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# Prevalence of Metabolic Syndrome and Overweight/Obesity among Chinese Women of Childbearing Age: A Cross-Sectional Epidemic Study

**Xiaomiao Zhao[1#], Renmin Ni[1#], Yu Li[1], Lin Li[1], Jia Huang[1], Na Di[1], Ricardo Azziz[2] and Dongzi Yang[1*]**

[1]*Department of Obstetrics and Gynecology, Sun Yat-Sen Memorial Hospital, Sun Yat-Sen University, Guangzhou, PR China*
[2]*Georgia Health Sciences University, Augusta, GA, USA*
[#]contributed as the co-first authors

## Abstract

**Objects:** Metabolic syndrome (MS) is an independent risk factor for chronic metabolic disorders (CMD). This study investigated the prevalence of MS and overweight/obesity among women of childbearing age in southern China.

**Methods:** A nationally representative sample of 3200 southern Chinese women aged 20-45 years were randomly selected from 16 sampling units of two rural areas (Zhongshan and Xinhui) and two city regions (Guangzhou and Shenzhen) in Guangdong Province in China between June 2008 and July 2009. The prevalence of MS according to modified ATP III criteria and overweight/obesity (≥ 23.0 kg/m$^2$) were analyzed.

**Results:** Approximately 1.28 million women in Guangdong, China, were estimated to have MS, with an age-adjusted prevalence of 6.6% (95% CI 5.3%-7.5%), and 4.22 million [21.7% (95% CI 20.2%-23.2%)] were estimated to have overweight/obesity. In total, 39.5% women had one component of MS, 19.4% two components, 5.6% three components, and 0.9% at least four components. Compared to the 4.7% MS prevalence in women aged 20-25 years, the prevalence increased in women aged 31-35 years (1.3-fold) and increased more sharply in women aged 36-45 years (2.3-fold). The age-specific prevalence of overweight/obesity increased steadily by 1.3-1.8-fold beginning at 26-30 years of age (9.0%), and it reached a peak at 36-45 years of age (36.0%). The prevalence of MS and overweight/obesity increased in rural residents who preferred unhealthy diets and exercised less compared to urban residents.

**Conclusion:** Some women of reproductive age in southern China had MS, and a significant, and perhaps growing, proportion of women were overweight. Less exercise contributes to the higher prevalence of MS and overweight/obesity among rural residents than urban residents.

**Keywords:** Metabolic syndrome; Overweight; Chinese women; Reproductive age; Prevalence

## Introduction

Metabolic syndrome (MS) has become one of the major public-health challenges worldwide. The first attempt definition of MS was proposed by a WHO diabetes group in 1999 [1], considering insulin resistance or its surrogates, impaired glucose tolerance or diabetes, as essential components, together with at least two of: raised blood pressure, hypertriglyceridaemia and/or low HDL-cholesterol, obesity (as measured by waist/hip ratio or body-mass index), and microalbuminuria. An updated approach came from the US National Cholesterol Education Program: Adult Treatment Panel III in 2001, with a focus on cardiovascular disease risk [2]. It was less glucocentric than the definition from WHO, requiring the presence of any three of five components: central obesity, raised blood pressure, raised triglycerides, low HDL-cholesterol, and fasting hyperglycaemia. Suspiciously low prevalence figures in Asian populations resulted, the need for ethnic-specific cutoffs, at least for obesity was also suggested. Modified in 2005 [3], the definition of MS lowerd the criteria of high fasting glucose (modified ATP III criteria) from ≧ 110 mg/dL (6.1 mmol/L) to ≧ 100 mg/dL (5.6 mmol/L). ATP III recognizes the metabolic syndrome as a secondary target of risk-reduction therapy, after the primary target-LDL cholesterol. The ultimate importance of metabolic syndrome is that it helps identify individuals at high risk of both type 2 diabetes and cardiovascular disease (CVD) which is the leading cause of mortality worldwide [4,5]. China and other economically developing countries have experienced a CVD epidemic in recent decades [3-5]. Economic growth and changes in lifestyle and diet have led to an increase in the incidence of important modifiable risk factors for CVD and stroke, including impaired glucose tolerance and type 2 diabetes mellitus (DM2), hypertension, dyslipidemia, and overweight/obesity, in China and other developing countries [4,6,7]. The reported age-adjusted prevalence of MS and overweight was 17.8% and 26.9%, respectively, in Chinese women ages 35-74 years in 2000-2001. Ten years later, the occurrences of MS and obesity have increased in younger women [8-10].

The high prevalence of MS (approximately 10 to 50%) [11,12] is also a striking feature among women with polycystic ovary syndrome (PCOS), which is a common reproductive endocrine disorder that affects 7%-12% of women of childbearing age. PCOS causes chronic ovulatory dysfunction infertility, obesity, insulin resistance, and dyslipidemia, which are risk factors for CVD and DM2 [13,14]. However, few studies have reported the prevalence of overweight/obesity and MS among Chinese women of reproductive age. Vahratian et al. [10] reported that the prevalence of overweight [body mass index

***Corresponding author:** Dongzi Yang, Department of Obstetrics and Gynecology, Sun Yat-Sen Memorial Hospital, Sun Yat-Sen University, Guangzhou, P.R. China, 510120, Tel: +86-20-81332257; Fax: +86-20-81332853; E-mail: yangdz@mail.sysu.edu.cn

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(BMI) 25.0-29.9 kg/m$^2$] women of childbearing age (aged 20-44 years) was 24.5% in United States. Park et al. [15] compared the prevalence of MS in the US and Korea among young adults aged 20 to 39 years and found large variations between the two countries, 21.6% vs. 6.9% and 23.0% vs. 6.9%, according to National Cholesterol Education Program-Adult Treatment Panel III and International Diabetes Federation criteria, respectively.

Scant data exist on the prevalence of MS and overweight/obesity among women of reproductive age in China and other economically developing countries. Therefore, we estimated the prevalence of these metabolic abnormalities among women aged 20-45 years in South China and examined the impact of urbanization using a large-scale population-based study.

## Materials and Methods

### Ethics statement

The Human Research and Ethics Committee of Sun Yat-Sen Memorial Hospital, Guangzhou, Guangdong, China, and the National Center for Chronic and Non-communicable Disease Control and Prevention approved this survey. All participants provided written informed consent.

### Study population

This study was part of a cross-sectional study that assessed the prevalence of PCOS in nationally representative samples of the general female population, including reproductive age (20-45 years old) women, in South China between June 2008 and July 2009. A four-stage stratified sampling method was used, as previously described [16]. In stage one, two rural areas (Zhongshan and Xinhui) and two city regions (Guangzhou and Shenzhen) were selected to be representative of the geographic and economic characteristics in Guangdong province; 800 individuals from each region were included. In the second stage of sampling, two townships or districts (about 1000-2000 households) or institutions like factories, hospitals (medical workers), or schools (500-3000 individuals) were selected randomly from each of the rural areas and city regions, based on their locations (eastern, western, southern, northern and center) and activities. In the third stage, four villages or communities (100-200 individuals in each unit) were randomly chosen by stratified and cluster sampling from these units. In the final stages, all women of childbearing age in each sampling unit were stratified into five layers by age: 20-25 years, 26-30 years, 31-35 years, 36-45 years and 40-45 years; they were randomly chosen in each stratum. A total of 3200 women aged 20-45 years were randomly selected and invited to participate. The current analysis was restricted to individuals who had complete information concerning metabolic parameters (n=3000). The number of women studied was 1593 cases in urban area, and 1407 cases in rural area.

### Data collection

Data were collected at examination centers located at local health stations or community clinics in the participants' residential areas. Trained research staff administered a standard questionnaire in Chinese during visits. The staff obtained information on demographic characteristics, including age, sex, education, occupation, and household income and the status of menstruation and parity, the interview included questions related to the diagnosis and treatment of hypertension and diabetes. Women were asked whether diabetes had been diagnosed during pregnancy and whether it had been diagnosed when they were not pregnant. Sexual hormones were also examined. Women with peri-menopause or pregnancy were not included in this study. We collected information about the subjects' income using a uniform questionnaire designed by our gynecological experts and Public Health Professors from Peking University to identify the relationship between economic situations and metabolic syndrome. The gross income per capita monthly was divided into four categories: under ￥700; ￥701-￥1500; ￥1501-￥5000; and Over ￥5001. Income included all money that they earned, which mainly consisted of monthly salaries from their employer.

Clinical examinations included blood pressure and anthropometric measurements, which were obtained by trained and certified observers using standard protocols and techniques. Three blood pressure measurements were obtained with the participant in the seated position after 5 min of rest. Participants were advised to avoid cigarette smoking, alcohol, caffeinated beverages, and exercise for at least 30 min before blood pressure measurements. Bodyweight and height were measured twice during the examination. Weight was measured in light indoor clothing without shoes to the nearest 100 g. Height were measured without shoes to the nearest mm using a stadiometer. Waist circumference was measured at 1 cm above the navel at minimal respiration, and hip circumference was measured at the level of maximum extension of the buttocks.

Overnight fasting blood specimens were obtained for measurement of serum lipids and plasma glucose. Fasting times were verified before blood specimens were taken. Participants who had not fasted for at least 10 h did not have their blood drawn. Blood specimens were processed at the examination center and shipped to a central clinical laboratory in Peking University Third Hospital, Beijing, China, where the specimens were stored at -70°C until laboratory assays were performed.

Plasma glucose levels were measured using a One-Touch SureStep glucometer (Jnjmedical, USA) using the last drop of venous blood during blood collection. Insulin level was measured using an automatic chemical luminescence immunoassay (IMMULITE1000, Siemens, China Medical Solutions Group). Concentrations of total cholesterol, HDL-cholesterol, LDL-cholesterol and triglycerides were assessed enzymatically using commercially available reagents (Hitachi automatic biochemical analyzer model 7170, Japan). Intra-assay coefficients of variance were less than 1.5%, and inter-assay coefficients of variance were less than 3.0%.

All study personnel successfully completed a training program on the aims of the study and the specific methods used for the epidemiological survey of PCOS and its related metabolic disorders. The central study laboratory was standardized for lipid measurements according to the criteria of the US Centers for Disease Control and Prevention-National Heart, Lung, and Blood Institute Lipid Standardization Programs.

The presence of MS was defined according to the guidelines of the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) in 2005 [15], modified from the 2001 Adult Treatment Panel III (ATP III) criteria (modified ATP III criteria) and adjusted for the waist circumference to Asian women criteria: a) waist circumference (WC) greater than 80 cm in women; b) serum triglyceride concentration of 1.7 mmol/L or greater; c) HDL-cholesterol concentration of less than 1.30 mmol/L in women; d) blood pressure 130/85 mm Hg or greater; or e) serum glucose concentration of 5.6 mmol/L or greater. Individuals who were using antihypertensive or antidiabetic medications met the criteria for high blood pressure or high fasting glucose. BMI was calculated as weight in kg divided

by the square of height in m. Based on the criteria of overweight and obesity by WHO definitions and the results of our study [17], BMI ≥ 25 kg/m$^2$ was classified as obesity, 23 ≤ BMI<25 kg/m$^2$ as overweight, 18 ≤ BMI<23 kg/m$^2$ as normal, and BMI<18 kg/m$^2$ as underweight for Asian women. The criterion for MBS was BMI ≥ 23 kg/m$^2$, and only a classification of BMI ≥ 23 kg/m$^2$ was analyzed in the current study, which included the populations of overweight and obesity.

## Statistical methods

The prevalence of the individual components of MS and the prevalence of MS and overweight/obesity by areas of residence (rural or urban) and in the four age groups, 20-25, 26-30, 31-35 and 36-45 years of age, were analyzed. Sample sizes were estimated to meet generally recommended requirements for precision in a complex survey. Assuming a design effect of 1.5 (the ratio of the variance of a statistic from a complex sample to the variance of the same statistic from a simple random sample of the same size) and a risk factor prevalence of 5%, it was estimated that a minimum of 200 study participants would be needed for each final sample stratum.

All calculations were weighted to represent the Chinese women of Guangdong aged 20-45 years. Weights were calculated on the basis of data from the 2006 Guangdong Population Census. Prevalence estimates were calculated for the overall population and by the four age groups. Additionally, age-adjusted prevalence estimates were calculated for women in urban and rural areas after age standardization to the 2006 population distribution for Guangdong. Standard errors were calculated using a technique that was appropriate for the complex survey design. Except for the economic data and life style analysis by region performed with the Statistical Package for the Social Sciences (SPSS 15.0; SPSS Inc., Chicago, IL, USA), all other data analyses were performed with Stata (Version 10.0; StataCorp LP, Texas, USA).

## Results

The characteristics of the study participants are shown in Table 1. Women residents of urban areas had higher systolic and diastolic blood pressure, waist circumference, waist to hip ratio, and total cholesterol but lower LDL-cholesterol than their counterparts in rural areas ($P$<0.05). Table 2 denotes the crude and age-adjusted prevalence of overweight/obesity and the individual components of MS.

Overall, the age-adjusted prevalence of overweight/obesity (BMI ≥ 23 kg/m$^2$) of women aged 20-45 years was 21.7%. Of the women studied, 39.5% had one component of MS, 19.4% had two components, 5.6% had three components, and 0.9% had four components based on the modified ATP III criteria (Table 3). Residents of rural areas had a higher prevalence of having three components of the modified ATP III definition than residents in urban areas ($P$<0.05).

| | Total | Urban | Rural | *P*-value |
|---|---|---|---|---|
| Age (yrs) | 29.8 (0.1) | 30.3 (0.2) | 29.2 (0.2)[a] | <0.001 |
| SBP (mm Hg) | 110.8 (0.3) | 115.2 (0.3) | 105.7 (0.5)[a] | <0.001 |
| DBP (mm Hg) | 73.1 (0.2) | 74.6 (0.2) | 71.4 (0.3) | <0.001 |
| Weight (kg) | 52.0 (0.1) | 52.1 (0.2) | 51.9 (0.2) | 0.573 |
| BMI (kg/m$^2$) | 20.9 (0.1) | 21.0 (0.1) | 20.9 (0.1) | 0.655 |
| Waist (cm) | 72.0 (0.1) | 72.6 (0.2) | 71.3 (0.2)[a] | <0.001 |
| Waist-Hip ratio | 0.81 (0.00) | 0.81 (0.00) | 0.80 (0.00)[a] | 0.001 |
| Total cholesterol (mmol/L) | 4.63 (0.03) | 4.70 (0.04) | 4.58 (0.03)[a] | 0.019 |
| LDL-cholesterol (mmol/L) | 2.48 (0.02) | 2.42 (0.03) | 2.52 (0.03)[a] | 0.013 |
| HDL-cholesterol (mmol/L) | 1.49 (0.01) | 1.50 (0.01) | 1.48 (0.01) | 0.381 |
| Triglycerides (mmol/L) | 1.05(0.04) | 1.04 (0.09) | 1.05 (0.03) | 0.929 |
| FPG (mmol/L) | 5.28 (0.02) | 5.28 (0.02) | 5.28 (0.02) | 0.986 |
| Total numbers | 3000 | 1593 | 1407 | |

Data are means (SE); SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index; FPG=fasting plasma glucose.
[a]$P$<0.05 urban vs. rural.

**Table 1:** Metabolic characteristics of participants by region.

| | WC ≥ 80 cm | TG ≥ 1.7 mmol/L | HDL-C <1.3 mmol/L | HBP[b] | FPG ≥ 5.6 mmol/L | BMI ≥ 23 kg/m$^2$ |
|---|---|---|---|---|---|---|
| Crude | | | | | | |
| All | 16.2 (0.7) | 8.2 (0.7) | 28.4 (1.2) | 16.2 (0.7) | 29.5 (1.0) | 20.5 (0.7) |
| Urban | 17.8 (1.0) | 6.1 (0.9) | 25.6 (1.7) | 16.9 (0.9) | 30.4 (1.4) | 21.1 (1.0) |
| Rural | 14.3 (0.9)[a] | 9.7 (1.0)[a] | 30.8 (1.6)[a] | 15.4 (1.0) | 28.4 (1.5) | 19.8 (1.1) |
| *P* | 0.0100 | 0.0086 | 0.0254 | 0.2660 | 0.3295 | 0.4053 |
| Age-adjusted | | | | | | |
| All | 17.4 (0.7) | 8.3 (0.7) | 28.6 (1.2) | 16.2 (0.7) | 29.8 (1.1) | 21.7 (0.7) |
| Urban | 18.1 (0.9) | 6.1 (0.9) | 25.5 (1.7) | 16.9 (0.9) | 30.3 (1.4) | 21.4 (1.0) |
| Rural | 16.8 (1.1)[a] | 10.5 (1.1)[a] | 31.3 (1.7)[a] | 15.0 (1.0) | 29.9 (1.6) | 22.2 (1.2) |
| *P* | 0.0127 | 0.0046 | 0.0304 | 0.2246 | 0.5293 | 0.4258 |

Data are percentages (SE): WC: Waist Circumstance; TG: Triglycerides; HDL-C: High Density Cholesterol; FPG: Fasting Plasma Glucose; BMI: Body Mass Index;

The total crude numbers of women studied were 1593 cases in urban area, and 1407 cases in rural area.

[a]$P$<0.05 urban *vs.* rural;

[b]HBP, high blood pressure, defined as systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg or on antihypertensive medication.

**Table 2:** Crude and age-adjusted prevalence of individual components of metabolic syndrome and overweight.

| | modified ATP III criteria | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | ≥ 4 |
| Crude | | | | |
| All | 39.5 (1.3) | 19.0 (1.0) | 5.4 (0.6) | 0.9 (0.2) |
| Urban | 38.5 (1.9) | 17.0 (1.4) | 4.1 (0.8) | 1.2 (0.4) |
| Rural | 40.4 (1.8) | 20.8 (1.5) | 6.5 (0.9)[a] | 0.7 (0.3) |
| *P* | 0.4425 | 0.0670 | 0.0479 | 0.2845 |
| Age-adjusted | | | | |
| All | 39.5 (1.3) | 19.4 (1.1) | 5.6 (0.6) | 0.9 (0.3) |
| Urban | 38.4 (1.9) | 17.0 (1.4) | 4.1 (0.7) | 1.2 (0.4) |
| Rural | 40.6 (1.8) | 21.9 (1.6) | 7.0 (1.0) | 0.7 (0.3) |
| *P* | 0.4723 | 0.0705 | 0.0509 | 0.2471 |

Data are percentages (SE);

The total numbers of women studied were 1593 cases in urban area, and 1407 cases in rural area.

[a]$P$<0.05 urban *vs.* rural.

**Table 3:** Crude and age-adjusted prevalence of one or more components of metabolic syndrome.

In total, the age-adjusted prevalence of MS was 6.6% (95% *CI* 5.3%-7.5%) among women aged 20-45 years in southern China (Figure 1A), and the prevalence of overweight/obesity was 21.7% (95% *CI* 20.2%-23.2%) (Figure 1B). Moreover, the age-specific prevalence of MS and overweight/obesity increased with age (Figure 1). Compared to the 4.7% prevalence of MS by 20-25 years of age, the prevalence increased for 31-35 years of age (1.3-fold) and more sharply for 36-45 years of age (2.3-fold) (Figure 1A). The age-specific prevalence of overweight/obesity (Figure 1B) increased steadily by approximately 1.3-1.8-fold beginning at 26-30 years of age (9.0%), and it reached a peak at 36-45 years of age (36.0%). In total, as estimated according to the female population in Guangdong province in 2006, approximately 1.28 million women aged 20-45 years had MS as defined by the modified

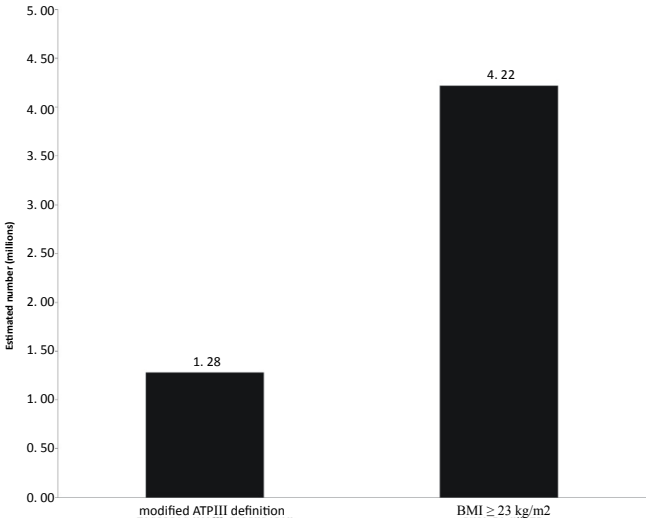


**Figure 1**: Age-specific prevalence of metabolic syndrome (A) and overweight/obesity (B) in the study population.

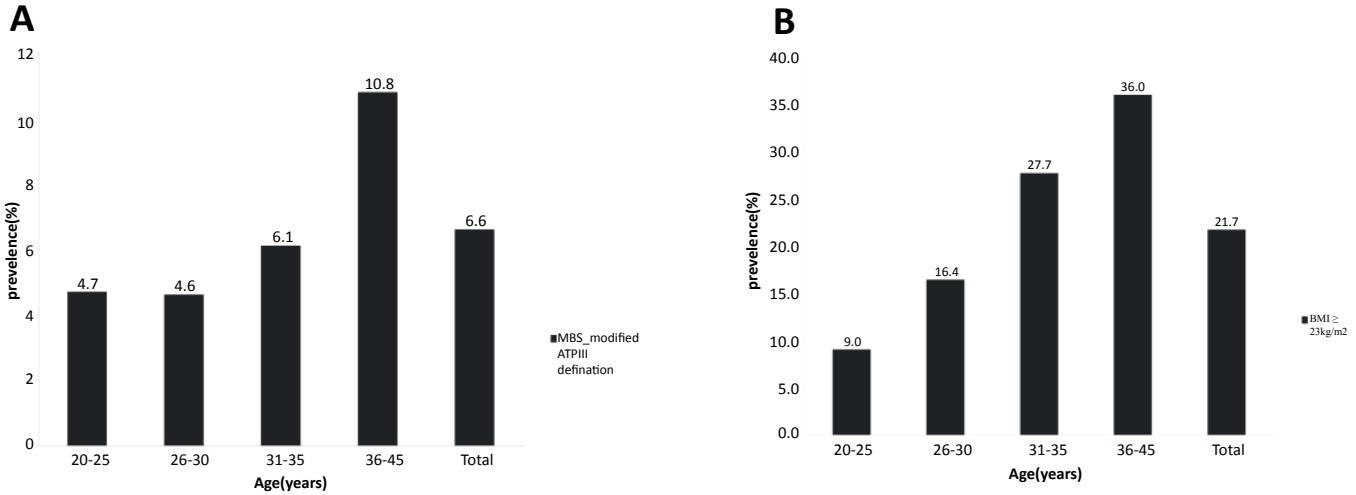


**Figure 2:** Estimated total numbers of women with metabolic syndrome and overweight in Guangdong province.

ATP III criteria, and 4.22 million had overweight/obesity defined by a BMI of 23 kg/m$^2$ or greater (Figure 2).

We assessed the role that rural vs. urban settings played in the prevalence of metabolic risk factors. Women in urban areas had a higher age-adjusted prevalence of abdominal obesity [18.1% (95% *CI* 16.3%-19.9%)] than women in rural areas [16.8% (95% *CI* 14.6%-19.0%), *P*<0.01]. However, women in urban settings had a lower prevalence of hypertriglyceridaemia [6.1% (95% *CI* 4.3%-7.9%)] and lower HDL-cholesterol [25.5% (95% *CI* 22.2%-28.8%)] levels than women in rural areas [10.5% (95% *CI* 8.3%-12.7%) and 31.3% (95% *CI* 28.0%-34.6%), respectively]. The prevalence of overweight, hypertension and impaired glucose tolerance were similar among women dwelling in urban and rural areas (Table 2).

We analyzed the income and selected lifestyle parameters of women in urban and rural areas to explain the differences in metabolic risk factors between these groups of women (Table 4). There were fewer individuals among the residents of urban areas who earned very low wages (less than ￥700), but they performed less manual labor, exercised less, and ate sweets and snacks more frequently (Table 4).

## Discussion

Our results indicated that 1.28 million (or 6.6%) women aged 20-45 years in Guangdong Province in southern China had MS as defined by the modified ATP III criteria, and 4.22 million (21.7%) women had overweight/obesity as defined by a BMI of 23 kg/m$^2$ or greater in 2008-2009. At least 39.5% of the women had one component of MS. These findings showed that MS and overweight/obesity are serious public health challenges because of the large population in China. The obvious increased rate of MS in 31-35-year-old women suggests that public attention to the risks of CVD and other metabolic disorders needs to start from age 31 years in women in southern China. However, the steady increase in the prevalence of overweight/obesity after 26-30 years of age indicated that this attention should begin at 26 years of age.

Moreover, the prevalence of estimated MS in the present study is

| | Total (%) | Urban (%) | Rural (%) | P-value |
|---|---|---|---|---|
| Education | | | | |
| Illiteracy | 9(0.3) | 4(0.3) | 5(0.4) | 0.000407 |
| Primary school | 174 (5.9) | 78 (5.0) | 96 (6.9) | |
| Secondary school | 1574 (53.3) | 889 (56.8) | 685 (49.4) | |
| College degree or above | 1195 (40.5) | 595 (38.0) | 600 (43.3) | |
| Income | | | | |
| Under ￥700 | 398 (14.3) | 210 (14.1) | 188 (14.5) | 7.89E-22 |
| ￥701-￥1500 | 1259 (45.0) | 607 (40.7) | 652 (50.1) | |
| ￥1501-￥5000 | 974 (34.8) | 529 (35.4) | 445 (34.2) | |
| Over ￥5001 | 165 (5.9) | 148 (9.9) | 17 (1.3) | |
| Diet | | | | |
| Sweet foods | 2494 (84.0) | 1305 (82.8) | 1189 (85.4) | 0.048 |
| Fried food | 2650 (89.9) | 1387 (88.9) | 1263 (91.1) | 0.05 |
| Snacks | 2370 (79.9) | 1254 (79.7) | 1116 (80.0) | 0.85 |
| Exercise | | | | |
| Seldom | 9 (0.3) | 1 (0.1) | 7 (0.5) | 8.92E-23 |
| One time per week | 2226 (74.2) | 1042 (65.4) | 1166 (82.9) | |
| One time per day | 765 (25.5) | 550 (34.5) | 234 (16.6) | |
| Job type | | | | |
| Physical labor | 1652 (55.9) | 793 (50.3) | 859 (62.3) | 6.13E-11 |
| Intellectual work | 1303 (44.1) | 783 (49.7) | 520 (37.7) | |

Data are expressed as percentages.

"Sweets" means foods with added sugar that taste sweet, usually including both carbohydrates and fat-laden foods, such as candy, chocolate, cakes, bread, biscuits/cookies, ice cream, and sweet dried fruits. "Snacks" means other unsweetened snacks, such as melon seeds, sunflower seeds, peanuts, pistachio nuts, almond, and spicy broad beans or peas (Chinese relish).

The total numbers of women in difference sub-groups were various, because some cases with missing record were deleted.

**Table 4:** Economic status and life style of participants by region.

similar to that in other regions or countries that have a similar level of economic development [18,19]. However, the prevalence of these conditions remains lower than in regions that are more economically developed [20]. In addition, the prevalence of MS in this study is lower than in PCOS patients in our previous report [12], which was 12.7% in the group aged ≤ 30 years, 26.8% in the group aged 30-39 years, and 75.0% in the group aged ≥ 40 years using the 2005 modified ATP III criteria [3]. The prevalence of overweight/obesity in southern China reported in this study is lower than in the USA [10], but the prevalence exceeds other Asian countries [21].

Interestingly, the prevalence of MS and overweight/obesity reported in our study were higher in rural areas than in urban areas. This result is different from the report of Gu et al. [22] and Wang et al. [21] in older Chinese women in 2000-2001 that showed the opposite results. The reason for this difference might be due to the rapid economic growth in China during the past ten years, especially in southern China, which greatly improved living standards in rural areas [23]. The people in the rural areas of Guangdong province could get more than enough food, but lack of enough educations for healthy diet and live habit. This result is consistent with some reports from other Chinese scholars in recent years [24] and from economically developed counties [25]. Food acquisition for women in rural areas is no longer a problem, and knowledge of healthy diet habits and life styles is needed in order to avoid sweet and fried foods and exercise more. Furthermore, MS and overweight are associated with an increased risk of diabetes and cardiovascular disease morbidity and mortality, which results in an enormous economic burden to society [26]. A meta-analysis of prospective data showed that reductions in overweight (BMI ≥ 24·0 kg/m$^2$) might reduce the incidence of stroke by 22% in women in China [27]. Briefly, the current findings remind us that women who are recently economically satisfied may be a new emerging population that is exposed to a high risk of chronic metabolic diseases, and education on health and nutrition is necessary for these women currently in China and other developing countries.

There are several strengths of the current report. The study was conducted in a large representative sample of southern Chinese women of reproductive age using standard protocols and instruments. Strict training processes and vigorous quality assurance programs were used to ensure the quality of data collection. Additional strengths of the study include a high response rate, three blood pressure measurements, detailed information on the history of diabetes and hypertension, standard laboratory methods for glucose and lipid measurements, and the use of a central clinical laboratory for all glucose and lipid assays. The study limitations included the lack of an extensive exploration of the environmental and social factors that were related to the occurrence of MS and overweight.

## Conclusion

These findings indicate that few reproductive-aged women in southern China had MS, but a significant, and perhaps growing, proportion demonstrates overweigh/obesity. Less exercise contributes to the higher prevalence of MS and overweight/obesity among rural residents than urban residents.

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