The Prevalence of Type 2 Diabetes Mellitus and Its Associated Risk Factors in Medan, North Sumatera, Indonesia

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Abstract
Introduction: Diabetes mellitus (DM) is a public health problem in Indonesia. This study aims to know the prevalence of type 2 DM in Medan city and its risk factors.

Method: A survey was conducted among Medan inhabitants aged ≥21 years. Subjects were invited to the nearest community health center to get anthropometric, blood pressure, and random blood glucose measurements. Type 2 DM was diagnosed if the blood glucose level was ≥200 mg/dL.

Result: The study involved 1028 subjects. Type 2 DM was found in 126 (12.3%) cases, with a higher frequency among aged ≥45 years (p=0.001), had a family history of DM (p<0.001), and having hypertension (p=0.005). Although obesity was found in 55% of the subjects, it was not statistically associated with type 2 DM.

Conclusion: Prevalence of type 2 DM in Medan was higher than national prevalence. Intensive strategies to prevent type 2 DM in Medan population is needed. J Indon Med Assoc: 2014;64:143-7.

Key words: Type 2 diabetes mellitus, urban population, prevalence, risk factor
The Prevalence of Type 2 Diabetes Mellitus and Its Associated Risk Factors in Medan

Prevalensi Diabetes Mellitus tipe 2 dan Faktor Risiko yang Berhubungan di Kota Medan, Sumatera Utara, Indonesia

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Abstrak

Metode: Survei potong lintang dilakukan pada penduduk kota Medan berusia 21 tahun atau lebih. Subyek disumbang ke peselamatan setempat untuk pengukuran antropometri, tekanan darah, dan glukosa darah sesuatu. Diagnosis DM tipe 2 didiagnosis bila kadar glukosa darah sesuatu mencapai 200 mg/dl atau lebih.

Hasil: Sebanyak 1028 subyek berpartisipasi. Diabetes ditemukan pada 126 (12.3%) subyek. Faktor yang berhubungan adalah usia 45 tahun atau lebih (p=0.001), riwayat DM pada keluarga (p<0.001), dan hipertensi (p=0.005). Obesitas ditemukan pada 35% subyek namun secara statistik tidak berhubungan dengan DM tipe 2.

Kesimpulan: Prevalensi DM tipe 2 di kota Medan lebih tinggi dari prevalensi nasional. Strategi pencegahan yang lebih agresif dan intensif perlu diterapkan.

Kata kunci: Diabetes mellitus tipe 2, masyarakat perkotaan, prevalensi, faktor risiko

Introduction
Currently, type 2 diabetes mellitus (DM) is still a major health problem worldwide with cases projected to increase from 171 million in the year 2000 to 366 million by 2030. Indonesia is among the top four countries in the world that will suffer from an increasing number of diabetic people which is projected to be more than 20 million in 2030. Community-based studies in Jakarta and Makassar showed that the prevalence of diabetes has increased from less than 2% in the late 19th century to almost 12.5% in the 20th century. The Indonesian National Socio-Economy Survey pointed out that lifestyle changes and risk factors ignorance were the most important determinants of the rising prevalence of degenerative diseases, including DM.

The Indonesian National Household Survey emphasizes that the epidemiological transition is still ongoing with some degrees of local variation. Urban cities, which are believed to experience most of the rapid modern individualization and individual lifestyle changes, are expected to have higher prevalence than rural areas. A national survey involving 24,417 urban participants in Indonesia aged 15 years and above found that the prevalence of type 2 DM was 5.7%, consisted of 1.5% diagnosed type 2 DM and 4.2% undiagnosed type 2 DM. However, the prevalence rates of type 2 DM may vary considerably across the country, which is the largest archipelago country in the world. Medan, the capital city of North Sumatera, is among the largest urban cities in Indonesia which experiences rapid changes of urbanization. This study was aimed to know the prevalence of type 2 DM in Medan, North Sumatera and its associated risk factors.

Methods
Study Area and Sample Collection
This survey was conducted in Medan, North Sumatera in 2006. The study population was adult inhabitants of 21 districts in Medan. Participants were invited by public announcement using banners to come to the nearest community health center in the district to get free random blood glucose and blood pressure measurements. Participants aged 21 and above were recruited consecutively. A written consent was sought to each study participant prior to interview and measurements. Each subject was interviewed by a trained interviewer using structured questionnaires pertaining socio-demographic information, signs-symptoms of DM, family history of DM and history of having a baby with birth weight more than 4 kg (among married women), preceded the clinical
and laboratory measurements. The Ethical Committee of the Faculty of Medicine University of North Sumatera reviewed and approved this study.

**Anthropometric Assessment**

Body mass index (BMI) was calculated as body weight in kg divided by square of body height in meter and was categorized as normal (18.5-22.9 kg/m²), overweight (23-24.9 kg/m²) and obese (>25 kg/m²) according to the World Health Organization criteria for Asian population.¹ Waist circumference (WC) was measured with an inelastic tape placed directly on the skin, perpendicular to the long axis of the body while the subject stood balanced on both feet, with both arms hanging freely. The measurement was taken at the end of expiration, at the midway between the costal arch and the iliac crest to the nearest 0.1 cm. Central obesity is defined as WC of >80 cm for females and >90 cm for males.

**Diagnosis of Diabetes Mellitus**

All subjects underwent random capillary blood glucose measurement using a blood glucose meter (Glucotest™, Merck). The results were grouped according to the Indonesian Society of Endocrinology consensus as follows: not DM (<90 mg/dL), uncertain DM (90-199 mg/dL), and DM (>200 mg/dL).⁸

**Blood Pressure Measurement**

Hypertension is defined as systolic blood pressure of 140 mmHg or above and/or diastolic blood pressure of 90 mmHg or above. The subject’s arm was placed at heart level in sitting position. After the subject has rested for at least 5 minutes, systolic and diastolic blood pressures were measured by well-trained personnel using a standardized sphygmomanometer and cuff of appropriate sizes. The appearance (phase 1) and disappearance (phase 5) of Korotkoff sounds were recorded for the systolic and diastolic blood pressures, respectively. Based on the classification of blood pressure by the Joint National Committee (JNC) 7, hypertension was diagnosed if systolic blood pressure is >140 mmHg or diastolic blood pressure is >90 mm Hg.⁹

**Data Analyses**

Demographic data and risk factors of all subjects were presented descriptively as frequency and percentage. Bi-variate analyses were performed to test the association of diabetes and several risk factors using the Chi-square test. A p-value below 0.05 was considered significant statistically. Data were analyzed using SPSS version 13 for Windows PC (SPSS Inc., Chicago, Illinois, USA).

**Results**

A total of 1028 subjects were enrolled in this study, of which about three-quarter of them were females. Fifty-four percent of subjects had higher education. More than 70% of subjects were 45 years old and above (Table 1).

Anthropometric assessment showed that half of the subjects were obese with mean waist circumference of 88.9±13.05 cm in male subjects and 89.30±14.47 cm in female subjects. Obesity was found in 55% of subjects, that was significantly higher in female compared to male (57.8% vs. 46%, p<0.001; data not shown). Furthermore, we diagnosed hypertension in 44.7% subjects, 53.2% of which were aged 45 years or above and 22.1% were younger (p<0.001; data not shown).

In order to determine the diabetic state of subjects, a random capillary blood glucose measurement were performed using a blood glucose meter. The mean random blood glucose level was 139.6±68.03 g/dl. Type 2 DM was found in 126 (12.3%) subjects, while 520 others (50.6%) had uncertain DM. Type 2 DM was found in only 4.3% among subjects aged less than 45 years compared to 15.2% among older subjects. Among 733 married female subjects, 179 had a history of delivering a baby with birth weight more than 4 kg; 35 of them (19.6%) had DM while another 82 (45.8%) had uncertain DM. Type 2 DM was significantly higher in subjects aged 45 years and above (p<0.001), with a positive family history of DM (p<0.001), positive signs and symptoms of DM (p<0.001), a history of having baby with birth weight more than 4 kg (p=0.006), and hypertension (p=0.005) (Table 2).

**Discussion**

The number of people aged 45 years and above in our study was very high compared to the real proportion of people of similar age in Medan, which was around 31% of Medan adult population in 2000.¹⁰ Considering people with older age could be more aware to health issues compare to...
Table 2. The Association of Type 2 Diabetes Mellitus and its Known Risk Factors Among Urban Population in Medan, North Sumatera.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Net DM n (%)</th>
<th>Diabetic State Uncertain n (%)</th>
<th>DM n (%)</th>
<th>Total n (%)</th>
<th>p value (chi-square)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Male</td>
<td>70 (28.2)</td>
<td>150 (60.5)</td>
<td>28 (11.3)</td>
<td>248 (100)</td>
<td>0.001</td>
</tr>
<tr>
<td>* Female</td>
<td>312 (40.0)</td>
<td>370 (47.4)</td>
<td>98 (12.6)</td>
<td>780 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* &lt;45 years</td>
<td>134 (47.9)</td>
<td>134 (47.9)</td>
<td>12 (4.3)</td>
<td>280 (100)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>* &gt;45 years</td>
<td>248 (33.2)</td>
<td>386 (51.6)</td>
<td>114 (15.2)</td>
<td>748 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>BMI group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Normal</td>
<td>104 (38.0)</td>
<td>127 (46.4)</td>
<td>43 (15.7)</td>
<td>274 (100)</td>
<td>0.271</td>
</tr>
<tr>
<td>* Overweight</td>
<td>72 (38.1)</td>
<td>97 (51.3)</td>
<td>20 (10.6)</td>
<td>189 (100)</td>
<td></td>
</tr>
<tr>
<td>* Obese</td>
<td>266 (36.5)</td>
<td>296 (52.4)</td>
<td>61 (12.1)</td>
<td>565 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>Male waist circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* &lt;90 cm</td>
<td>39 (32.5)</td>
<td>67 (55.8)</td>
<td>14 (11.7)</td>
<td>120 (100)</td>
<td>0.306</td>
</tr>
<tr>
<td>* &gt;90 cm</td>
<td>31 (24.2)</td>
<td>83 (64.8)</td>
<td>14 (10.9)</td>
<td>128 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>Female waist circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* &lt;80 cm</td>
<td>57 (40.4)</td>
<td>65 (46.1)</td>
<td>19 (13.5)</td>
<td>141 (100)</td>
<td>0.911</td>
</tr>
<tr>
<td>* &gt;80 cm</td>
<td>255 (39.9)</td>
<td>305 (47.7)</td>
<td>79 (12.4)</td>
<td>639 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>History of DM</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>* Yes</td>
<td>83 (39.4)</td>
<td>142 (52.0)</td>
<td>45 (17.6)</td>
<td>273 (100)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>* No</td>
<td>261 (39.2)</td>
<td>342 (51.4)</td>
<td>62 (9.3)</td>
<td>665 (100)</td>
<td></td>
</tr>
<tr>
<td>* Don't Know</td>
<td>38 (42.2)</td>
<td>36 (40.9)</td>
<td>16 (17.8)</td>
<td>90 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>Signs/symptoms of DM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Yes</td>
<td>111 (39.5)</td>
<td>172 (47.3)</td>
<td>81 (22.3)</td>
<td>364 (100)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>* No</td>
<td>253 (41.1)</td>
<td>324 (52.7)</td>
<td>38 (6.2)</td>
<td>615 (100)</td>
<td></td>
</tr>
<tr>
<td>* Uncertain</td>
<td>18 (35.7)</td>
<td>24 (49.0)</td>
<td>7 (14.3)</td>
<td>49 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>History of having a baby with birth weight &lt;4kg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Yes</td>
<td>62 (34.6)</td>
<td>82 (45.8)</td>
<td>35 (19.6)</td>
<td>179 (100)</td>
<td>0.006</td>
</tr>
<tr>
<td>* No</td>
<td>232 (41.9)</td>
<td>263 (47.5)</td>
<td>59 (10.6)</td>
<td>554 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>Hypertension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Yes</td>
<td>147 (32.0)</td>
<td>247 (51.7)</td>
<td>66 (14.3)</td>
<td>460 (100)</td>
<td>0.005</td>
</tr>
<tr>
<td>* No</td>
<td>235 (41.4)</td>
<td>273 (48.1)</td>
<td>60 (10.6)</td>
<td>568 (100)</td>
<td></td>
</tr>
</tbody>
</table>

The prevalence of type 2 DM in Medan was 12.3%. This prevalence was higher than the national data (Riskesdas) and could be due to the high number of older people among the subjects. As comparisons, studies in other developing countries showed prevalence between 6.6-11.1% among people in urban areas, while the prevalence rates among sub- or semiurban population the prevalence rate were found between 2.0-10.4%. A recent survey in Terate in the North Moluccas Province, a suburban area which was believed to be less developed than Medan, found a diabetes prevalence of 19.6% by applying fasting blood glucose test.

The American Diabetic Association (ADA) has identified several risk factors for DM, i.e. physical inactivity, first-degree relative with DM, hypertension, HDL cholesterol < 35 mg/dL and/or a triglyceride level > 250 mg/dL. Moreover, ADA also recommended diabetes screening in individuals >45 years of age. Despite some limitations in the selection of subjects, our findings were consistent with ADA in terms of age, family history of DM, and hypertension. Older age was consistently found as an independent risk factor for having DM among studies in Indonesian population as well as in other countries.

Diabetes and hypertension are a common findings among older people aged 40 years and above. The prevalence of hypertension in our study was very high (44.7%). Several studies indicated that the prevalence rates of hypertension were higher in urban than in rural areas. A study in Vietnam found a prevalence of 32.7% in urban area compared to 17.3% in rural area (p<0.001). However, it should be noted that the majority of our respondents were older people. This might contribute to the high prevalence of hypertension in this study.

Obesity was found in 55% of subjects, which is similar with the data from Malaysia. In Malaysia, a 2011 national survey found that abdominal obesity was higher in female...
Updated data from the same survey in Malaysia showed that BMI more than 30 kg/m² is associated with a 3-fold increase of having newly-diagnosed type 2 DM. Yet, our study did not find a significant association between obesity and the presence of type 2 DM, which might be due to the higher proportion of subjects with uncertain DM. Further investigations such as oral glucose tolerance test is required to determine the diabetic state in these subjects.

The need to ascertain the diagnosis among those with uncertain DM also explain the significant statistical association between gender and type 2 DM. Prevalence of DM was almost similar in both gender. Yet higher proportion of uncertain DM was found among male compare to female.

Conclusion

Our study showed that the prevalence of type 2 DM of urban population in Medan, North Sumatera is still high. Several risk factors that significantly associated with type 2 DM are older age, family history with diabetes and hypertension. These results should alert health professionals and policy makers to design more aggressive preventive strategies in the future to prevent complications of type 2 DM.

Conflict of Interests

The author(s) declare that they have no conflict of interests.

Acknowledgements

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