Waist circumference is the key risk factor for diabetes in Korean women with history of gestational diabetes

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Received 11 May 2004; received in revised form 18 March 2005; accepted 2 June 2005
Available online 27 July 2005

Abstract

This study investigated relationships between various obesity indices and an onset of type 2 diabetes mellitus (TY2DM) in Korean women with history of gestational diabetes mellitus (GDM).

A total of 909 women with history of GDM were enrolled from the four major hospitals, and the first postpartum follow-up examination was made at 6 weeks, and annually thereafter. During postpartum follow-up period, mean 2.13 ± 1.75 years, we conducted 2 h 75 g OGTT and measured glucose, insulin, c-peptide, lipid profiles, lifestyle and dietary evaluation. For obesity parameters, we measured body weight, body mass index (BMI), waist and hip circumference, subcutaneous fat thickness, body fat percent and weight using bioelectrical impedance tests.

Diabetes incidence for 6 years was 12.8% and all the obesity indices were significantly higher in subjects with diabetes or glucose intolerance than those with normal glucose tolerance (\( p < 0.001 \)). When obesity indices were compared between <25th versus >75th percentile, the waist circumference presented with the strongest relationship (odds ratio = 5.8, 95% CI 2.8–11.8). This relationship persisted, OR = 3.86 (95% CI 1.8–8.2), even after adjusting for the potential confounders.

This prospective study revealed that waist circumference is one of the key risk factors for the onset of diabetes in Korean women with history of GDM.

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Keywords: Epidemiology; Abdominal obesity; Diabetes; Risk factors; GDM

1. Introduction

Gestational diabetes mellitus (GDM) is one of the most common complications of pregnancy, and women with GDM are at increased risk for type 2 diabetes mellitus (TY2DM) [1,2]. Uncomplicated
pregnancy is characterized by insulin resistance and enhanced insulin secretion as a compensatory mechanism to maintain normal glucose tolerance (NGT). However, previous studies indicated that in women with GDM more pronounced insulin resistance phenomena occurs [3]. These phenomena might contribute to hyperglycemia in addition to defective insulin release [3]. Furthermore, women with history of GDM have been considered a high-risk group for diabetes mellitus [4,5].

Several studies have shown that the prevalence of DM after GDM varies in wide ranges: Kjos et al. reported with 47% [4], Metzger et al. 50% [6], Damm 3–65% [7], Steinhart et al. 53% [8], and Ali and Alexis 62% [9]. This variability might be related to the ethnic variation, lack of uniformity in diagnostic criteria for GDM, diversity in follow-up care, demographic and metabolic characteristics of women who did not participated in follow-up examination, and differences in statistical management of data [10]. Many risk factors for the high incidence of DM after GDM were identified among the various ethnic groups. Of these many risk factors, obesity was one of the known risk factor for TY2DM after GDM [11,12]. However, it is not clear whether what the types of obesity parameters or magnitude of obesity are associated with an onset of diabetes in this high-risk population. Therefore, in this multi-centered prospective study, we evaluated the incidence of diabetes and the relationships between the various obesity indices and the onset of diabetes in Korean women who had a history of GDM.

2. Materials and methods

This research was conducted in the four major general and university hospitals in Korea. The study subjects were recruited from August 1995 to May 1997 and registered into the GDM registry. During 24–28 weeks’ gestation, we performed 1 h 50 g screening, and followed by 3 h oral glucose tolerance test (OGTT) during 28–32 weeks’ gestation if 1 h glucose value was ≥130 mg/dL. The National Diabetes Data Group (NDDG) criterion was used to diagnosis GDM [13]. Two or more of the following venous plasma glucose concentrations must be met or exceeded for a positive diagnosis; fasting value of ≥105 mg/dL (5.8 mmol/L), 1 h ≥190 mg/dL (10.6 mmol/L), ≥2 h 165 mg/dL (9.2 mmol/L), and 3 h ≥145 mg/dL (8.1 mmol/L).

To evaluate the risk factors and DM status, the initial examination was made at 6 weeks postpartum and annual follow-up examinations were performed thereafter. From the GDM registry (n = 2300), we identified a total of 1050 subjects who were available to be re-exam at the four study sites. Of the 1050 available subjects, 909 subjects were successfully completed follow-up examination more than once during a 6-year postpartum period. All subjects participated in the study voluntarily and informed consent was obtained in all participants. This study protocol was approved by the Ethical Committee of Institutional Review Board.

2.1. Questionnaire evaluation

During the initial and annual follow-up evaluation, the life style, dietary intake, family history of diseases, medical and reproductive history, socioeconomic status, educational level, and habitual factors of each participant were recorded by face-to-face interviews using the standardized questionnaire administered by the trained interviewers.

2.2. Chemical and anthropometric evaluation

After 8–14 h overnight fasting, all participants underwent 2 h of 75 g OGTT. The NDDG diagnostic criteria were used to diagnose DM during the postpartum follow-up period. During the OGTT, fasting, 30 min, 1 h, 90 min, and 2 h blood samples were obtained by venipuncture from antecubital veins. Serum were separated by centrifugation at 1900 × g for 15 min. The serum was transferred into labeled vials and frozen at −70 °C; within a month of freezing the serum, serum insulin and c-peptide levels were assayed. Plasma glucose level was measured using the glucose oxidize method (YSI 2300-STAT; Yellow Springs Instrument Co., Ohio) immediately after the blood was drawn. Plasma insulin and c-peptide levels were measured using radioimmunoassay kits (Linco Research Inc., St. Louis, MO). Once insulin and glucose values were obtained, the pancreatic beta-cell function and insulin resistance were calculated by a homeostasis model assessment (HOMA) [14]. Total area under the curve (AUC) for glucose, insulin, and c-
peptide was calculated by the trapezoidal method. Fasting blood samples were also sent to the hospital central laboratory immediately to analyze the lipid profiles. Total cholesterol and triglyceride concentrations were determined by enzymatic procedures with Beckman analyzer (Beckman Instruments, Brea, CA). High-density lipoprotein (HDL)-cholesterol levels were determined using the direct EZ-HDL Sigma assay, which uses anti-human 9-lipoprotein antibody to bind with low-density lipoprotein (LDL)-cholesterol, very low-density lipoprotein (VLDL)-cholesterol, and chylomicrons (Sigma Diagnostics, St. Louis, MO), and HDL-cholesterol levels then were directly analyzed by enzymatic procedures. The LDL-cholesterol was calculated from total cholesterol, triglyceride, and HDL-cholesterol by using the Friedwald equation [15]. Morning blood pressure (BP) was measured three times at the supine position after 10 min rest and the average values were used for the analyses. Two minutes rest period was given between each measurement. Blood pressure measurement was made before drawing blood. To assess obesity levels, we applied various methods, such as weight, body mass index (BMI), waist and hip circumference, and its ratio, body fat percent by the bioelectrical impedance method (Body Composition Analyzer, Giru Co., Korea), and skin fold thickness at four different sites. Skin fold measurement was made by the two researchers, whose inter-personal measurement was validated. Percent body fat was generated from the manufacturer’s equation that was formulated using Korean reference [16]. To calculate BMI, height and weight were measured while the patient was bare foot and wearing lightweight clothing. The BMI was calculated by dividing weight in kg × height in m². Moreover, pre-pregnant weight was questioned at the time of pregnancy evaluation. Waist circumference (WC) was measured at the level of the umbilicus, and hip circumference (HC) was measured at the level of the greater trochanters. Skin fold thickness (including bicep, tricep, subscapular, and suprailliac region) was measured using Lange skin fold callipers [17].

2.3. Statistical analysis and mathematical model

Statistical analyses were conducted using SPSS Window 10.0. All data were expressed as mean ± standard deviation (S.D.) and statistical significance at the level of \( p < 0.05 \). The study subjects were stratified into the three subgroups (normal glucose tolerance, NGT; impaired glucose tolerance, IGT; diabetes mellitus, DM) according to the NDDG criteria for the analysis [13]. Comparisons among the groups were made using analysis of variance (ANOVA), and the \( \chi^2 \)-test. In an attempt to identify a significant set of risk factors for DM among the parameters, Pearson correlation and a multiple logistic regression model was used. Relative risks of data were analyzed using both \( \chi^2 \)-test and logistic regression, with postpartum DM status as the dependent variable and obesity measurements, including WC as independent variables. A stepwise multiple logistic regression analysis was used to evaluate independent effects of the potential risk factors on the onset of DM during the postpartum period. The mathematical model to calculate AUC, beta-cell function, and insulin resistance is as follows [14]:

- Total AUC = \( \frac{(\text{fasting} + 120 \text{ min})/4 + (30 \text{ min} + 60 \text{ min} + 90 \text{ min})/2}{1} \).
- Beta-cell function = \( \frac{20 \times \text{basal insulin}}{\text{basal glucose} (\text{mg/dL})/18 - 3.5} \).
- Insulin resistance = \( \frac{\text{fasting serum insulin (mU/mL)} \times \text{fasting blood glucose (mmol/L)}}{22.5} \).

3. Results

During the 6 years postpartum follow-up, 116 of 909 (12.8%) and 120 of 909 (13.2%) women were converted into either DM or IGT, respectively. For the analyses, we used the measurements at the time of first diagnosis of DM or IGT, and the most recent measurement values were used for the healthy subjects. The mean duration of follow-up period was 2.13 ± 1.75 years, and no significant differences were observed among the three groups (NGT = 2.12 ± 1.78, IGT = 2.39 ± 1.8 and DM = 1.94 ± 1.53 years). Demographic characteristics of the study population are also summarized in Table 1. Mean age and parity were very similar among the three study groups. However, a frequency of positive family history (i.e., a parent or sibling) of diabetes in DM subjects was 55.2%, and when this rate was compared to the NGT 39.8% or IGT 49.2% groups it is significantly \( (p < 0.01) \) different. Furthermore,
family history of DM in either mother or father were more frequent in the DM group (42.2%, 42.2%, respectively) than the NGT group (35.8% study, 38.4%, respectively). Of 391 subjects who had a positive family history of DM, 299 (76.5%) presented a positive history of DM in either mother or father. When we compared working status and onset of diabetes, we found no relationships. However, when we adjusted for the putative risk factors such as age, waist/hip ratio (WHR), and bicep skin fold thickness using multiple logistic regression analysis, the onset of diabetes after GDM was significantly higher in women who worked outside of their home \((p < 0.001)\). We found no significant differences in other factors, such as drinking, smoking, and an education level among the groups.

Point-biserial correlations analysis between the status of diabetes (NGT, IGT, DM) and the putative risk factors, including clinical characteristics, lipid profile, and variables of obesity measurements were analyzed using the Pearson correlation. Blood pressure, family history of diabetes, total cholesterol, triglyceride, and LDL-cholesterol variables were all positively associated with diabetes status \((p < 0.01)\). While, HDL-cholesterol showed significantly negative correlation \((p < 0.01)\). All variables of obesity measurement also showed significantly positive correlation with the diabetes parameters \((p < 0.05)\) such as insulin, glucose and c-peptide, as well as the lipid parameters such as total cholesterol, triglyceride, HDL and LDL. Furthermore, indices of the all obesity variables were also positively correlated with most of the glucose, insulin, c-peptide and the lipid variables exception of HDL-cholesterol. HDL-cholesterol was negatively correlated with the obesity indices. The most significant positive associations were seen between total glucose AUC and waist circumference \((r = 0.21, p < 0.01)\), fasting blood sugar and body weight \((r = 0.17, p < 0.01)\), total insulin AUC and subscapular skin fold thickness \((r = 0.25, p < 0.01)\), fasting insulin and BMI \((r = 0.30, p < 0.01)\). We revealed that all of the obesity indices that were

<table>
<thead>
<tr>
<th>NGT ((n = 673))</th>
<th>IGT ((n = 120))</th>
<th>DM ((n = 116))</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>33.2 ± 4.7</td>
<td>34.2 ± 4.4</td>
<td>33.0 ± 4.2</td>
</tr>
<tr>
<td>Duration of follow-up (years)</td>
<td>2.12 ± 1.78</td>
<td>2.39 ± 1.8</td>
<td>1.94 ± 1.53</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>157.5 ± 4.7</td>
<td>157.5 ± 4.9</td>
<td>158.6 ± 5.2</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>57.3 ± 8.8</td>
<td>59.1 ± 8.0</td>
<td>63.7 ± 10.8</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>23.0 ± 3.4</td>
<td>23.8 ± 3.1</td>
<td>25.2 ± 3.9</td>
</tr>
<tr>
<td>Body fat (%)</td>
<td>29.6 ± 5.6</td>
<td>30.1 ± 5.3</td>
<td>31.1 ± 5.7</td>
</tr>
<tr>
<td>Total cholesterol (mmol/L)</td>
<td>4.94 ± 1.07</td>
<td>5.05 ± 0.89</td>
<td>5.43 ± 1.25</td>
</tr>
<tr>
<td>Triglyceride (mmol/L)</td>
<td>1.29 ± 0.83</td>
<td>1.42 ± 0.79</td>
<td>1.9 ± 1.19</td>
</tr>
<tr>
<td>HDL (mmol/L)</td>
<td>1.43 ± 0.38</td>
<td>1.41 ± 0.39</td>
<td>1.31 ± 0.4</td>
</tr>
<tr>
<td>LDL (mmol/L)</td>
<td>2.91 ± 0.95</td>
<td>2.99 ± 0.78</td>
<td>3.24 ± 1.04</td>
</tr>
<tr>
<td>Beta-cell function(^a)</td>
<td>2.1 ± 1.6</td>
<td>2.1 ± 1.2</td>
<td>1.7 ± 1.0</td>
</tr>
<tr>
<td>Insulin resistance(^a)</td>
<td>40.3 ± 26.0</td>
<td>54.6 ± 67.2</td>
<td>76.5 ± 63.1</td>
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<table>
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<th>Parity (n)</th>
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<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>&gt;3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family history (%)</th>
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<tbody>
<tr>
<td>Mother</td>
</tr>
<tr>
<td>Father</td>
</tr>
<tr>
<td>Siblings</td>
</tr>
<tr>
<td>Others</td>
</tr>
<tr>
<td>50 (18.7)</td>
</tr>
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<table>
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<tr>
<th>Occupation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

NS: not significant.

\(^a\) It is based on the HOMA calculations.

Table 1
Demographic characteristics at the final follow-up examination

In the table above, the demographic characteristics at the final follow-up examination are presented for subjects classified into three groups: NGT, IGT and DM. The table lists various parameters including age, duration of follow-up, height, weight, BMI, body fat percentage, total cholesterol, triglyceride, HDL, LDL, beta-cell function, insulin resistance, parity, family history, occupation, and gender. The table shows the mean ± standard deviation for each parameter in each group. The significance levels are indicated by asterisks or by the symbol \(p\).
evaluated in this study were significantly correlated on the onset of diabetes. Thus, we further analyzed the magnitude of the obesity level by comparing various obesity indices among the three groups. As shown in Table 2, we found that most of the obesity indices (exception of pre-pregnant weight and subscapular skin fold) showed a trend associated with the glucose status, highest in DM and followed by IGT and NGT. Therefore, to identify the best obesity index to predict onset of DM after the GDM, we further stratified the obesity levels by the percentiles. When the level of obesity was compared between the lowest (25th percentile) and the highest (>75th percentile) using logistic regression analysis, we found that all of the eight obesity indices were independently and significantly associated with an onset of DM during the 6 years postpartum. Of these eight significant obesity indices, we found that the waist circumference revealed with the highest Odds ratio (OR 5.8, 95% CI 2.8–11.8), and the lowest in tricep skin fold thickness (OR 2.02, 95% CI 1.1–3.6) When the potential confounders (such as blood pressure, lipid profiles, age, duration of follow-up, parity, family history of DM, and working status) were adjusted using multiple logistic regression method, the magnitude of OR further declined. However, waist circumference persisted as the strongest independent variable to predict postpartum DM in this study population (OR 3.86 CI 1.8–8.2). Triglyceride positively correlated with total cholesterol but negatively with HDL-cholesterol. However, total cholesterol positively correlated with HDL-cholesterol. Also, Pearson correlation between triglyceride and total cholesterol was as high as 0.4. Thus, based on the rule of multiple co-linearity we excluded total cholesterol from the model when we performed multiple logistic regressions. The multiple logistic regression analysis further revealed that WC was the strongest obesity index along with systolic blood pressure; triglyceride counted as an independent risk factor to predict postpartum DM after GDM (Table 3).

4. Discussion

GDM is currently defined as a carbohydrate intolerance identified during pregnancy with variable severity [18]. It has been suggested that gestational hormones are involved in metabolic changes of pregnancy, as hormones of the placental lactogen, growth hormone, and prolactin family enhances insulin production and release, as well as cell proliferation in islets of Langerhans. Simultaneously with the changes in the endocrine and the pancreas, the sensitivity of the maternal tissues for insulin decreases during pregnancy, thereby increasing the demand for insulin [19,20].

More than three decades ago, O’Sullivan and Mahan [21] have initiated studies of glucose intolerance during pregnancy in an effort to identify women

### Table 2
Comparison of the obesity variables among the three study groups

<table>
<thead>
<tr>
<th></th>
<th>NGT (n = 673)</th>
<th>IGT (n = 120)</th>
<th>DM (n = 116)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-pregnant body weight (kg)</td>
<td>59.6 ± 12.7</td>
<td>59.5 ± 17.9</td>
<td>66.6 ± 10.9***</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>76.2 ± 8.6</td>
<td>78.9 ± 9.2</td>
<td>81.9 ± 9.3***</td>
</tr>
<tr>
<td>Hip circumference (cm)</td>
<td>92.0 ± 6.7</td>
<td>93.0 ± 5.2</td>
<td>94.8 ± 7.6***</td>
</tr>
<tr>
<td>Waist/hip ratio</td>
<td>0.78 ± 0.10</td>
<td>0.80 ± 0.09</td>
<td>0.82 ± 0.09***</td>
</tr>
<tr>
<td>Skin fold thickness (mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicep (mm)</td>
<td>13.9 ± 5.9</td>
<td>15.3 ± 5.7</td>
<td>15.8 ± 6.9***</td>
</tr>
<tr>
<td>Tricep (mm)</td>
<td>20.9 ± 5.8</td>
<td>21.5 ± 5.4</td>
<td>23.2 ± 6.6***</td>
</tr>
<tr>
<td>Subscapular (mm)</td>
<td>20.7 ± 6.4</td>
<td>22.0 ± 5.9</td>
<td>24.8 ± 6.4***</td>
</tr>
<tr>
<td>Suprailiac (mm)</td>
<td>21.1 ± 7.4</td>
<td>23.7 ± 7.1</td>
<td>24.6 ± 8.1***</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>57.3 ± 8.8</td>
<td>59.1 ± 8.0</td>
<td>63.7 ± 10.8***</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>23.0 ± 3.4</td>
<td>23.8 ± 3.1</td>
<td>25.2 ± 4.0***</td>
</tr>
<tr>
<td>Body fat weight (kg)</td>
<td>17.2 ± 5.3</td>
<td>18.0 ± 4.4</td>
<td>20.1 ± 6.4***</td>
</tr>
<tr>
<td>Body fat (%)</td>
<td>29.6 ± 6.0</td>
<td>30.1 ± 5.3</td>
<td>31.1 ± 5.7*</td>
</tr>
</tbody>
</table>

ANOVA was used to test the significance among the groups.
* Significant at \( p < 0.05 \).
*** Significant at \( p < 0.001 \).
Women with history of GDM were found to be at increased risk for diabetes mellitus, and various predictors were also found to be associated. Severity of glucose intolerance during pregnancy, insulin requirement during pregnancy, earlier diagnosis during pregnancy, family history of diabetes, recurrence of GDM, increasing parity, maternal age, pre-pregnancy obesity, weight gain during and after pregnancy, presence of islet cell antibodies, and delivery of a macrosomic infant were reportedly the key risk factors for DM in women with history of GDM [10,22,23]. However, wide geographic and ethnic variations in the incidence of abnormal glucose tolerance after GDM have been reported from numerous studies [1,24]. In this prospective study, we observed approximately 41% incidence rates when data were analyzed using the 5 years postpartum survival analysis. This rate is very similar to the rate reported from Kjos et al. in a different ethnic group [2]. Although the incidence rate of DM in Korean women with history of GDM was very similar [25], the demographic characteristics of the Korean population were considerably different. For example, most of the studies reported from Korean subjects indicated that their DM subjects were leaner than the reports based on Caucasian population [25,26]. However, despite the lower level of obesity in the Korean population, most of the obesity indices in this study were significantly associated with an onset of DM in women with history of GDM. In addition to the obesity indices, most metabolic variables, including hyperlipidemia and blood pressure parameters, were also significantly associated with an onset of DM during the postpartum. However, the insulin changes after 75 g OGTT (IAUC) and the pancreatic beta-cell function evaluated by HOMA model during postpartum follow-up assessment were significantly lower in diabetic subjects than IGT or NGT subjects.

Obesity was considered the high-risk factor for diabetes mellitus. Several studies showed that TY2DM generally started with insulin resistance and obesity before the development of overt diabetes. The decreased pancreatic beta-cell function developed at a later stage, accompanied with clinical manifestations of diabetes [27–30]. DM subjects in our study showed these characteristic findings of TY2DM.

Numerous epidemiological studies showed that obesity contributes to the development of type 2 diabetes mellitus after GDM [9,10]. Thus, we evaluated various types of obesity parameters and magnitudes to determine the best index to predict diabetes in Korean women with history of GDM. We measured body weight, BMI, waist circumference, waist hip ratio, skin fold thickness at four different sites, and percent body fat assessment by bioelectrical impedance test. Based on the multiple logistic regression analysis, we found that suprailiac and tricep skin fold thickness, waist hip ratio, percent body fat, BMI, subscapular skin fold thickness, body weight, and waist circumference were all significantly associated with odds ratios of 2.6, 2.6, 4.4, 4.4, 4.4, 4.5, 4.6, and 5.8, respectively. This relationship persisted even after adjustment of the potential confounders by using multiple logistic regression analysis. Also, we found that waist circumference persisted as the strongest independent variable to predict DM with OR of 3.86 (95% CI 1.8–8.2).

In conclusion, although the level of obesity was lower in this population, this prospective study revealed that most of the obesity indices were also important risk factors for diabetes in Korean women with history of GDM. Of which, waist circumference was the most sensitive predictor for postpartum diabetes. Therefore, careful evaluation and monitoring of waist circumference may contribute to prevent DM in women with history of GDM. Further studies evaluating this risk factor should be performed.

<table>
<thead>
<tr>
<th></th>
<th>ORa</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suprailiac skin fold thickness</td>
<td>2.10 (2.6)</td>
<td>1.2–3.7</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Tricep skin fold thickness</td>
<td>2.02 (2.6)</td>
<td>1.1–3.6</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Waist/hip ratio</td>
<td>3.11 (4.4)</td>
<td>1.7–5.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body fat weight</td>
<td>3.76 (4.4)</td>
<td>1.8–7.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body mass index</td>
<td>3.34 (4.4)</td>
<td>1.7–6.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Subscapular skin fold thickness</td>
<td>2.82 (4.5)</td>
<td>1.4–5.6</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Body weight</td>
<td>3.06 (4.6)</td>
<td>1.6–6.0</td>
<td>0.001</td>
</tr>
<tr>
<td>Waist circumference</td>
<td>3.86 (5.8)</td>
<td>1.8–8.2</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

a Odds ratio was calculated using the logistic regression analysis. The potential confounders, such as blood pressure, lipid profiles, age, duration of follow-up, parity, family history of DM, and working status were included in the model as an independent variable to be controlled its effect. OR in parenthesis are the values before multiple adjustment.
Acknowledgement

This work was supported by the Korea Science and Engineering Foundation Special Basic Research Grant.

References


