The Association Between Parity and Metabolically Unhealthy Normal-Weight in Chinese Postmenopausal Women

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Research article

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Abstract

Background

Studies analyzing the association between parity and metabolically unhealthy normal-weight (MUHNW) individuals in postmenopausal women remain limited, this study aimed to explore the association between parity and MUHNW among Chinese postmenopausal women.

Methods

In total, 776 normal-weight undiagnosed type 2 diabetes postmenopausal women who visited the Second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University for a routine health check-up between 1 January 2017 and 31 December 2019 were included in the study. All individuals had fully completed information records encompassing standardized electronic medical records, physical examinations, and biochemical measurements. The association between parity and MUHNW was analyzed using multivariate logistic regression.

Results

Compared to women with a parity of one, the odds ratios (OR) [95% confidence interval (CI)] of the parity 2, 3, and ≥4 groups were observed to be 1.40 (0.89, 2.20), 2.00 (1.16, 3.44) and 1.87 (0.96, 3.62), respectively, with P for trend < 0.05 after adjusting for potential confounding factors. Women with a higher parity (≥3) had an increased OR of abdominal obesity, while the OR (95% CI) of the parity 3 group was 2.54 (1.46, 4.40) and that of the parity 4 group was 4.25 (2.11, 8.56), the P for trend < 0.001 after adjusting for age, body mass index (BMI), education level, first-degree relatives of patients with diabetes, smoking status, alcohol drinking status, physical activity, pregnancy losses, age at menarche, and duration of reproductive years. No significant differences were detected for other metabolic disorders including high levels of triglycerides (TG), blood pressure, fasting plasma glucose (FPG), and decreased high-density lipoprotein cholesterol (HDL-C) in different parity groups.

Conclusion

Higher parity was associated with a higher risk of MUHNW in Chinese postmenopausal women. Accordingly, it may be plausible that parity serves as a risk factor for metabolic disorders irrespective of BMI, and abdominal obesity may play an important role in metabolic disorders.

Introduction

In recent years, the incidence of metabolic syndrome (MetS) has markedly increased in China due to the westernization of life. Thus far, epidemiologic studies have suggested that MetS prevalence in China was 9.8% to 18.2% in different districts according to different diagnostic criteria[1-5]. Studies have found that women had a higher prevalence in elderly groups than men after 60 years of age (47.9% vs 27.6)[5]. Compared to men, female reproductive factors may explain the disparity among the elderly. Therefore, researchers have been interested in studying the correlation between female reproductive factors and MetS.
The metabolically unhealthy normal-weight (MUHNW) served as a subgroup of MetS. MUHNW individuals were those who presented with MetS with a normal body mass index (BMI) (18.5–24.9 kg/m$^2$)[6]. Nowadays, information on the global prevalence of MUHNW is scarce and inconsistent for different criteria of metabolic abnormalities [7-9]. Zheng et al concluded that the prevalence of metabolic abnormality was 34.1% in normal-weight individuals[16]. In 2017, Zhang et al.[7] reported that MetS prevalence was 8.14% among normal-weight individuals in Beijing, China. Previous studies [10-14] have also indicated that the risk of cardiovascular disease (CVD) in MUHNW individuals was about 1.5 to 3-fold higher than metabolically healthy individuals of normal weight. Moreover, MUHNW individuals were considered to have a worse prognosis compared to metabolically healthy obesity (MHO) individuals, which may be easily masked by having a normal weight. Therefore, it is necessary to focus on the subgroup of MetS.

Pregnancy is considered to be accompanied by major alterations in the metabolic system, which may play an important role in the metabolic abnormalities of postmenopausal women[15]. Although numerous studies have focused on the association between parity and MetS, the results have been inconsistent. To-date, studies analyzing the association between parity and MUHNW in postmenopausal women remain limited. Accordingly, this study aims to evaluate the associations between parity and MUHNW as well as its components among MUHNW in postmenopausal women.

Materials And Methods

Patients

In this study, 776 undiagnosed type 2 diabetes Chinese postmenopausal women aged 40 to 75 years old with normal weight who visited the Second Hospital Affiliated to Wenzhou Medical University Healthcare Center for a routine health check between 1 January 2017 and 31 December 2019 were recruited in this study. All participants completed their standardized electronic medical records, which included their demographic characteristics, reproductive history, lifestyle information such as physical activity, smoking and drinking status. This study was approved by the Institutional Review Board of the Second Affiliated Hospital of Wenzhou Medical University (KYKT2018-112).

Physical examination and laboratory tests

Physical examinations including body height, weight, and waist circumference(WC) along with blood pressure assessment were performed in the morning of testing a day after fasting for least 8 hours. Body weight and height were measured with light clothing and without shoes. The BMI was calculated as weight (kg)/height (m)$^2$. Blood pressure was measured by Omron intelligence electronic blood pressure monitor with the patient supine after resting for 10 minutes. Laboratory tests included glucose metabolism indexes such as fasting plasma glucose (FPG), 2 hours postprandial glucose (2hPG), and hemoglobin A1c (HbA1c). Undiagnosed diabetic participants took 75 g glucose orally, and lipid levels including total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C) and liver functions were analyzed.

Record of lifestyle information
The International Physical Activity Questionnaire was used to evaluate the physical activity by asking questions related to the frequency and duration of moderate and vigorous activities. Physically active was defined as having at least 150 minutes/week moderate-intensity activity, 75 minutes/week vigorous-intensity activity, or ≥150 minutes/week for a combination of the two[16]. Current smoking was defined as smoking at least one cigarette per day for >6 months. Current drinking was defined as consuming one or more alcoholic drink on ≥1 day in a week during the past half year.

**Definition of MetS and MUHNW**

MetS was diagnosed according to the criteria of the American Heart Association and the National Heart, Lung, and Blood Institute, together with the International Diabetes Federation in 2009: (1) WC of ≥80 cm, according to Asian-Pacific criteria; (2) fasting glucose of ≥100 mg/dL or current treatment for elevated glucose; (3) fasting triglycerides of ≥150 mg/dL or medication use; (4) HDL-C of <50 mg/dL or medication use; and (5) systolic blood pressure (SBP) of ≥130 mmHg, diastolic blood pressure (DBP) of ≥85 mmHg or under drug treatment for hypertension[17]. MUHNW individuals were those who presented with MetS with a normal BMI (18.5-23.9 kg/m²) from China.

**Statistical analysis**

Continuous variables which were normally distributed were expressed as means and standard deviation while non-normal distribution parameters were given as medians and interquartile ranges (IQR). Comparisons among normally distributed continuous variables were made using one-way ANOVA while that among non-normal distribution parameters were made using Kruskal-Wallis. Additionally, categorical variables were analyzed by the Chi-square test. Statistical analyzes were performed using the SPSS statistical software (Version 23.0, SPSS, Inc., Chicago, IL, USA), and analyses of the relationship between parity and MetS were performed using the statistical software package EmpowerStats (http://www.empowerstats.com, X&Y Solutions, Inc., Boston, MA). P values less than 0.05 (two-sided) were considered to be statistically significant.

**Results**

**Baseline characteristics**

A total of 776 patients were enrolled in the present study. Overall, 288 (37.1%) of the study population had MetS. Moreover, women with higher parity were more likely to be older, and a significant statistical difference was present among WC, FPG, 2hPG, HbA1c, SBP, DBP with the increase in parity. The levels of HDL-C had a significant statistical difference in relation to the increase in parity, however, TC, TG and LDL-C did not demonstrate any statistical difference. Lifestyle, such as alcohol drinking status, exhibited a significant difference across parity groups, while smoking status, physical activity did not. In terms of reproductive factors, age at menarche and duration of reproductive years were different in different parity categories, with no statistical difference in age at menopause among different parity groups. More details are listed in Table 1.

**Univariate analysis and multivariate logistic regression analysis**

The results of the univariate analysis demonstrated that age, SBP, DBP, FPG, BMI, WC, HDL-C and TG were...
correlated with MUHNW, while pregnancy loss, parity and educational attainment were probably associated with MUHNW (Table 2).

Multivariate logistic regression analysis was utilized to evaluate the association between parity and MUHNW as well as its components. Compared to the parity 1 group, the ORs (95% CI) of the parity 2, 3, and ≥4 groups were 1.86 (1.25, 2.77), 3.01 (1.96, 4.62) and 3.19 (1.92, 5.29), respectively, the P for trend <0.001, and after adjusting for age, BMI, education level, first-degree relatives of patients with diabetes (FDR), smoking status, alcohol drinking status, physical activity, pregnancy losses, age at menarche, duration of reproductive years, this association was attenuated, the OR (95% CI) of the parity 2 group was 1.40 (0.89, 2.20), while those of the parity 3 and ≥4 groups were 2.00 (1.16, 3.44) and 1.87 (0.96, 3.62), respectively, with a P for trend = 0.025. (Table 3)

Among the components of MUHNW, women with a higher parity showed a significantly higher prevalence of elevated WC than those in the parity 1 group even after confounding factors, such as age, BMI, education level, FDR, smoking status, alcohol drinking status, physical activity, pregnancy losses, age at menarche, and duration of reproductive years, were further adjusted [adjusted OR (95%CI) for the parity 3 group was 2.54 (1.46, 4.40), while that of the parity 4 group was 4.25 (2.11, 8.56), respectively, P for trend <0.001. Table 4 Model 3]. No significant difference was observed for the other components of MUHNW among the different parity groups (P > 0.05). (Table 4)

**Discussion**

To the best of our knowledge, few studies have evaluated the association between parity and MUHNW. The present study’s findings demonstrated that multi-parity was associated with an increased prevalence of MetS in postmenopausal women with a BMI lower than 24 kg/m², which was found to be significant. However, this trend was attenuated and became non-dose-dependent after adjusting for confounding factors. In regard to the components of MUHNW, only WC was significantly associated with parity after adjusting for confounding factors.

Several cross-sectional studies have concluded that parity was independently associated with an increased prevalence of MetS in different races and ethnicities[18-22]. Young Lee et al. conducted a cross-sectional study on 4098 Korean postmenopausal women and reported according to 5 groups of parity (0, 1, 2, 3 and ≥4). Accordingly, only higher parity (≥ 3 live births) was significantly associated with MetS when the parity 2 group was taken as reference (parity 3: OR 1.40 and ≥4: OR 1.38)[18]. Ortiz et al. found that women with MetS were also more likely to have had at least three children (P = 0.05) [23], though the associations were marginally significant. In addition, findings from a U.S. Hispanic/Latina study have shown that compared to one birth, those with four births had the highest odds of overall MetS (OR=1.4, 95%CI 1.0, 2.0) after adjusting for confounding factors including education, marital status, income, nativity, smoking, physical activity, menopausal status, oral contraceptive use, and hormone therapy[21]. However, Shamima Akter concluded that only pre-menopausal women with the highest parity (≥ 4) had 1.65 times higher odds of having MetS compared to those in the lowest parity (0-1), but not among postmenopausal women[20]. All of the aforementioned studies were conducted using general MetS, and none of these studies have focused on the relationship between parity and MUHNW. Specifically, only YAO et al. has compared the associations between
parity and MetS as well as its components in two groups according to BMI (normal weight vs overweight)[24]. Here, they concluded that there was a significant statistical difference between normal weight BMI and higher weight BMI in terms of associations between parity and MetS (P-interaction<0.001)[24]. However, they did not further evaluate the associations between parity and MetS as well as its components in the normal weight group. In this study, normal-weight women with multiple parturition (more than 3 times) were found to be at high risk of MUHNW. Although the ORs for the parity 4 group was lower than that for the parity 3 group, it was thought that the fewer individuals present in group ≥4 attributed to the results.

By further analyzing the components of MetS, no consensus was reached regarding the association between parity and WC as well as other metabolic disorders. Blaudeau TE conducted a cross-sectional study in order to assess total body fat and intraabdominal adiposity in 170 nonsmoking Caucasian women and found no relationship between parity and waist circumference (P= 0.16) [25]. Moreover, parity was also found to not be associated with central obesity (wc=88cm) both in an unadjusted and multivariable adjusted model (p= 0.66) [20]. Koch et al found that parity was associated with BMI, but was not related to WC[26]. However, A.A. Mansour et al. concluded that the number of births remained significantly and independently associated with increased WC after adjusting for age, BMI, employment, education, and marital status[OR=1.10, 95%CI(1.06,1.12)] [27]. In addition, researchers also found that parity was significantly associated with risk of abdominal obesity measurements (WC), exhibiting a greater OR than general obesity measurements (BMI) [28]. The present results demonstrated that high parity was found to be associated with increased WC. Potential reasons pertaining to the disparate results from this study could be due to the heterogeneity in the background of the study populations. Moreover, our study was conducted in women of normal weight, thus, it may be plausible that parity serves a risk factor of MUHNW irrespective of BMI, and WC may play an important role in metabolic disorders.

Potential biological mechanisms may explain the association between parity and WC. Excessive fat accumulation and postpartum weight retention induced by excess calories taken during pregnancy play a role in the pathophysiological mechanism of abdominal obesity. Studies have suggested that intra-abdominal adipose tissue increases with increasing parity[25], which has larger influences on central obesity than on overall obesity[22]. Furthermore, insulin resistance triggered by hormonal changes during pregnancy and relative increments in insulin may promote lipid synthesis[29] and triacylglycerol surplus to deposit as visceral adipose tissue[30], whereas repeated pregnancies may amplify such effect. In addition, the release of placental corticotropin-releasing hormone during pregnancy may result in excess cortisol exposure, causing intra-abdominal adipose tissue accumulation[31].

In the present study, the association between parity and other metabolic components (high fasting blood glucose, high blood pressure, elevated triglycerides and low HDL cholesterol) were not detected. The aforementioned studies have previously reported inconsistent results regarding the relationship between parity and other metabolic components. In this regard, it is believed that the socio-economic status of the study populations as well as different correction factors may partially account for the discrepancy.

Various limitations exist in the present study. First, similar to previous studies, this is a cross-sectional study, hence, a causal link between parity and MUHNW cannot be established. Second, recall bias was inevitable as information about reproductive factors was collected based on electronic medical records. Third, variables of
pregnancy related complications, such as gestational diabetes and pregnancy induced hypertension, were not taken into account in the data analysis as most postmenopausal women were not even aware of the related history of pregnancy complications. Furthermore, a history of lactation and oral contraceptives was not adjusted, although previous studies have reported that breast feeding was associated with a decreased risk of obesity[32] while a longer duration of breast feeding could help reduce postpartum weight retention[33]. In terms of the strengths of this study, this is first study that validates the association between parity and MUHNW in Chinese postmenopausal women. In addition, researchers have previously reported that pregnancy loss was associated with MetS[34] and other metabolic disorders such as diabetes or nonalcoholic fatty liver disease (NALFD)[35]. In this study, reproductive variables including duration of reproductive years and pregnancy loss were adjusted as confounding factors when exploring this association, whereas pregnancy loss was ignored in most previous studies.

Conclusion

In conclusion, higher parity (≥3) was found to significantly be associated with MUHNW after controlling for confounding risk factors. WC, which was thought to contribute to MetS in postmenopausal women, may serve as a risk factor for MUHNW. Routine screening for MetS in women of normal weight deserved more attention, prospective studies should explore the association between parity and MUHNW to better elucidate the potential mechanisms linking parity and MUHNW.

Abbreviations

MetS: Metabolic syndrome; MUHNW: Metabolically unhealthy normal-weight; BMI: Body mass index; CVD: Cardiovascular disease; MHO: Metabolically healthy obesity; WC: Waist circumference; FPG: Fasting plasma glucose; 2hPG: 2 hours postprandial glucose; HbA1c: Hemoglobin A1c; IQR: Interquartile ranges; SBP: Systolic blood pressure, DBP: Diastolic blood pressure; TG: Triglyceride; TC: Total cholesterol; HDL-C: High-density lipoprotein cholesterol; LDL-C: Low-density lipoprotein cholesterol; OR: Odds ratio; 95% CI: 95% confidence interval; FDR: First-degree relatives of patients with diabetes; NALFD: Nonalcoholic fatty liver disease.

Declarations

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Authors’ contributions

Mengte Shi, Chao Zheng and Youjin Pan designed, planned, and interpreted the study. Xinhe Zhou collected the data and performed the statistical analysis, Mengte Shi wrote the initial paper, Chao Zheng revised the paper, Youjin Pan led the study. All authors read and approved the final manuscript. Youjin Pan and Chao Zheng contributed equally and are co-corresponding author to this paper.

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Availability of data and materials
The data used to support the findings of this study from Institutional Review Board of the second affiliated hospital and Yuying Children's Hospital of Wenzhou Medical University but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Institutional Review Board of the Second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University.

Ethics approval and consent to participate
This study was approved by the Institutional Review Board of the Second Affiliated Hospital of Wenzhou Medical University (KYKT2018-112). All subjects agreed to participate in this study and provided written informed consent.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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Tables

Table 1. Baseline Characteristics of participants (N =776), by number of parity
| Variable                   | Parity   | \( P \) value |
|----------------------------|----------|---------------|
|                           | 1        | 2             | 3             | \( \geq 4 \) |
| N(%)                      | 217(28.0)| 283(36.5)     | 179(23.0)     | 97(12.5)    |
| Age, mean (SD)            | 54.40 ± 4.42 | 59.62 ± 5.60 | 63.21 ± 5.99 | 64.87 ± 5.97 | <0.001 |
| WC (cm)                   | 77.71 ± 6.17 | 80.17 ± 6.43 | 82.43 ± 7.52 | 83.73 ± 7.92 | <0.001 |
| BMI (kg/m\(^2\))         | 21.65 ± 1.62 | 22.00 ± 1.41 | 21.95 ± 1.46 | 22.02 ± 1.50 | 0.118 |
| FPG(mmol/L)               | 5.45 ± 1.01 | 5.50 ± 0.79   | 5.54 ± 0.78   | 5.55 ± 0.77  | 0.024 |
| 2hPG(mmol/L)              | 6.85 ± 2.69 | 7.33 ± 2.46   | 7.77 ± 2.57   | 8.32 ± 3.09  | <0.001 |
| HbA1C(%)                  | 5.76 ± 0.56 | 5.80 ± 0.51   | 5.85 ± 0.47   | 5.85 ± 0.48  | 0.017 |
| HDL(mmol/L)               | 1.58 ± 0.34 | 1.47 ± 0.33   | 1.50 ± 0.33   | 1.48 ± 0.30  | 0.006 |
| LDL(mmol/L)               | 3.4 ± 0.9  | 3.3 ± 0.9     | 3.3 ± 0.8     | 3.3 ± 0.8    | 0.548 |
| TC(mmol/L)                | 5.79 ± 1.00 | 5.66 ± 1.05   | 5.63 ± 1.01   | 5.68 ± 0.99  | 0.340 |
| TG(mmol/L)                | 1.50 ± 0.81 | 1.69 ± 1.12   | 1.66 ± 1.05   | 1.67 ± 0.89  | 0.131 |
| SBP (mmHg)                | 123.51 ± 15.89 | 129.12 ± 17.71 | 134.34 ± 17.60 | 137.61 ± 17.89 | <0.001 |
| DBP (mmHg)                | 76.47 ± 10.01 | 76.56 ± 9.76 | 77.97 ± 9.72 | 79.36 ± 9.89 | 0.036 |
| Age at menarche(y)        | 15.68 ± 1.77 | 16.13 ± 1.72 | 16.47 ± 1.78 | 17.03 ± 1.96 | <0.001 |
| Age at menopause(y)       | 49.31 ± 4.09 | 50.04 ± 3.87 | 49.77 ± 3.91 | 49.28 ± 5.07 | 0.269 |
| Duration of reproductive years(y) | 33.64 ± 4.41 | 33.91 ± 4.03 | 33.30 ± 4.29 | 32.25 ± 5.31 | 0.033 |
| Alcohol drinker,n(%)      | 0.002     |
| Never(548)                | 129 (59.4%) | 213 (75.3%)   | 133 (74.3%)   | 73 (75.3%)   |
| Current(220)              | 83 (38.2%) | 69 (24.4%)    | 44 (24.6%)    | 24 (24.7%)   |
| Former(8)                 | 5 (2.3%)   | 1 (0.4%)      | 2 (1.1%)      | 0 (0.0%)     |
| Smoking, n (%             | 0.868     |
| Never                     | 216 (99.54%) | 281 (99.29%) | 178 (99.44%) | 97 (100.00%) |
| Current                   | 1 (0.46%) | 2 (0.71%)     | 1 (0.56%)     | 0 (0.00%)    |
| Physical activity         | 0.201     |
| yes                       | 52 (23.96%) | 70 (24.73%)   | 41 (22.91%)   | 14 (14.43%)  |
| no                        | 165 (76.04%) | 213 (75.27%) | 138 (77.09%) | 83 (85.57%)  |
| Educational attainment | <0.001 |
|------------------------|--------|
| Illiteracy             |        |
| 9 (4.15%)              | 35 (12.37%) | 56 (31.28%) | 37 (38.14%) |
| Primary school         |        |
| 56 (25.81%)            | 101 (35.69%) | 73 (40.78%) | 43 (44.33%) |
| Middle school          |        |
| 108 (49.77%)           | 103 (36.40%) | 38 (21.23%) | 15 (15.46%) |
| High school            |        |
| 41 (18.89%)            | 37 (13.07%) | 11 (6.15%) | 2 (2.06%) |
| College or above       |        |
| 3 (1.38%)              | 7 (2.47%) | 1 (0.56%) | 0 (0.00%) |

| FDR                    | <0.001 |
|------------------------|--------|
| Yes                    |        |
| 175 (80.65%)           | 255 (90.11%) | 163 (91.06%) | 94 (96.91%) |
| No                     |        |
| 42 (19.35%)            | 28 (9.89%) | 16 (8.94%) | 3 (3.09%) |

| MUHNW                  | <0.001 |
|------------------------|--------|
| No                     |        |
| 166 (76.5%)            | 180 (63.6%) | 93 (52.0%) | 49 (50.5%) |
| Yes                    |        |
| 51 (23.5%)             | 103 (36.4%) | 86 (48.0%) | 48 (49.5%) |

Values are mean ± SD

Abbreviations: WC, waist circumference; BMI, body mass index; HbA1c, hemoglobin A1c; FPG, fasting plasma glucose; 2hPG, 2 hours postprandial glucose; TC, total cholesterol; TG, triglyceride; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; FDR, first-degree relatives of patients with diabetes; MUHNW, metabolically unhealthy normal-weight.

**Table 2** Univariate analysis for MUHNW
| Variable                          | Statistics   | OR (95%CI) | P-value |
|----------------------------------|--------------|------------|---------|
| Age, mean (y,SD)                 | 59.64 ± 6.60 | 1.07 (1.04, 1.09) | <0.001 |
| WC (cm)                          | 80.48 ± 7.16 | 1.17 (1.13, 1.20) | <0.001 |
| BMI(kg/m²)                       | 21.89 ± 1.50 | 1.53 (1.37, 1.71) | <0.001 |
| FPG(mmol/L)                      | 5.50 ± 0.85  | 2.94 (2.29, 3.79) | <0.001 |
| HDL(mmol/L)                      | 1.51 ± 0.33  | 0.03 (0.02, 0.06) | <0.001 |
| TG(mmol/L)                       | 1.63±1.00    | 3.94 (3.06, 5.08) | <0.001 |
| DBP (mmHg)                       | 77.21 ± 9.87 | 1.07 (1.05, 1.08) | <0.001 |
| SBP (mmHg)                       | 129.82 ± 17.86 | 1.04 (1.03, 1.05) | <0.001 |
| Age at menarche(y)               | 16.20 ± 1.83 | 1.01 (0.93, 1.09) | 0.846 |
| Age at menopause(y)              | 49.68 ± 4.11 | 1.01 (0.97, 1.04) | 0.772 |
| Duration of reproductive years(y)| 33.49 ± 4.39 | 1.00 (0.97, 1.04) | 0.849 |
| Alcohol drinker, n(%)            |              |            | 0.451   |
| Never                            | 548 (70.62%) | 1.0        |         |
| Current                          | 220 (28.35%) | 0.81 (0.58, 1.12) |       |
| Former                           | 8 (1.03%)    | 0.96 (0.23, 4.05) |       |
| Smoking, n (%)                   |              |            | 0.620   |
| Never                            | 772 (99.5%)  | 1.0        |         |
| Current                          | 4 (0.5%)     | 0.56 (0.06, 5.44) |       |
| FDR                              |              |            | 0.348   |
| No                               | 687 (88.5%)  | 1.0        |         |
| Yes                              | 89 (11.5%)   | 0.80 (0.50, 1.28) |       |
| Physical activity                |              |            | 0.765   |
| No                               | 599 (77.2%)  | 1.0        |         |
| Yes                              | 177 (22.8%)  | 0.95 (0.67, 1.34) |       |
| pregnancy losses                 |              |            | 0.121   |
| 0                                | 230 (29.6%)  | 1.0        |         |
| 1                                | 287 (37.0%)  | 0.67 (0.47, 0.96) |       |
| 2                                | 166 (21.4%)  | 0.79 (0.52, 1.19) |       |
| ≥3                               | 93 (12.0%)   | 1.01 (0.62, 1.64) |       |
| Parity | Count (Percentage) | OR (95% CI) |
|-------|-------------------|-------------|
| 1     | 217 (28.0%)       | 1.0         |
| 2     | 283 (36.5%)       | 1.86 (1.25, 2.77) |
| 3     | 179 (23.1%)       | 3.01 (1.96, 4.62) |
| ≥4    | 97 (12.5%)        | 3.19 (1.92, 5.29) |

**Educational attainment.**

| Level        | Count (Percentage) | OR (95% CI) |
|--------------|--------------------|-------------|
| Illiteracy   | 137 (17.65%)      | 1.0         |
| Primary school | 273 (35.18%)    | 0.60 (0.40, 0.91) |
| Middle school | 264 (34.02%)    | 0.52 (0.34, 0.79) |
| High school  | 91 (11.73%)       | 0.61 (0.36, 1.05) |
| College or above | 11 (1.42%)   | 0.90 (0.26, 3.08) |

Abbreviations: MUHNW, metabolically unhealthy normal-weight; WC, waist circumference; BMI, body mass index; FPG, fasting plasma glucose; TG, triglyceride; HDL-C, high density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; FDR, first-degree relatives of patients with diabetes; OR, odds ratio; SD, standard deviation.

**Table 3** Relationship between parity and MUHNW in different models
| Variable | Crude | Model 1 | Model 2 | Model 3 |
|----------|-------|---------|---------|---------|
|          | OR (95%CI) | P-value | OR (95%CI) | P-value | OR (95%CI) | P-value |
| Parity   |       |         |         |         |         |         |
| 1        | 1     | 1       | 1       | 1       |
| 2        | 1.86  | (1.25, 2.77) | 1.51  | (0.99, 2.30) | 1.52(0.98, 2.37) | 1.40 (0.89, 2.20) |
| 3        | 3.01(1.96, 4.62) | 2.12  | (1.30, 3.46) | 2.14(1.26, 3.64) | 2.00 (1.16, 3.44) |
| ≥4       | 3.19  | (1.92, 5.29) | 2.10  | (1.18, 3.75) | 2.13(1.13, 4.01) | 1.87 (0.96, 3.62) |
| P for trend | 1.52  | (1.31, 1.77) | <0.001 | 1.31 | (1.09, 1.56) | 0.004 | 1.31(1.07, 1.60) | 0.009 | 1.27 (1.03, 1.56) | 0.025 |

Model 1: adjusted for age;
Model 2: adjusted for model 1 + smoking, drinking, exercise, education first-degree relatives of patients with diabetes, pregnancy losses, age at menarche, duration of reproductive years, exercise;
Model 3: adjust 3 adjust for: model 2 + BMI;
Abbreviations: CI, confidence interval; OR, odds ratio.

Table 4 Association between parity and the prevalence of metabolic disorders
| Parity          | Crude        | Model 1     | Model 2     | Model 3     |
|-----------------|--------------|-------------|-------------|-------------|
|                 | OR(95%CI)    | P-value     | OR(95%CI)   | P-value     | OR(95%CI)   | P-value     |
| Abdominal obesity |             |             |             |             |
| 1               | Reference    | Reference   | Reference   | Reference   |
| 2               | 1.58 (1.11, 2.27) | 0.012       | 1.68 (1.14, 2.46) | 0.009       | 1.57 (1.05, 2.36) | 0.027       | 1.45 (0.93, 2.24) | 0.099       |
| 3               | 2.57 (1.71, 3.87) | <0.001      | 2.83 (1.76, 4.54) | <0.001      | 2.59 (1.56, 4.31) | <0.001      | 2.54 (1.46, 4.40) | 0.001       |
| ≥4              | 4.46 (2.61, 7.61) | <0.001      | 4.99 (2.72, 9.17) | <0.001      | 4.32 (2.24, 8.32) | <0.001      | 4.25 (2.11, 8.56) | <0.001      |
| P for trend     | 1.63 (1.40, 1.90) | <0.001      | 1.70 (1.41, 2.05) | <0.001      | 1.63 (1.33, 1.99) | <0.001      | 1.63 (1.31, 2.02) | <0.001      |
| High FPG        |             |             |             |             |
| 1               | Reference    | Reference   | Reference   | Reference   |
| 2               | 1.32 (0.90, 1.92) | 0.153       | 1.20 (0.80, 1.79) | 0.385       | 1.16 (0.76, 1.77) | 0.499       | 1.15 (0.75, 1.76) | 0.516       |
| 3               | 1.54 (1.01, 2.33) | 0.043       | 1.31 (0.81, 2.11) | 0.276       | 1.22 (0.72, 2.05) | 0.457       | 1.22 (0.72, 2.07) | 0.450       |
| ≥4              | 1.38 (0.83, 2.28) | 0.210       | 1.14 (0.64, 2.03) | 0.664       | 1.06 (0.56, 2.00) | 0.860       | 1.04 (0.55, 1.97) | 0.911       |
| P for trend     | 1.14 (0.98, 1.33) | 0.081       | 1.06 (0.89, 1.27) | 0.531       | 1.03 (0.84, 1.26) | 0.773       | 1.03 (0.84, 1.25) | 0.806       |
| High Bp         |             |             |             |             |
| 1               | Reference    | Reference   | Reference   | Reference   |
| 2               | 1.46 (1.02, 2.08) | 0.040       | 1.16 (0.79, 1.70) | 0.460       | 0.99 (0.66, 1.49) | 0.974       | 1.01 (0.67, 1.52) | 0.966       |
| 3               | 2.13 (1.42, 3.18) | <0.001      | 1.45 (0.91, 2.30) | 0.117       | 1.15 (0.69, 1.90) | 0.598       | 1.16 (0.70, 1.93) | 0.559       |
| ≥4              | 2.60 (1.58, 4.26) | <0.001      | 1.65 (0.94, 2.90) | 0.084       | 1.23 (0.66, 2.29) | 0.520       | 1.27 (0.68, 2.37) | 0.461       |
| P for trend | 1.40 (1.21, 1.62) | <0.001 | 1.19 (1.00, 1.42) | 0.049 | 1.08 (0.89, 1.31) | 0.446 | 1.09 (0.89, 1.33) | 0.395 |
|---|---|---|---|---|---|---|---|---|

### Elevated TG

| 1 Refrence | Refrence | Refrence | Refrence |
|---|---|---|---|
| 2 | 1.49 (1.04, 2.14) | 0.031 | 1.06 (0.72, 1.57) | 0.755 | 1.13 (0.75, 1.70) | 0.547 | 1.03 (0.68, 1.57) | 0.873 |
| 3 | 1.48 (0.99, 2.22) | 0.054 | 0.84 (0.52, 1.34) | 0.463 | 0.97 (0.59, 1.61) | 0.914 | 0.88 (0.53, 1.47) | 0.619 |
| ≥4 | 1.34 (0.82, 2.17) | 0.242 | 0.67 (0.38, 1.19) | 0.175 | 0.83 (0.45, 1.54) | 0.553 | 0.71 (0.38, 1.34) | 0.294 |
| P for trend | 1.12 (0.97, 1.29) | 0.134 | 0.87 (0.73, 1.04) | 0.126 | 0.93 (0.77, 1.14) | 0.498 | 0.89 (0.73, 1.09) | 0.264 |

### Low HDL-C

| 1 Refrence | Refrence | Refrence | Refrence |
|---|---|---|---|
| 2 | 1.64 (1.08, 2.49) | 0.019 | 1.48 (0.95, 2.30) | 0.083 | 1.51 (0.95, 2.41) | 0.084 | 1.41 (0.88, 2.26) | 0.156 |
| 3 | 1.48 (0.93, 2.35) | 0.096 | 1.24 (0.73, 2.11) | 0.422 | 1.24 (0.70, 2.20) | 0.469 | 1.13 (0.63, 2.01) | 0.690 |
| ≥4 | 1.47 (0.85, 2.56) | 0.168 | 1.20 (0.64, 2.25) | 0.577 | 1.14 (0.57, 2.29) | 0.703 | 1.01 (0.50, 2.05) | 0.978 |
| P for trend | 1.12 (0.96, 1.32) | 0.152 | 1.03 (0.85, 1.25) | 0.745 | 1.01 (0.82, 1.26) | 0.897 | 0.98 (0.78, 1.22) | 0.831 |

Model 1: adjusted for age;

Model 2: adjusted for model 1 + smoking, drinking, exercise, education first-degree relatives of patients with diabetes, pregnancy losses, age at menarche, duration of reproductive years, exercise;

Model 3: adjust 3 adjust for: model2+BMI;

Abbreviations: CI, confidence interval; OR, odds ratio; FPG, fasting plasma glucose; TG, triglyceride; HDL-C, high density lipoprotein cholesterol; Bp, blood pressure.