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*Original Article*

# The prevalence and risk factors of metabolic syndrome a suburban community in Pathum Thani province, Thailand

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**Abstract**

This study investigated prevalence and risk factors of metabolic syndrome (MetS) in a suburban community in Pathum Thani province, Thailand. Anthropometric data, blood pressure, blood glucose and lipid levels were recorded from 222 participants, 35-65 years old. Identification of MetS was based on guidelines of the National Cholesterol Education Program III. The study found the prevalence of MetS was 36.49% with no significant differences between male and female participants. An advancing body mass index (BMI) emerged as one of the most significant risk factors. Participants with BMI $\geq$ 23 kg$^{*}$m$^{-2}$ had an increased risk of MetS (OR 3.17). Furthermore, participants in the age group 55-65 years had an increased risk of MetS (OR 2.28). Lack of exercise and high waist to height ratio were also important risk factors (OR 2.38 and 3.37, respectively). Therefore, increased physical activity or exercise and weight control are advised to reduce the prevalence of MetS.

**Keywords:** metabolic syndrome, prevalence, community, physical activity, overweight

## 1. Introduction

Metabolic syndrome (MetS) has been defined in terms of a group of risk factors for cardiovascular disease (CVD) and cerebrovascular disease. However, definitions of MetS by different criteria have been proposed, for example by the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III), the International Diabetes Foundation (IDF), the World Health Organization (WHO), and the European Group for the Study of Insulin Resistance (EGIR). The proposed clinical diagnosis criteria of MetS are defined as $\geq$ 3 of the following: central obesity, elevated blood pressure (BP), low high-density lipoprotein cholesterol (HDL-C), elevated triglycerides (TG), impaired fasting glucose (Huang, 2009; NCEP, 2002). It has been reported that individuals diagnosed with MetS have a twofold increased risk to develop CVD over the next 5-10 years and a five-fold increased risk of type II diabetes mellitus (Alberti *et al.,* 2009). The prevalence of MetS is increasing worldwide and in the 2010 National Health and Nutrition Examination Survey (NHANES) a 22.9% prevalence of MetS was reported in the United States of America (Beltran-Sanchez *et al.,* 2013).

In Thailand, the overall prevalence of MetS among adults was 32.6% with 35% in the capital Bangkok (Aekplakorn *et al.,* 2011). The socioeconomic environment of Pathum Thani province, which is located to the north of Bangkok, has

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rapidly changed in recent decades and among the provinces it has the fastest population and economic growth compared to the capital. Despite its rapid growth and the associated negative health consequences the prevalence of MetS had never been investigated in this province. Therefore, the present study was undertaken to record the prevalence of MetS in a limited area of Pathum Thani province, the Klong Luang 4 community by applying the NCEP definition. In addition, risk factors of MetS were investigated.

## 2. Materials and Methods

The present study was a cross-sectional population survey with participants from the Klong Luang 4 community, Pathum Thani province, Thailand. Males and females were recruited either through poster advertisements, distributed flyers and brochures or directly, by approaching them in their primary care hospital. Ethics and protocols were approved by the Research Ethics Committee on Human Subjects, Thammasat University, and written and informed consent was obtained from all participants. The cross-sectional study was designed to explore the prevalence of MetS. Anthropometric data, blood samples and blood pressure (BP) data were collected. Anthropometric measures were performed as previously described (Yuenyongchaiwat, 2015). Briefly, standing waist circumference was measured in duplicate using a tape measure in centimeters at the level of the umbilicus and the mean value was calculated. All participants were asked to refrain from drinking and food consumption for 8-12 hours before blood samples were drawn for analysis of lipid and glucose levels. Plasma glucose, high-density lipoprotein cholesterol (HDL-C), and triglyceride (TG) levels were measured. Resting BP (5 min initial rest) was recorded on the left arm using an Omron[â] M6 Comfort BP monitor (HEM-7211; Omron Healthcare B.V., Kruisweg, Hoofddorp, The Netherlands). An appropriate arm cuff size was connected on the left semi-flexed arm at the heart height level as recommended by the manufacturer. According to a new American Heart Association (AHA) recommendation, at least two BP readings should be taken at a one-minute interval (Smith, 2005). Therefore, BP measurements were recorded at minutes five and six and the mean BP was calculated. However, if the two BP readings differed by > 5 mmHg, a third BP reading was recorded and then the three BP readings were averaged.

The NCEP ATP III guidelines were used to categorize symptoms of MetS. The ATP criteria were defined as a person having a waist circumference in male > 102 cm (> 40 inches) or female > 88 cm (> 35 inches) plus any two or more of the following four risk factors: (1) TG $\geq$ 150 mg/dL; (2) low HDL-C, male < 40 mg/dL, female < 50 mg/dL; (3) high BP (systolic BP $\geq$ 130 or diastolic BP $\geq$ 85 mmHg) or persons taking antihypertensive medicine; and (4) high fasting glucose ($\geq$ 110 mg/dL) or previously diagnosed with type 2 diabetes (NCEP, 2002). The study defined a positive family history of CVD as myocardial infarction, coronary revascularization, or sudden death before 55 years of age in father or other male first-degree relative, or before 65 years of age in mother or other female first-degree relative, or essential hypertension in one or both biological parents or siblings (Lloyd-Jones *et al.,* 2004; Treiber *et al.,* 1997). According to the American College of Sports Medicine (ACSM) and the AHA exercises were defined as individual accumulations of 30 minutes of moderate intensity at least five days per week or 150 minutes per week (Haskell *et al.,* 2007). It has been suggested that a waist to height ratio is a simple and suitable screening tool applicable to a wide variety of populations for all cardiometabolic outcomes (e.g., diabetes) (Alberti *et al.,* 2009; Ashweel & Hsieh, 2005; Browning *et al.,* 2010). Therefore, the waist to height ratio was calculated and the mean boundary values for waist to height ratio are used for males and females at 0.5.

Descriptive data are presented as percentage (%), mean, standard deviation (SD), and median. Body mass index (BMI) was computed as body weight (kg) divided by the square of the body height ($m^2$). Data were verified for normality of distribution using the Kolmogorov–Smirnov Goodness of Fitness test. A chi-square test was used to analyze differences between the obtained values in participants with or without MetS. In addition, ANOVA was conducted to compare variables between participants with MetS where appropriate. Finally, logistic regression analysis was used to determine independent predictors for MetS. A *p*-value of < .05 was considered statistically significant. All statistical analyses were performed with SPSS version 20.0.

## 3. Results

In total 222 subjects (60 males, 162 females) participated in this study. The mean age in this group was 48.50± 7.39 years (range: 36-65 years) and the overall prevalence of metabolic syndrome (MetS) was 36.49% with 26.66% (16) in males and 40.12% (65) in females. Main occupations of the participants were grocer and housemaid (53.5%), followed by laborer and agriculturist (33.7%). Only 8.4% were employed as office workers or administrative staff. The remaining participants (4.4%) did not specify any occupation. The summarized data of the participants with and without MetS are shown in Table 1.

At the selected significance level ($p < .05$) gender was found to be unrelated to the prevalence of MetS, i.e. females did not show a higher prevalence of MetS compared to males ($c^2 = 3.42, p = .064$). Participants with a parent history of CVD had a higher prevalence of MetS compared to individuals without a family history of CVD ($c^2 = 4.89$, $p = .027$). The highest prevalence of MetS was observed in participants who seldom or never exercised and also had a high waist/height ratio (defined as $\geq$ 0.5). Furthermore, the prevalence of MetS was found to increase with age ($F(1,220) = 6.51$, $p = 0.011$) and BMI ($F(1,220) = 32.82$, $p < .001$).

In detail, in the age groups 35-44 years, 45-54 years, and 55-65 years the prevalence of MetS increased from

Table 1. Baseline characteristics of participants with and without metabolic syndrome

| Variables | MetS (%) n = 81 | without MetS (%) n = 141 | Total (%) n = 222 | $\chi^2$ | *p*-value |
|---|---|---|---|---|---|
| Gender | | | | 3.42 | .064 |
| - Male | 16 (19.75%) | 44 (31.21%) | 60 (27.03%) | | |
| - Female | 65(80.25%) | 97 (68.79%) | 162 (72.97%) | | |
| Smoking history | | | | .15 | .700 |
| - No smoking | 71 (87.65%) | 121 (85.82%) | 192 (86.49%) | | |
| - Current smoking | 10 (12.35%) | 20 (14.18%) | 30 (13.51%) | | |
| Family history of CVD | | | | 4.89 | .027 |
| - No family history | 40(49.38%) | 91 (64.54%) | 131 (59.01%) | | |
| - Family history | 41 (50.6%) | 50 (35.5%) | 91 (40.99%) | | |
| Exercise | | | | 7.62 | .006 |
| Non-exercise | 63 (77.78%) | 84 (59.57%) | 147 (66.22%) | | |
| Exercise | 18 (22.22%) | 57 (40.43%) | 75 (33.78%) | | |
| Waist to height ratio | | | | 9.13 | .003 |
| < 0.5 | 8 (9.88%) | 38 (26.95%) | 46 (22.72%) | | |
| $\geq$ 0.5 | 73 (90.12%) | 103 (73.05%) | 176 (79.28%) | | |
| | Mean ± SD | Mean ± SD | Mean ± SD | *t* | *p*-value |
| Age (yr) | 50.15 ± 7.23 | 47.55 ± 7.32 | 48.50 ± 7.39 | 2.55 | .011 |
| BMI (kg*m$^{-2}$) | 28.43 ± 4.07 | 26.09 ± 4.08 | 26.31 ± 4.37 | 5.73 | <.001 |
| Waist circumference (cm) | 95.33 ± 8.92 | 86.24 ± 9.44 | 89.57 ± 10.23 | 6.99 | <.001 |
| SBP (mmHg) | 129.50 ± 15.24 | 118.31 ± 13.05 | 122.38 ± 14.87 | 5.75 | <.001 |
| DBP (mmHg) | 82.48 ± 12.38 | 118.31 ± 13.05 | 77.90 ± 11.70 | 4.59 | <.001 |
| FBS (mmol/l) | 129.61 ± 21.40 | 113.76 ± 22.42 | 119.55 ± 23.30 | 5.12 | <.001 |
| HDL-C (mg/dL) | 53.86 ± 11.49 | 51.93 ± 11.68 | 52.64 ± 11.62 | 1.19 | .234 |
| TG (mg/dL) | 139.43 ± 70.50 | 111.13 ± 54.57 | 121.50 ± 62.25 | 3.33 | .001 |

4.01% to 9.12%, and 16.42%, respectively ($c^2 = 7.34, p = .026$). In addition, participants with a BMI > 23 kg$^*$m$^2$ had a higher prevalence of MetS at 32.43% (*n* = 72) compared to individuals with a lower BMI (4.05%, *n* = 9) ($c^2 = 8.91, p = .003$). Similarly, participants with a waist to height ratio $\geq$ 0.5 had a higher MetS prevalence than those with a lower waist to height ratio (32.88%, *n* = 73 versus 3.60%, *n* = 8; $c^2 = 9.13$, $p = .003$).

To determine the risk of developing MetS, a logistic regression analysis was performed. Age, gender, history of smoking, CVD in the family, and exercise were evaluated (Table 2). A high BMI emerged as one of the most significant risk factors for developing MetS. A BMI $\geq$ 23 kg$^*$m$^{-2}$ as recorded in 173 participants (77.93%) was significantly associated with an increased risk of MetS at an odds ratio (OR) of 3.17 (95% confidence interval (CI) 1.45-6.94, $p = .004$). Individuals with a waist to height ratio $\geq$ 0.5 were at higher risk for MetS compared to participants with a waist to height ratio < 0.5 (OR 3.37, CI 1.48-7.64, $p = .004$). In addition, participants in the age group 55-65 years had an OR of 2.28 (CI 1.03-5.08, $p = .043$) for MetS compared to those in the age group 35-45 years. Lack of exercise was found to be a major risk factor (OR 2.38, CI 1.27-4.43, $p = .006$) while female gender was not identified as an independent risk factor for MetS (OR 1.84, CI 0.96-3.54, $p = .064$).

## 4. Discussion

The aim of the present study was to explore the prevalence and pattern of MetS in a suburban community located at Klong Luang 4, Pathum Thani province, Thailand. Data was sampled from 222 individuals aged 35-65 years; 77.93% were obese (defined as BMI $\geq$ 23 kg$^*$m$^{-2}$) with 45 males and 128 females. The total prevalence of MetS was 36.49% by NCEP ATP III with 16 males and 65 females. The prevalence of MetS was not significantly different between males and females.

The findings of the present study were similar to previous findings and studies of the prevalence of MetS in Asian populations. For example, Ravikiran *et al.* reported a 35.8% prevalence of MetS in adult Asian Indians by using NCEP ATP III (Ravikiran *et al.,* 2010). Mohamud *et al.* (2011) reported a 34.3% prevalence of MetS in Malaysians based on ATP II definition. The Korean National Health and Nutrition Examination Surveys reported a 31.3% prevalence of MetS in

Table 2. Results of logistic regression analysis for risk factors for metabolic syndromes

| Risk factors for MetS | Odds ratio | 95% CI for OR | *p*-value |
|---|---|---|---|
| Gender | Reference group- male | | |
| Female | 1.84 | .96 - 3.54 | .064 |
| Age groups (in years) | Reference age group 35-44 years | | |
| 45-55 | 1.10 | .48 - 2.54 | .826 |
| 55-65 | 2.28 | 1.03 - 5.08 | .043 |
| Family history of CVD | Reference family history group - no family history | | |
| Family history | 1.87 | 1.07 - 3.25 | .028 |
| Smoking history | Reference smoking history - no smoking history | | |
| Current smoking | .85 | .38 - 1.92 | .700 |
| Exercise | Reference exercise – moderate to high intensity of exercise | | |
| Low / never Exercise | 2.38 | 1.27 - 4.43 | .006 |
| BMI | Reference BMI < 23 kg/m$^2$ | | |
| BMI $\geq$ 23 kg/m$^2$ | 3.17 | 1.45 - 6.94 | .004 |
| WHtR | Reference WHtR < 0.5 | | |
| $\geq$0.5 | 3.37 | 1.48 - 7.64 | .004 |

CI; confidence interval, OR; odds ratio MetS; metabolic syndrome, CVD; cardiovascular disease, BMI; body mass index, WHtR; waist to height ratio

2007 and it was noted that it had significantly increased from a figure of 24.9% in 1998 (Lim *et al.,* 2011). In addition, the results of the present study were comparable to populations in non-Asian countries such as the United States of America (34.4%) (Ervin, 2009). In Thailand, Aeklakorn *et al.* (2014) found the prevalence was 32.6% from four geographic regions of Thailand including the capital Bangkok. They also reported that the prevalence of MetS in Bangkok of approximately 35% was higher than that in rural areas or other urban areas of Thailand. Pathum Thani province has become a suburb of Bangkok, in fact a part of the Bangkok metropolitan area. Furthermore, it has been shown that Pathum Thani province has a tendency to develop just like a major city and, not surprisingly, the observed prevalence of MetS was accordingly high.

Differences in MetS prevalence can be largely predicted by traditional risk factors; such as family history of CVD, age and gender. The present study is in accordance with other studies which demonstrated that the prevalence of MetS is age-dependent with a lower prevalence in young adults and a higher prevalence in older people (Pattyn *et al.,* 2013). Gender is also a risk factor for MetS, however, the present study found no significant differences between males and females. In this study 162 participants were females and 60 were males and this difference in gender sample size (factor 2.7) might have affected the result. Although, it seemed that there was a difference regarding gender and MetS (26.66% (16) in males and 40.12% (65) in females), the difference was not significant ($p$ = .064).

Remarkably, it has been shown that the risk to develop MetS can be reduced by 50% with sufficient physical activity or exercise, and weight control (Yu *et al.,* 2013) Therefore, an approximate 50% variation in the number of MetS cases should be considered and it is important to focus on these risk factors. As this study has confirmed, lack of exercise or physical activity is a major risk factor. Participants who had exercised less frequently had a higher prevalence of MetS. Following a meta-analysis of randomized and clinical controlled trials it was suggested that dynamic endurance exercises (e.g., walking, cycling) could significantly reduce the risk of MetS (i.e., waist circumference, HDL-C, systolic BP, diastolic BP) (Ashwell *et al.,* 2012; Pattyn *et al.,* 2013). Furthermore, approximately 30% of people with a high BMI have hypertension (NHLBI, 2004). In addition, a lack of physical activity or a sedentary lifestyle increases the risk to develop hypertension by 20-50% (NIH, 2004). Waist circumference is also one of the clinical criteria for MetS. Several studies reported that BMI, waist circumference and waist to height ratio are correlated and, in addition, these factors are associated with a risk of MetS, e.g., diabetes mellitus, hypertension (Dalton *et al.,* 2003; Guasch-Ferre *et al.,* 2012; Ko *et al.,* 1999; Liu *et al.,* 2011; Misra *et al.,* 2006). Thus, it appears that much of the variation in the prevalence of MetS can be prevented by lifestyle modifications such as increasing physical activity or exercising and controlling body weight.

Limitations of the present study are noted as follows. Only 222 participants were recruited by convenience sampling from the Klong Luang 4 community. Therefore, the participants may not represent the whole community and, consequently, the results should not be used to draw conclusions for the whole population of the community. Multistage probability surveys of the community might result in more representative data. In addition, it has been suggested that employment status might be correlated to the prevalence of MetS (Davila *et al.,* 2010). Therefore, various occupational groups and their differences in obesity and MetS should be analyzed.

In summary, the prevalence of MetS in the Klong Luang 4 community, Pathum Thani province, Thailand was 36.49% (81 from 222 participants) and 77.93% of the participants were already obese (defined as BMI $\geq$ 23 $kg^{*}m^{-2}$). A high waist to height ratio and lack of exercise are associated with MetS. In addition, participants with high BMI emerged as having one of the most significant risk factors for developing MetS.

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