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Research Article

Diabetic Risk Score and Fasting Plasma Glucose Testing in the Screening for Type 2 Diabetes Mellitus Risk

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ABSTRACT

Type 2 diabetes mellitus (T2DM) is a common metabolic disorder and one of the leading causes of morbidity and mortality in both developed and developing countries. Early recognition and intervention will be helpful in reducing the personal and financial cost of the disease. We used the diabetic risk score (DRS) and fasting plasma glucose test (FPGT) for identification the risk of T2DM. A total of 142 female participants were randomly participated in the present study. These participants were identified as 39 (27.5%) high risk (Gr-III) and 71 (50%) very high risk (Gr-IV) for T2DM groups according to the DRS. In addition with 13 (9.2%) and 2 (1.4%) were newly diagnosed as having HT and T2DM. Both HT and T2DM participants were older than the normal participants. BMI and WC were not significantly different in the comparison of T2DM with Non-T2DM and HT with Non-HT patients. The DRS would be practical to use as tool for T2DM risk screening while FPGT was used to identify impaired fasting glucose and T2DM onset. Then, we recommended FPGT for the individuals with high and very high DRS groups.

Keywords: Diabetic risk score, fasting plasma glucose test, hypertension, type 2 diabetes mellitus.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is one of the leading causes of morbidity and mortality in both developed and developing countries. Increased prevalence of T2DM is significantly associated with socioeconomic development and industrialization. In general, the number of adults with T2DM in the world is expected to more than double between 2000 and 2030 with most of the increase in developing countries, particularly in Asia. India and China are at the top of the lists. By the year 2030, India and China will have 79–87 million and 42–63 million adults with diabetes, respectively[1]. A recent national study by Yang et al.[2] found that 92.4 million Chinese adults may already have diabetes. In Thailand, Diabetes Association of Thailand reported the prevalence of diabetes in adults (age 20-79 years) is 8.0%. In 2015, more than 4 million Thai adults (4,025,100 of Thai adults of 20-79 years) had diabetes with 75,994 adults in deaths attributed to diabetes. The cost per person with diabetes was about 351 USD and about 2,077,900 adults were expected to have undiagnosed diabetes[3].

Early identification and intervention for the conditions will be benefit and success for T2DM prevention and cardiovascular complications after the diabetes onset[4]. Because of these patients are asymptomatic in early stage and the anthropometric measurements are not different. The diabetic risk score (DRS) may be successfully implemented as a practical screening tool to assess the diabetes risk. Aekplakorn et al.[5] proposed a simple DRS test without laboratory tests, using for early intervention and prevention of T2DM in Thailand. This preliminary study, we try to test the DRS and fasting plasma glucose test (FPGT) for identification people who risk for T2DM.

MATERIALS AND METHODS

Subjects

Two hundred and five of female merchants were randomly selected from two main markets of Muang Districts, Phitsanulok Province to participate with the project of Type 2 Diabetes Mellitus Prevention during July - December 2016. Fifty three participants dropped out during the study period, and 10 were later excluded because they did not provide complete data and blood samples. The eligible participants were one hundred and forty two in the present study. The research protocol was approved by the Ethics Committee of the Naresuan University. Informed consent was obtained from each subject prior to collect blood samples and DRS questionnaire test.

Diabetic risk score assessment

We used the DRS[5] form as in Table 1 which is obtained from a simple and easy questionnaire. The DRS consists with the simple parameters included age, sex, body mass index (BMI), waist circumference (WC), hypertension, family history or sibling of T2DM addition with fasting plasma glucose testing. The DRS for each participant was calculated and categorized as: Group (Gr)-I score where ≤2 was defined as low risk; Gr-II score = 3-5 defined as moderate risk; Gr-III score = 6-8 defined as high risk; Gr-IV score >8 defined as very high risk.

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Table 1: Diabetic risk score.

Risk factor	Coefficient	Diabetic risk score
Age (years)		
34–39	-	0
40–44	-0.07	0
45–49	0.27	1
≥50	0.60	2
Sex		
Women		0
man	0.44	2
BMI (kg/m^2)		
<23		0
≥23 but <27.5	0.69	3
≥27.5	1.24	5
Waist circumference (cm)		
<90 in men, <80 women		0
≥90 in men, ≥80 in women	0.56	2
Hypertension		
No		0
Yes	0.64	2
History of diabetes in parent or sibling		
No		0
Yes	1.08	4

Anthropometric and blood pressure measurement

Height, weight, and blood pressure (BP) were measured and BMI was calculated. WC was measured at the midpoint between the rib cage and the top of lateral border of iliac crest during minimal respiration. Waist circumference values ≥90 cm in men or ≥80 cm in women was defined as abdominal obesity (AO)[6]. Blood pressure was recorded as the mean value of at least two measurements of each participant on the same day using a Terumo digital blood pressure monitor (ES-P110). Hypertension (HT) was defined as an average BP ≥140/90 mmHg or history of antihypertensive medications[7].

Fasting plasma glucose test (FPGT)

Fasting venous blood was collected from all participants. Plasma glucose levels were measured by glucose oxidase enzymatic method.

Statistical analysis

All variables are expressed as median and interquartile range. The Kruskal-Wallis Test was used to compare the difference of clinical characteristics of 4 groups. The Mann-Whitney U test was used to estimate difference between groups. Tests were two-tailed, and a p-value <0.05 was considered significant by using the SPSS version 13.0 (SPSS, Chicago, IL).

RESULTS

Total of 142 participants in the present study were categorized to 4 groups (Gr) according to DRS where in 9 (6.3%) subjects scores were ≤2 as Gr-I (low risk); 23 (16.2%) subjects scores were 3-5 as Gr-II (moderate risk); 39 (27.5%) subjects scores were 6-8 as Gr-III (high risk); 71 (50%) subjects scores were >8 as Gr-IV (very high risk). Of the participants, 35 (24.6%) were HT, 15 (10.6%) were T2DM and 25 (17.6%) had dyslipidemia by history of medication. They were distributed in Gr-IV (very high risk), Gr-III (high risk) and Gr-II (moderate risk) respectively. Thirteen (9.2%) and 2 (1.4%) were newly diagnosed as HT (NewHT) and T2DM in the present study. The comparison of all clinical characteristics of those 4 groups according to the DRS was significantly different in all clinical characteristics except plasma blood glucose by using the Kruskal-Wallis test (p<0.001) as shown in Table 2. We also compared the clinical characteristics according to DRS in each group. Gr-IV was the eldest group and significantly higher in BMI and WC than Gr-III and Gr-III>Gr-II> Gr-I. Gr-III and Gr-IV were not significantly different in SystBP but significantly higher than Gr-II and Gr-I and DiastBP was significantly different in each group. Plasma glucose levels were not significant different within any group.

The comparison of clinical characteristics in 13 NewHT participants were significantly higher in SystBP and DiastBP and no significantly different in Age, BMI, WC and glucose levels than 35 HT participants as shown in Table 3. Addition with the comparison of the clinical characteristic of all HT participants were significantly higher in Age, WC and glucose levels (p<0.05) than Non-HT participants as shown in Table 4. The comparison of clinical characteristics in of 15 T2DM participants were significantly higher in age and glucose levels while SystBP, DiastBP, BMI and WC were not significantly different than 127 Non-DM participants as shown in Table 5. The results suggested that only DRS screening may demonstrate the same risk and these Non-DM participants are in the T2DM risk and need intervention or life style change to improve their health risk.

Table 2: Demonstrated age, plasma glucose levels, BMI, WC, SystBP and DiastBP in each group according to the diabetes risk score.

Variables	Gr-I (n=9)	Gr-II (n=23)	Gr-III (n=39)	Gr-IV (n=71)	p-value
Age (years)	43.0 (40.3–51.5)*	45.0 (39.5–54.5)*	48.5 (43.0–53.3)*	56.5 (53.00–64.00)*	<0.001
BMI (kg/m^2)	20.1(17.7 – 21.0)	23.8 (21.7–25.8)	26.4 (23.7–30.2)	28.2 (25.9–30.6)	<0.001
WC (cm)	71.8(66.3 – 74.5)	78.0(75.8 – 81.0)	89.0 (80.8–94.1)	92.0 (86.0–98.0)	<0.001
SystBP (mmHg)	113.5 (98.3–121.0)	112.5 (101.8–123.0)	120.5 (110.0–130.3)	127.0 (118.8–138.5)	<0.001
DiastBP (mmHg)	77.0(63.3 – 84.5)	76.0(67.5 – 83.0)	79.5(71.0 – 83.0)	83.0(73.0 – 91.3)	0.027
Glucose (mg/dl)	82.5(78.2 – 93.8)	80.1 (75.3–87.0)	85.6 (79.3–94.0)	87.0 (79.3–108.2)	0.125

* median (inter quartile)

Table 3: Comparison the clinical characteristics of newly HT with HT in female merchants.

Variables	NewHT (n=13)	HHT (n=**35**)	*p*-value
Age (years)	56.0 (52.0 – 65.5)*	58.0 (52.0 -65.0)*	0.626
Glucose (mg/dl)	86.3 (80.2 – 94.7)	90.2 (82.6 -108.1)	0.187
BMI (kg/m^2)	27 (23.9 – 31.7)	26.7 (24.6 -30.2)	0.845
WC (cm)	91.0 (86.5 – 100.3)	92.0 (86.0 -98.0)	0.853
SystBP (mmHg)	148.0 (143.0 – 150.5)	129.0 (121.0 -145.0)	0.002
DiastBP (mmHg)	93.0 (86.0 – 98.5)	83.0 (71.0-93.0)	0.007

* median (inter quartile)

Table 4: Comparison the clinical characteristics of all HT with Non-HT in female merchants.

Variables	HT (n=48)	Non-HT (n=94)	*p*-value
Age (years)	58.0 (52.3 – 64.8)*	50.5 (42.8 – 57.0)*	<0.001
Glucose (mg/dl)	89.1 (81.4 – 106.1)	81.9 (78.2 – 93.8)	0.033
BMI (kg/m^2)	26.8 (24.6 – 31.0)	26.3 (23.2 – 29.8)	0.108
WC (cm)	91.5 (86.0 – 98.0)	85.0 (78.8 – 93.3)	<0.001
SystBP (mmHg)	138.5 (123.3 – 148.8)	117.0 (109.0 – 126.0)	<0.001
DiastBP (mmHg)	85.5 (75.0 – 93.0)	77.0 (71.0 – 83.0)	<0.001

* median (inter quartile)

Table 5: Comparison the clinical characteristics of T2DM with Non-T2DM in female merchants.

Variables	DM (n=15)	Non-DM (n=127)	*P-value*
Age (years)	59.0 (56.0 - 65.0)*	52.0 (45.0 - 59.0)*	<0.001
Glucose (mg/dl)	148.8 (123.9 -270.6)	83.1 (78.9 - 92.9)	<0.001
BMI (kg/m^2)	26.7 (23.5 - 32.1)	26.4 (23.6 - 29.9)	0.757
WC (cm)	92.0 (86.0 - 105.0)	87.0 (80.0 - 94.5)	0.092
SystBP (mmHg)	129.0 (115.0 - 138.0)	122.0 (110.0 - 132.0)	0.356
DiastBP (mmHg)	77.0 (71.0 - 93.0)	80.0 (71.0 - 88.0)	0.698

* median (inter quartile)

DISCUSSION

One hundred and forty two female participants were categorized according to the DRS as follow: 9 (6.3%) as Gr-I (low risk), 23(16.2%) as (moderate risk), 39(27.5%) as Gr-III (high risk) and 71(50%) as Gr-IV (very high risk). Most participants are overweight, obesity and abdominal obesity. Gr-III and Gr-IV (77.5%) were higher risk groups for T2DM (Table 2).

BMI, WC and BP were not significantly different between DM and Non-DM groups while age and plasma glucose levels were significantly higher ($p<0.001$) in the DM group. According to the DRS screening both DM and Non-DM groups may demonstrate the same risk. Both BMI and WC were the major risk of the DRS questionnaire, only FPGT can identify the T2DM onset. Our results suggested that T2DM, Non-T2DM, HT and Non-HT participants were obesity and abdominal obesity. Most participants were overweight and obesity in the present study. They are likely to have more increased obesity and abdominal obesity in the next consecutive year and continuous creating the high risk for T2DM development and onset in the future (older or longer time) with continuation of the same lifestyle. According to the results of the present study that HT and T2DM participants were significantly older than Non-HT and Non-T2DM. Obesity is the major risk factor for cardiovascular events and T2DM[8,9] and increases morbidity and mortality in adults[10]. There are several inflammatory mediators involved in obesity and IR[11]. Now, obesity is considered as a chronic, low-grade inflammation state[12]. Excessive adipocytes may play the crucial role in the pathogenesis of impaired glucose metabolism.

In the present study, hypertension (24.6%) is the major health problem. Hypertension is an important health problem and associated with severe CVD and renal complications risks. It has high medical and social costs[13,14]. There are many risk factors for hypertension such as older age, having a family history of HT, overweight or obesity and no physical activity. Genetic and daily behavioral factors are involved as the substantial portions of variability in outcomes remain unexplained. Stress may the underlying contributor to the overall cardiometabolic and diabetes risk[15]. Many research studies had demonstrated psychological stress as the major risk factor for HT[16], and some demonstrated the association between psychosocial stress (daily stress at work place) with elevated BP[17,18]. These female participants experience little physical activity, stress at work place (getup early at 3.00-4.00 AM for selling preparation), waiting for customers and stress due to low income and diet (more rice, carbohydrate and fat) that occur every day. The effects of chronic stress (work related stress, relationship stress and low socioeconomic status) were associated with HT[19,20]. These participants need suitable interventions and lifestyle training, including relaxation as well as increased physical activity and healthy eating interventions to improve their health risk. The interventions may include low carbohydrate/fat intake and healthy food choices. They also need optimal sleep (7-8 hrs/night) to maintain their metabolic health, increase insulin sensitivity and aid

their weight loss. A shorter sleep regime (<5-6 hrs) has also been associated with the diabetes risk[21,22].

Therefore, DRS questionnaire can used as screening tool concomitant with FPGT and BP measurement for individuals with the high risk score for identification the onset of T2DM. People at high risk for T2DM will benefit from receiving health education and having healthy lifestyles intervention to prevent or delay the onset of T2DM.

CONCLUSION

The DRS would be practical to use as tool for T2DM risk screening and FPGT was used to identify T2DM onset. Then, we recommended FPGT for the individuals with high and very high DRS groups.

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