

## Prevalence and estimated incidence of type 2 diabetes among working population in Bangkok: A preliminary report

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- Background** : *The incidence rate of type 2 DM is essential for the national plan of public health. However, it is problematic to obtain the information through direct observation.*
- Objective** : *To predict the incidence rate of type 2 DM among working Thai adult population from available data on the prevalence of DM.*
- Study design** : *Cross-sectional study.*
- Subject** : *Annual health examination records during 1999-2002 of 21,123 professional and office workers of 45 companies and agencies in and around Bangkok who were between the age of 35-60 years old.*
- Method** : *Prevalence rates of DM in specific age groups for both genders were estimated by logistic regression model. Corresponding incidence rates of DM in specific age groups were then predicted based on the prevalence data obtained through calculation which is analogue to life-table method.*

- Results** : *The estimated prevalence rates of DM among people of 35-60 years old of male and female were 10.2 to 112.3 and 19.6 to 195.3 per 1000, respectively; and the predicted prevalence rates of DM among people of the age range of 20-34 years old for both sexes were 2.4 to 9.3 per 1000 and 4.9 to 17.9 per 1000, respectively. Predicted annual incidence rates during 20-60 years age range of female and male workers increased exponentially and were 0.2 to 12.7 per 1000 and 0.5 to 25.6 per 1000, respectively. Predicted rates for male workers were almost twice higher than for female workers.*
- Conclusion** : *Present study provides data on the incidence of type 2 DM among Thai working population. Its validity, however, still needs to be verified.*
- Keywords** : *Prevalence, Incidence, Type 2 diabetes mellitus, Working population.*

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วิโรจน์ เจียมจรัสรังษี. อัตราชุกและอัตราอุบัติการณ์ประมาณการของโรคเบาหวานชนิดที่ 2  
ในประชากรวัยทำงานเขตกรุงเทพมหานคร : รายงานการศึกษาเบื้องต้น. จุฬาลงกรณ์เวชสาร  
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- ที่มา** : อัตราอุบัติการณ์ของโรคเบาหวานชนิดที่ 2 เป็นข้อมูลที่สำคัญต่อการวางแผนด้าน การสาธารณสุขระดับชาติ อย่างไรก็ตาม การหาอัตราอุบัติการณ์ของโรคโดยการสังเกตโดยตรงเป็นสิ่งที่กระทำได้ยาก
- วัตถุประสงค์** : เพื่อทำนายอัตราอุบัติการณ์ของโรคเบาหวานชนิดที่ 2 ในประชากรวัยแรงงานโดยอาศัยข้อมูลอัตราชุกของโรค
- รูปแบบการศึกษา** : การศึกษาภาคตัดขวาง
- ประชากรที่ศึกษา** : บ้านที่ผลการตรวจสุขภาพประจำปีระหว่างปี 2542-2545 ของนักวิชาชีพและพนักงานสำนักงานจำนวน 21,123 รายที่มีอายุระหว่าง 35-60 ปี จากหน่วยงานและบริษัท 45 แห่งในกรุงเทพมหานครและปริมณฑล
- วิธีการศึกษา** : ชั้นแรกประมาณการอัตราชุกจำเพาะเพศและอายุของโรคเบาหวานชนิดที่ 2 โดยใช้ Logistic regression model ต่อมาทำการทำนายอัตราอุบัติการณ์จำเพาะเพศและอายุของโรคโดยอาศัยข้อมูลอัตราชุกที่ประมาณการได้โดยใช้วิธีการที่เทียบเคียงกับ Life-table method
- ผลการศึกษา** : อัตราชุกของโรคเบาหวานชนิดที่ 2 ในช่วงอายุ 35-60 ปี ของพนักงานหญิงและชายอยู่ระหว่าง 10.2 ถึง 112.3 และ 19.6 ถึง 195.3 รายต่อ 1,000 คนตามลำดับ และอัตราชุกที่ทำนายสำหรับช่วงอายุ 20-34 ปีอยู่ระหว่าง 2.4 ถึง 9.3 และ 4.9 ถึง 17.9 รายต่อ 1,000 คน สำหรับพนักงานหญิงและชายตามลำดับ อัตราอุบัติการณ์ต่อปีที่ทำนายได้สำหรับช่วงอายุ 20-60 ปี มีลักษณะเพิ่มขึ้นแบบ Exponential และอยู่ระหว่าง 0.2 ถึง 12.7 และ 0.5 ถึง 25.6 ราย ต่อ 1,000 คน สำหรับพนักงานหญิงและชายตามลำดับ โดยอัตราอุบัติการณ์ในเพศชายสูงกว่าเพศหญิงประมาณ 2 เท่า
- สรุป** : การศึกษานี้แสดงถึงอัตราอุบัติการณ์ของโรคเบาหวานชนิดที่ 2 ของประชากรไทยวัยแรงงาน อย่างไรก็ตามควรมีการศึกษายืนยันความเชื่อถือได้ของข้อมูลนี้ด้วย
- คำสำคัญ** : อัตราชุก, อัตราอุบัติการณ์, โรคเบาหวานชนิดที่ 2, ประชากรวัยแรงงาน

Epidemiologic data, including prevalence and incidence rates, are essential inputs for national public health planning and policy setting. For chronic diseases with insidious onset and no obvious manifestation such as type 2 diabetes mellitus (DM), its prevalence rate can be obtained by cross-sectional survey among their target populations. However, to obtain a complete picture of the incidence rate along wide range of age span is difficult or impossible because it requires a continuous surveillance of the disease in a large group of cohort for a long period of time.<sup>(1)</sup> A more practical alternative is to estimate the incidence rates of the disease from available prevalence data.

Since DM is a chronic disease of growing importance in Thailand, we therefore try to estimate its incidence rate among the adults by using the latter approach.

## Materials and Methods

### Study population

Every year, Chulalongkorn Memorial Hospital provides on-site annual health examination services for professional and office workers of approximately 45 private companies and governmental agencies in and around the city of Bangkok. The data of the workers on their annual health examinations during 1999-2002 were utilized as study population. Since fasting plasma glucose investigation – the result of which is used in the DM diagnosis — is normally conducted for those who are 35 years of age or older, only employees who were 35-60 years of age at the time of annual health examination were thus included. Incomplete records and those with missing data on age, sex, and/or fasting plasma results were excluded.

### Statistical analysis

The prediction of the incidence rate of DM at each age was based on the calculation method analogue to the life-table method, which was used in the estimation of life expectancy of a certain population.<sup>(2)</sup> By this method, the age-specific DM prevalence rates from a cross-sectional survey among the target population were first calculated. The age-specific DM incidence rates were then estimated, assuming that if this group of population was followed along a certain time span, its DM experience or the probability of having DM at each age will be similar to the age-specific prevalence rates of DM obtained from the cross-sectional survey. This is described in details as follows:

First, the age- and sex-specific prevalence rates of DM among the study population were calculated by using the fasting plasma glucose level of 126 milligram per deciliter or higher as the DM diagnostic criterion.<sup>(3)</sup> However, since DM is a chronic and irreversible disease with usually a long survival period, its prevalence rates along the life-span must be accumulated or incremental. Therefore, the actual age-specific DM prevalence rates with up-and-down or fluctuate trend (Table 1) were not appropriate for the estimation of incidence of DM. Instead, the predicted prevalence rates of DM were used. These rates—including their 95% confidence intervals—were predicted by using the logistic regression method, treating the status of individual DM as binary outcome and his/her age and sex as independent variables.<sup>(4)</sup>

The incidence rates of DM among specific age groups of both genders—as well as their 95 % confidence limits—were then estimated by the following formula<sup>(2)</sup> :

$I_a = (P_{a+1} - P_a) / (1 - P_a)$       prevalence rate at the age of "a" years, and;  
 Where  $P_{a+1}$  = the predicted DM probability or  
 $I_a$  = the estimated DM incidence rate at      prevalence rate at the age of "a +1" years.  
 the age of "a" year;      All the prevalence and incidence data were  
 $P_a$  = the predicted DM probability or      presented in rates per 1000.

**Table 1.** Number of subjects and their age-specific DM prevalence rates (per 1,000), stratified by sex.

Age (years)	Female			Male		
	Number of DM cases	Number of subjects	Prevalence Rate	Number of subjects	Number of DM cases	Prevalence Rate
35	437	5	11.4	279	6	21.5
36	637	7	11.0	380	6	15.8
37	658	4	6.1	398	9	22.6
38	625	3	4.8	387	8	20.7
39	665	6	9.0	411	7	17.0
40	739	19	25.7	425	11	25.9
41	652	14	21.5	347	13	37.5
42	680	10	14.7	366	19	51.9
43	672	9	13.4	384	19	49.5
44	628	19	30.3	354	18	50.8
45	707	17	24.0	384	24	62.5
46	694	11	15.9	344	20	58.1
47	598	19	31.8	355	30	84.5
48	623	21	33.7	341	25	73.3
49	522	21	40.2	346	30	86.7
50	576	22	38.2	319	31	97.2
51	464	20	43.1	289	27	93.4
52	475	32	67.4	328	37	112.8
53	409	32	78.2	246	21	85.4
54	359	34	94.7	242	22	90.9
55	334	27	80.8	229	24	104.8
56	269	16	59.5	197	20	101.5
57	218	15	68.8	213	26	122.1
58	186	13	69.9	188	28	148.9
59	168	22	131.0	212	30	141.5
60	85	10	117.6	79	15	189.9
<b>Total</b>	<b>13,080</b>	<b>428</b>	<b>32.7</b>	<b>8,043</b>	<b>526</b>	<b>65.4</b>

## Results

In total, 21,123 records were studied: 13,080 were male and 8,043 female, (Table 1). The prevalence rates of all age groups among male workers were markedly higher than those rates for the female, generally more than two times higher.

The prediction parameters from logistic regression model are presented in Table 2. The prevalence rate of DM increases around 11 percent per year when the people get older. The odds ratio (OR) and 95 % confidence interval of 1.92 (1.68, 2.19) for male *versus* female workers were consistent with the twice higher prevalence rate of DM among the male population as shown in Table 1.

The corresponding predicted prevalence rates of DM for female and male workers are shown in Figures 1(a) and (b), respectively. The counterbalances of the excesses and deficits of the bars above and below the predicted lines look quite well. The estimated DM prevalence rates for female and male workers of 35 - 60 years age range were 10.2 to 112.3 and 19.6 to 195.3 per 1000, respectively. We also predicted the DM prevalence outside the age range of 35 - 60 years down to 20 years for both genders. The predicted DM prevalence rates for female and male workers of the age range of 20-34 years were 2.4 to 9.3 per 1000 and 4.9 to 17.9 per 1000, respectively.

The predicted incidence rates of DM among male workers were also twice higher than those rates among the female (Figures 2 (a) and (b)). Predicted annual incidence rates among the age group of 20-60 years of the male and female workers increased exponentially: 0.2 to 12.7 per 1000 and 0.5 to 25.6 per 1000, respectively.

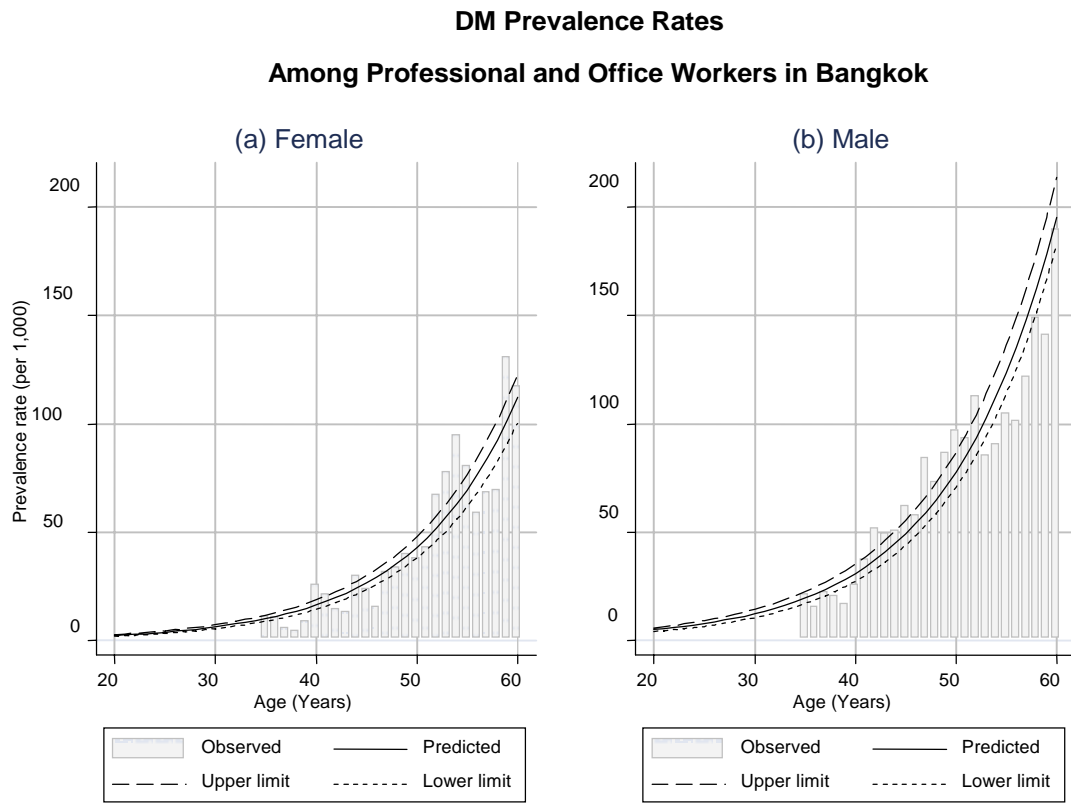
## Discussion

Since our subjects were mainly professional and office workers in Bangkok, the study results may well reflect the picture of DM in the middle- and the upper-class working population rather than of the general population. However, the magnitudes of DM prevalence reported in this study were quite comparable to other recent studies in Thailand conducted on different population groups<sup>(5-7)</sup> (Table 3).

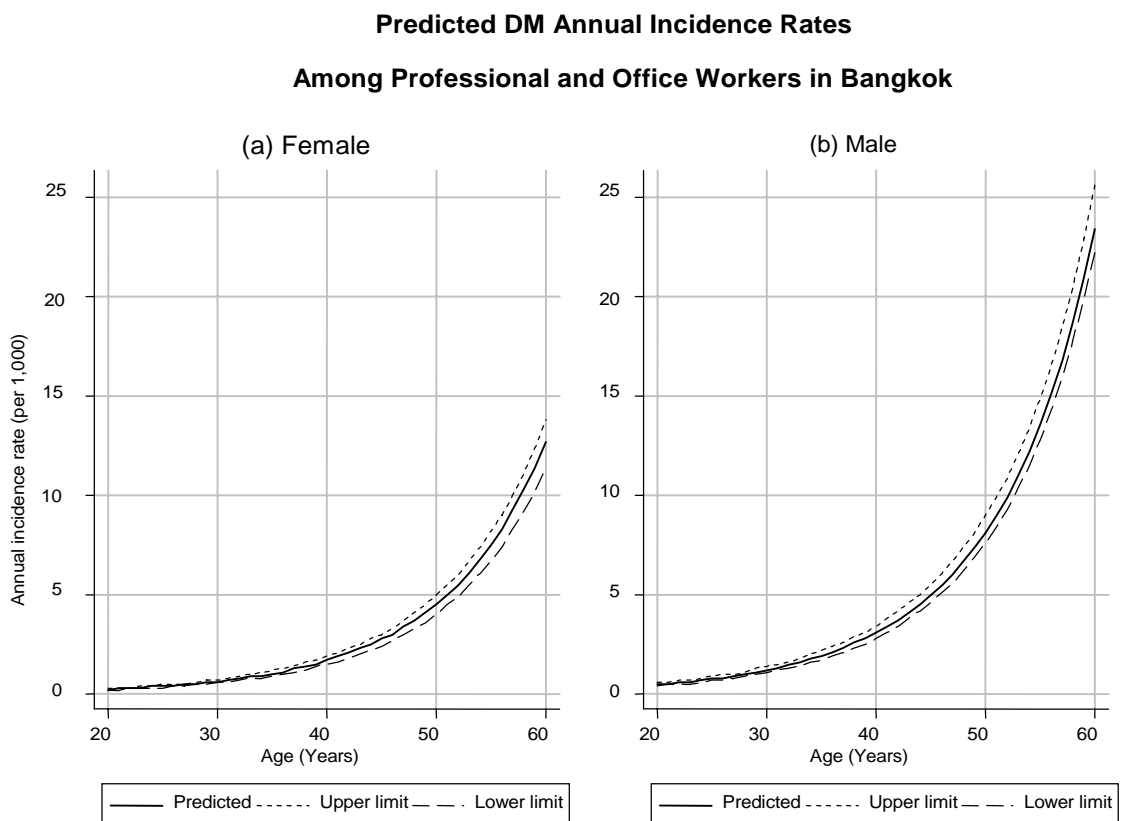
It was obvious in all studies that the prevalence rates of DM increased when the people are older. One disagreement among the studies was the sex distribution of DM. While Bhuripanyo *et al.* and our studies showed markedly higher prevalence rates of DM among male than female; a national survey and the results of Aekpalakorn *et al.* showed no such difference between both genders. It is noted that both studies of Bhuripanyo *et al.* and ours recruited subjects from professional workers in Bangkok area, while those of the latter two surveys

**Table 2.** Beta coefficients and their corresponding odds ratios for diabetes from the logistic regression model.

Variable	$\beta$ -coefficient	(95%CI)	Odds Ratio	(95%CI)	p-value
Age (year)	0.099	(0.089, 0.110)	1.11	(1.09, 1.12)	<0.001
Gender (female)	0.653	(0.520, 0.785)	1.921	(1.68, 2.19)	<0.001
Constant	-8.725	(-9.256, -8.193)			<0.001



**Figure 1.** Observed and predicted DM prevalence rates among the study subjects.



**Figure 2.** Predicted annual DM rates among the study subjects.

were from the general population all around the country.

Our predicted incidence rates of DM were also approximately twice higher among male than female. Since there has not been any study on the incidence rate of DM among Thai people, there is still no way to verify the validity of our predicted results. However, when compared it with the only available data of the population groups with the most similar genetic background such as the Taiwanese and the Japanese American, it seems that our prediction results are quite satisfactory.<sup>(8-9)</sup> Chou *et al.* reviewed the incidence of type 2 DM in Taiwan among the people of 30 years old or higher and reported an average annual incidence of 18 per 1000 in the studies that were based on similar

diagnostic criteria for DM (FPG of > 125 mg/dl).<sup>(8)</sup> Hara *et al.* analyzed prospective data of Japanese-Americans living in Hawaii and Los Angeles areas and reported the NIDDM incidence rate of 17.2 persons per 1000 person-years.<sup>(9)</sup> They also reported that the incidence of type 2 DM was 1.25 times higher in males than in females, and the rate increased with age. These reports were supportive of our results, although we predicted a slightly higher risk among males (1.9 times higher than female).

There are, however, two concerns in the interpretation of this study results: cohort effect and non-independence of the study subjects. As we estimated the age-specific DM prevalence rate basing on the different worker groups which might have

**Table 3.** Comparison of DM prevalence rates among recent studies in Thailand.

Age (yrs.)	Present Study*		Shinawatra Study**		National Survey <sup>†</sup>		InterAsia <sup>‡</sup>	
	Female	Male	Female	Male	Female	Male	Female	Male
35-39	0.8	1.9	0.5	3.9	4.3	2.3	4.9 ± 0.7	
40-44	2.1	4.3	0	3.8				
45-49	2.8	7.3	0	11.1	10.0	12.1		
50-54	6.1	9.7						
55-59	7.9	12.3					14.0 ± 1.6	

\* Subjects were 21,123 professional and office workers from 45 companies and agencies in Bangkok and vicinity (13,080 females and 8,043 males). Data were collected in Years 1999-2002. DM diagnostic criteria is fasting plasma glucose > 125 mg/dl.

\*\* Subjects were 3,615 employees of the Shinawatra Group, Bangkok (2,336 females and 1,239 males), Date of data collection was not specified. DM diagnostic criteria is fasting plasma glucose > 125 mg/dl.

<sup>†</sup> National Health Status Survey, Years 1995-1998. DM diagnostic criteria is fasting plasma glucose > 125 mg/dl.

<sup>‡</sup> The International Collaborative Study of Cardiovascular Disease in Asia (InterASIA), 5,105 subjects selected from 4 regions of the country, Data were collected in Year 2000. DM diagnostic criteria is fasting plasma glucose > 125 mg/dl or previous diagnosis of diabetes.

different experience or risk of the disease, thus introduced the cohort effect. Referring to the projection of the World Health Organization about increased future DM risk particularly in developing countries<sup>(10)</sup>, our results may then underestimate and represent the lowest estimate of the future DM risk especially at the older age range. Non-independence of the study subjects arose because some workers contributed more than one annual examination record for the DM prevalence analysis. However, each record each of these workers contributed was utilized in the prevalence estimate for different age, depending on their age at the calendar year of annual examination. By this manner, bias will be introduced only if there is differential probability to participate in the later annual examination among worker groups with different FPG results in the former examination year.

In summary, this study predicts that the annual incidence rates of DM among female and male Thai adults workers in their 20-60 years of age were 0.2 to 12.7 per 1000 and 0.5 to 25.6 per 1000, respectively. However, their validity needed to be further verified by the results of prospective studies on the same topic.

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