pre- hypertension criteria used as a determination of cases referred to the criteria of JNC 7, i.e. systolic blood pressure measurements (SBP) 120-139 mmHg or

diastolic blood pressure (DBP) 80-89 mmHg. Criteria for normotensi is SBP <120 mmHg and DBP <80 mmHg.[5]

Nutritional status was assessed by body mass index (BMI) and abdominal circumference. BMI is calculated based on body weight and height with the following formula: weight (kg) / height (m) ^{2}. Body weight was measured using a digital weight scale with a precision of 0.1 kg, while height used microtoise with 0.1 cm precision. Characteristic of BMI in this analysis refers to the WPRO 2000 with the following criteria: normal category (BMI 18.5-22.9), overweight (BMI 23.0 - 24.9), obese (BMI> = 25.0).[6] The size of abdominal circumference is used to determine central obesity. Limitation of central obesity status was 90 cm or more for men and 80 cm or more for women. Abdominal circumference was measured with a fiberglass measuring devices with precision of 0.1 cm.[7]

Examination of blood sugar was carried out by health workers in hospitals and medical laboratories. Subjects were fasting 10-14 hours, then they were given an oral glucose load of 75 grams (300 calories), then the blood was withdrawn. Patients who have a history of Diabetes Mellitus (confirmed by the physician coordinator of the laboratory team), were given a liquid diet of 300 calories. Venous blood sample was withdrawn 15 cc after 2 hours of loading. DM criteria were blood glucose ≥ 200 mg / dL and no DM <200 mg/dL.[8] Blood cholesterol is categorized into two: ≤ 200 mg / dL and> 200 mg / dL, HDL levels are categorized into normal if > 55 mg / dL for men and > 65 mg / dL for women and low if ≤ 55 mg / dL for men and ≤ 65 mg / dL for women. LDL levels are categorized into normal if <150 mg / dL and high if ≥ 150 mg / dL.

Consumption behavior (fiber, salty foods, fatty foods, and caffeine), smoking behavior and physical activity were collected by interview using a structured questionnaire. To get the same perception, at the time of the interview display card regarding the classification of physical activity and consumption of servings of fruit and vegetable fiber was used. Consumption of fiber is divided into 2 categories, insufficient consumption if fibers with a composite indicator of the portion and frequency of fruit and vegetable consumption was <4 servings a day and <7 days a week. Sufficient if consumption of fiber composite indicator of the portion and frequency of consumption of fruits and vegetables was ≥ 4 servings a day and 7 days a week. Consumption of salty foods, fatty and caffeine were categorized into 3: almost never if the respondent usually eat these foods less than 3 times per month or never consumed, not every day when respondents consume these foods 1-6 times per week, and every day if they consume the food ≥ 1 time per day.

Smoking behavior is categorized into never if subjects had never smoked at all, once when the respondent in the past month but previously did not smoke, active if the respondent smoked in the past month daily or occasionally.

Physical activity is categorized into adequate and inadequate. Activities were categorized into adequate if the activities were performed continuously for at least 10 minutes in an activity without interruption and in a cumulative 150 minutes for five days a week. In addition to frequency, intensity data collection was also carried, i.e. the number of days to do activity 'heavy', 'medium' and 'walk'. The calculation of the number of minutes of physical activity in a week also consider the type of activities undertaken, in which such weight was given to certain activity, one for the activities 'heavy' four times, the activity of 'being' twice on the activities of 'light' or a leisurely stroll. Age is categorized into 3 namely 18-29 years, 30-40 years and 41-60 years.

In this study, the entire analysis is based on the total sample of household members after the missing values and outliers were removed. Total sample was amputated by: 1) measurement variables of age group 18-60 years old, 2) blood pressure measurement variable of normotensi and prehypertension category, 3) weight, height and abdominal circumference variables, 4) biomedical test results variable, 5) consumption behavior, physical activity and smoking behavior variable. The level of obesity risk based on BMI and abdominal circumference categories as well as other risk factors against

prehypertension was determined by Cox regression. If the results of bivariate analysis of the value of P <0.25, risk factors can be considered as a candidate in a multivariate analysis to determine the strongest risk factor for the occurrence of prehypertension. Data analysis was performed using the program Stata version 9.

This study has received ethical approval from the Ethics Committee for Health Research, Health Research and Development Agency, Ministry of Health Republic of Indonesia.

RESULTS

Number of total *Riskesdas* subjects aged 18-60 years old was 367870. Following inclusion criteria and completeness of data for this assessment, the number of subjects was 2884

Table 1. Obesity, blood biochemistry, eating habit, physical activity, smoking habit and risk of prehypertension

	Normal (n=1224)		Prehypertension (n=1660)		Crude relative risk	95% confidence interval	P
	n	%	n	%			
Abdominal circumference							
Normal	966	43.6	1248	56.4	1.00	Reference	
Central obesity	258	38.5	412	61.5	1.09	0.98-1.22	0.126
Blood glucose level							
Less than 200 mg/dL	1190	42.8	1592	57.2	1.00	Reference	
200 mg/dL or more	34	33.3	68	66.7	1.50	0.98-2.27	0.073
HDL							
Normal	89	42.9	118	57.1	1.00	Reference	
Low	1135	42.4	1542	57.6	1.02	0.77-1.36	0.941
Cholesterol							
Normal	804	44.7	993	55.3	1.00	Reference	
High	420	38.6	667	61.4	1.29	1.10-1.49	0.002
Fiber consumption							
Adequate	24	51.1	23	48.9	1.00	Reference	
Inadequate	1200	42.3	1637	57.7	1.42	0.80-2.53	0.290
Salty food consumption							
Almost never	303	42.4	411	57.6	1.00	Reference	
Not everyday	607	41.9	840	58.1	1.01	0.89-1.14	0.888
Everyday	314	43.4	409	56.6	0.98	0.86-1.13	0.803
Fatty food consumption							
Almost never	392	43.2	515	56.8	1.00	Reference	
Not everyday	629	41.1	901	58.9	1.04	0.93-1.16	0.509
Everyday	203	45.6	242	54.4	0.96	0.82-1.12	0.580
Caffeine consumption							
Almost never	627	45.3	758	54.7	1.00	Reference	
Not everyday	177	38.6	282	61.4	1.12	0.98-1.29	0.097
Everyday	420	40.4	620	59.6	1.09	0.98-1.21	0.114
Physical activity							
Adequate	961	42.0	1327	58.0	1.00	Reference	
Inadequate	263	44.1	333	55.9	0.97	0.76-1.10	0.374
Smoking habit							
Never	834	45.6	994	54.4	1.00	Reference	
Occasionally	28	29.5	67	70.5	1.30	1.01-1.66	0.039
Active	362	37.7	599	62.3	1.15	1.04-1.27	0.008

of the total 2884 subjects, 1660 (57.6%) were prehypertension and 1224 (42.4%) were normal blood pressure.

Table 1 shows that prehypertension and normal blood pressure subjects were similarly distributed with respect of fiber consumption, salty food consumption, and physical activity. Those who had central obesity abdominal circumference, blood glucose level of 200 mg/dL or more, hypercholesterolemia, consumed caffeine, and smoking habit were more likely had higher prehypertension risk than their reference groups.

Table 2. Relationship between obesity factor based on BMI, LDL level, age and risk of prehypertension

	Normal (n=1224)		Prehypertension (n=1660)		Adjusted relative risk*	95% confidence interval	P
	n	%	n	%			
Body mass index							
Normal	789	47.5	873	52.5	1.00	Reference	
Overweight	202	37.8	333	62.2	1.15	1.06-1.24	0.001
Obese	233	33.9	454	66.1	1.25	1.16-1.34	0.000
Age							
18-29 years	513	51.6	482	48.4	1.00	Reference	
30-40 years	406	41.7	567	58.3	1.14	1.05-1.24	0.002
41-60 years	305	33.3	611	66.7	1.30	1.19-1.40	0.000
Gender							
Female	740	47.6	814	52.4	1.00	Reference	
Male	484	36.4	846	63.6	1.23	1.16-1.31	0.000
LDL							
Normal	987	44.2	1247	55.8	1.00	Reference	
High	237	36.5	413	63.5	1.11	0.99-1.24	0.076

*Adjusted each other among risk factors listed on this Table

Table 2 which is the final model shows that there are four dominant factors that increase prehypertension. These factors were BMI, age, gender and LDL cholesterol levels. Compared with the normal BMI, overweight and obese subjects had 15% and 25% more risk Prehypertension risk. The analysis also shows the proportion of prehypertension began to increase in the age group of 30-40 years and they are at higher risk in age 40 years or over. Male than female subjects were had 23% to experience prehypertension. In addition, those who had high than normal blood LDL levels had 11% more prehypertension risk.

DISCUSSION

There are limitations of this assessment, among others; it cannot infer cause and effect relationship to the occurrence of prehypertension. The *Riskesdas* 2007 was a cross sectional study.

America and Israel published the relationship between obesity and prehypertension, both in the general population and limited populations.[9,10,11] The difference with our assessment is that the analysis was performed for the population in the state of Indonesia, which is one of Asia, thus indicators of over-

weight, obesity and central obesity use indicators for Asian population.[6]

Our finding shows that the relationship between abdominal circumference and prehypertension was not significant (P = 0.126). Based on BMI, overweight may increase the risk of becoming prehypertension, and obesity increase the risk of becoming prehypertension. This result is consistent with previous research that proves the relationship of BMI with increased blood pressure in borderline category (130-159/85-99 mmHg). Overweight and obese people have a risk of 1.85 times and 2.52 times to substantially increase blood pressure than people who are not obese.[12]

This is consistent with the results of this research. Men have a risk of prehypertension 1.23 times (95% CI = 1.16 to 1.31) than women. DBP and SBP will increase with increasing age.

Research on adults aged 30-55 years in the New Week stated there is significant correlation between age and SBP, and SBP DBP / DBP. Each additional 1 year of age will increase by 0.493 mmHg SBP and DBP as much as 0.189 mmHg.4 combination of these changes due to blood vessel stiffness and decreased flexibility of the arteries that lead to increased pulse pressure in accordance with age.[14,15] Blood sugar levels, levels of total cholesterol and high LDL levels increase the risk of consecutive prehypertension of 1.50 times (95% CI = 0.98 to 2.27), 1.29 times (95% CI = 1,10 - 1.49) and 1.11 times (95% CI = 0.99 to 1.24). Linkages between prehypertension with blood sugar levels, levels of total cholesterol and LDL levels as a profile of CVD risk factors ever conducted in Israel with a big risk is similar to the results of this research.[11] Obesity is almost always accompanied by insulin resistance or diabetes.

Among several hypothetical mechanisms linking obesity with hypertension, there are two recurring themes. The first is the role of excessive sodium retention, mediated by sympathetic nerve traffic to the kidney, fat due to changes in renal function, increased production of aldosterone, and / or the effect of the kidney in improving insulin. The second is the sympathetic nervous system activation mediated by fat itself or with repeated episodes of hypoxemia during sleep apnea.[16] Based on the lifestyle known that a low fiber consumption habits and history of smoking may increase the risk prehypertension. Research in the United States reported the association of fiber consumption with prehypertension. The results of this study predicted the existence of other components in fruit that can lower blood pressure.[17] Potassium and magnesium are found in many fruits and vegetables can help control the blood pressure.[18] Smoking can cause stiffness in the artery and can survive for a decade after quitting smoking. The incidence of hypertension increased among those who smoked 15 cigarettes or more per day.[19] Smoking can cause the heart to work harder so that it can increase blood pressure. Toxic chemicals are inhaled through a cigarette like nicotine and carbon monoxide into the bloodstream can damage the endothelial lining of the arteries and lead the process of atherosclerosis and high blood pressure. Smoking also can increase heart rate and oxygen demand to be supplied to the heart muscles. Smoking habits in patients with high blood pressure increasing the risk of damage to blood vessels arteri.[20] Habit of eating salty foods, fatty foods and caffeine and physical activity did not show a tendency to increase the risk prehypertension. The discrepancy between the results of this study with a theory that had been believed, where physical inactivity it will minimize the risk of increased blood pressure, possibly because of the activities referred to in this research is a common activity performed by the subjects of everyday life, and not the activity in the form of physical exercise such as regular exercise. As a result the body has to adjust and related activities as risk factors for increased blood pressure to be weak.

In conclusion, higher body mass index, older age, male, and higher LDL may increase prehypertension risk. Monitoring of body weight and LDL level control routinely recommended.

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