GYNAECOLOGY

The Correlation of Body Mass Index and Waist-Hip Ratio to Insulin Resistance in Reproductive-aged Thai Women with Polycystic Ovary Syndrome

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ABSTRACT

Objective: To compare the correlation of body mass index (BMI) and waist-hip ratio (WHR) to insulin resistance (IR) in reproductive-aged Thai women with polycystic ovary syndrome (PCOS).

Material and methods: A retrospective cross-sectional study was conducted among 205 reproductive-aged women who attended the Gynecologic Endocrinology Unit of the Department of Obstetrics and Gynecology, Siriraj Hospital during July 2005 - December 2010. Reviewed data included age, body weight, height, waist circumference, hip circumference, HOMA-IR.

Results: Among 205 cases of PCOS women, 97 women had IR (47.3%) and 108 women did not have IR (52.7%). By a forward stepwise multiple logistic regression analysis, mean BMI and WHR in IR group were significant higher than non-IR group ($P < 0.001$). Area under an ROC curve of IR for BMI was 0.9 and for WHR was 0.82.   Both BMI and WHR correlate to insulin resistance. In comparison, BMI had better correlation than WHR ($P = 0.006$).

Conclusion: Reproductive-aged Thai PCOS women with IR had higher BMI and WHR than those who did not have IR. Both BMI and WHR correlate to insulin resistance. BMI correlates better to IR than WHR.

Keywords: Body mass index, Waist-Hip ratio, Insulin resistance, Polycystic ovary syndrome, Correlation

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Background

Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder in reproductive-aged women. It affects 5-10% of reproductive-aged women[1]. According to "The Revised Rotterdam Criteria 2003", the mostly used diagnostic criteria at the present time, is based on the presence of oligo-anovulation, signs of hyperandrogenism, and polycystic ovaries on ultrasonography[2].

The metabolic syndrome is a cluster of the cardiovascular risk factors: diabetes and prediabetes, abdominal obesity, high cholesterolemia and high blood

pressure[3]. The prevalence of metabolic syndrome was approximately 20% of Thai PCOS women and it increases with age and body mass index (BMI)[4]. The central obesity relates to insulin resistance (IR) in metabolic syndrome. Although most PCOS women have central obesity, lean PCOS women may also have IR[5]. Women with PCOS have overall risk of developing type 2 diabetes and impaired glucose tolerance. The risk is 3-7 folds higher than the non PCOS women[6]. PCOS associates with metabolic syndrome and IR. Thus PCOS women trend to develop hyperinsulinemia and type 2 diabetes especially if obese[7]. Now the treatments of PCOS are focused on reproductive, metabolic and psychological features. The gold standard to detect IR is the euglycemic hyperinsulinaemic clamp. However, this method is not suitable for clinical practice because it is complex and required experienced persons[8]. The detection of IR is implied from many strategies such as the fasting glucose-to-insulin ratio, 2-hour glucose tolerance test and Homeostatic Measurement Assessment Insulin Resistance (HOMA-IR). There has been no single recommended test for detecting insulin resistance.

HOMA-IR is one method to evaluate IR. The benefits of this test are simple and less invasiveness. Nevertheless there is no single definite cut-off point used in diagnosis of IR. The previous Thai study shown HOMA-IR > 2.0 can be used as a screening test for glucose intolerance in Thai PCOS women[9]. Though HOMA-IR evaluation is based on fasting glucose level and fasting insulin level, insulin level is available in only advanced laboratory center.

In previous study, the predictive factors for IR were age, waist circumference, presence of acanthosis nigricans and dyslipidemia[10]. The aim of our study was to explore the correlation of BMI and waist-hip ratio (WHR) to IR in Thai PCOS women which have never been reported.

Materials and Methods

This retrospective cross-sectional chart review study was conducted in 2013-2014. The data was collected from the medical records of 205 PCOS women who attended the Gynecologic Endocrinology Unit of the Department of Obstetrics and Gynecology, Siriraj Hospital in July 2005 - December 2010. The study was approved by the Ethic Committee of Faculty of Medicine Siriraj Hospital, Mahidol University.

Study population

The objective populations were reproductive PCOS Thai women who received medical services at the Gynecologic Endocrinology Unit of the Department of Obstetrics and Gynecology, Siriraj Hospital and who gave consent to previous study[9-10]. They were diagnosed to have PCOS by Revised Rotterdam Criteria 2003 and had necessary data; BMI, WHR and HOMA-IR.

Exclusion criteria were women who had premature ovarian failure or menopause, previous ovarian surgery, used hormonal treatment, used the medication for dyslipidemia within 3 months, or used steroid within 6 months before the time of data collection in previous studies.

Sample size was calculated based on null hypothesis, BMI and WHR were small effect to HOMA-IR (rho = 0.3), and alternative hypothesis, BMI and WHR were large effect to HOMA-IR (rho = 0.5). Type I error was 0.05 and type II error was 0.1. Primary sample size was 186 patients. We add 10% for incomplete data, total sample size was 205 patients.

Data collection

Medical records were reviewed. The collected data included age, body weight, height, waist circumference, hip circumference, HOMA-IR.

BMI was calculated by weight in kilogram divided by height in metres 2.

WHR was calculated by waist circumference divided by hip circumference.

HOMA-IR was calculated by multiplying fasting insulin by fasting glucose and dividing by 22.5[11].

HOMA-IR > 2.0 was used for diagnosis of insulin resistance[9].

Statistical analysis

Statistical analysis was performed using SPSS statistic package version 18 (SPSS Inc.). All quantitative

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variables are displayed as mean ± standard deviation. A forward stepwise multiple logistic regression analysis was performed on BMI and WHR to find the correlation to IR. Statistical significance was defined as p < 0.05. Comparison of the qualitative data was analyzed by t-test and receiver operator curves (ROCs) of BMI and WHR.

Result

The data of a total 205 women with PCOS were reviewed. The results were divided in two groups. There were 97 women who had IR (47.3%) and 108 women who did not have IR (52.7%).

The summary of characteristics of PCOS women in two groups were shown in Table 1. In IR group, the means age, weight, height, BMI, waist circumference, hip circumference, WHR were all higher than in non-IR group. Only weight, BMI, waist circumference, hip circumference, WHR were significantly higher than non-IR women (p < 0.001).

Table 1. Characteristics of 205 PCOS women among insulin resistance and non-insulin resistance groups

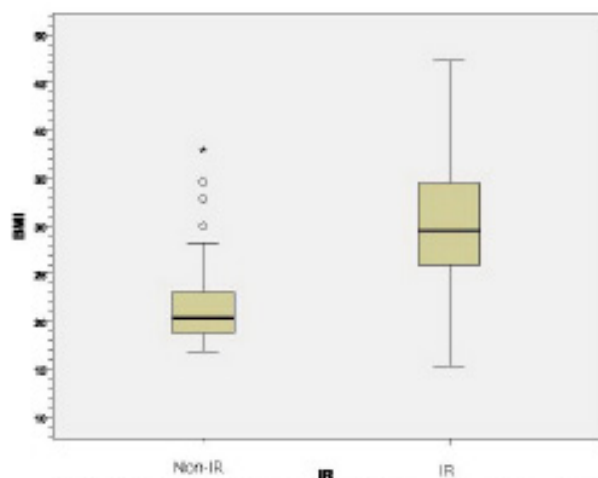| Characteristics	Mean ± SD		P
	Non-IR N = 108 (52.7%)	IR N = 97 (47.3%)	
Age (yr)	24.91 ± 5.37	25.68 ± 5.61	0.310
Weight (kg)	54.3 ± 10.8	79.1 ± 19.7	< 0.001
Height (m)	1.59 ± 0.05	1.60 ± 0.05	0.186
Body mass index (kg/m^2)	21.41 ± 3.90	30.65 ± 6.63	< 0.001
Waist circumference (cm)	71.64 ± 10.07	93.37 ± 16.69	< 0.001
Hip circumference (cm)	94.73 ± 8.43	109.93 ± 13.06	< 0.001
Waist- Hip ratio	0.75 ± 0.06	0.84 ± 0.09	< 0.001

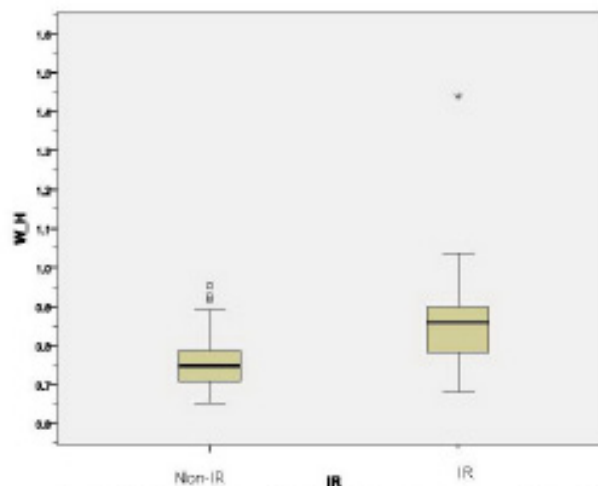Fig. 1. The distribution of BMI with insulin resistance in boxplots

Fig. 2. The distribution of WHR with insulin resistance in boxplots

Fig. 1. and 2. Showed the distribution of data of IR and non-IR with BMI and W-H ratio respectively in boxplots.

Fig. 3. Shown ROC curve of BMI and WHR with IR. The area under the curve (AUC) was 0.90 in BMI group, 0.82 in W-H ratio group. The comparison of AUC of BMI and WHR by Delong method shown the difference between areas was 0.082. There was statistically significant difference of BMI and WHR to IR (p-value = 0.006).
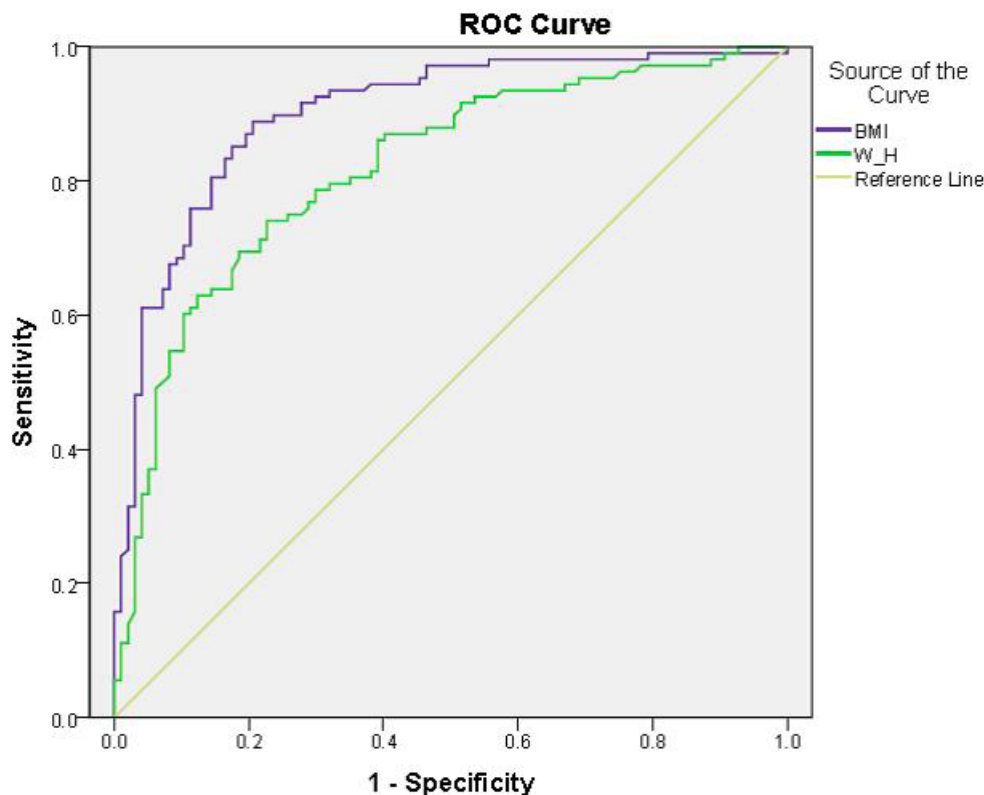

Fig. 3. ROC curve of BMI and WHR with IR

Discussion

We acknowledge that PCOS link to metabolic syndrome and IR. IR is one of risk factors of diabetes mellitus and cardiovascular disease. In general, most obese women with PCOS are IR, some lean PCOS women may have IR[5]. Multiple models were discovered to assess IR. Although the gold standard is euglycemic hyperinsulinaemic clamp, it is not practical because it is complex and need experienced persons[8]. There are others predictors such as age, waist circumference, presence of acanthosis nigricans and dyslipidemia[10]. Many studies declared the obese PCOS women with IR usually associated with central obesity[12-13]. The magnetic resonance imaging (MRI) is the most accurate way to locate the body fat, but waist circumference, hip circumference can substitute in general practice. We are interested in BMI and WHR because they can be implied obesity and may link to IR indirectly.

According to this study, IR group of Thai PCOS women shown higher BMI and WHR than non-IR group significantly. We imply that higher BMI and WHR associated with more obese state of patients. Thus obesity may relate with IR. In contrast, some studies conclude that insulin resistance was independent of obesity, change in body composition, and impaired glucose tolerance[14].

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Furthermore we studied the correlation of BMI and WHR to IR by using ROC curve. The results shown both BMI and WHR had correlation to IR. The area under the curve was 0.9 in BMI, 0.8 in WHR. These mean they were clinically useful, may be good predictive tests in the future .When comparing the clinical value of both, BMI had a better correlation to IR than WHR.

In Thailand, we suggest BMI may be a new model in insulin resistance screening because it is noninvasive, inexpensive, and suitable for a limited resource country. These lead to early cardiovascular risks detection and health promotion in PCOS women. However BMI reflexes obesity, it may be a confounding factor because obesity is a multifactorial disease.

The limitations of this study were that it was a retrospective cross-sectional study and the parameters did not study with the gold standard of IR detection. Further studies may focus on the relationship of other anthropometric factors or the cut off level for IR screening by this method.

Conclusion

Reproductive-aged PCOS Thai women with IR had higher BMI and WHR than who did not have insulin resistance. Both BMI and WHR correlate to insulin resistance. BMI correlates better to IR than WHR.

Acknowledgement

References

1. Ehrmann DA. Polycystic ovary syndrome. N Engl J Med 2005; 352:1223-77.
2. Rotterdam ESHRE/ASRM-Sponsored PCOS consensus workshop group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome (PCOS). Hum Reprod 2004; 19:41-7.
3. Alberti KG, Zimmet P, Shaw J. Metabolic syndrome – a new world-wide definition. A Consensus Statement from the International Diabetes Federation. Diabet Med 2006: 23:469–80.
4. Indhavivadhana S,Wongwananuruk T,Ratthanachaiyanont M,Techatraisak K,Leerasiri P,Tanmahasamut P,et al. Prevalence of metabolic syndrome in reproductive-aged polycystic ovary syndrome Thai women. J Med Assoc Thai 2010; 93:653-60.
5. Vrbikova J,Cibula D,Dvorakova K,Stanicka S,Sindelka G,Hill M,et al .Insulin sensitivity in women with polycystic ovary syndrome. J Clin Endocrinol Metab 2004; 89: 2942-5.
6. Hudecova M,Holte J,Olovesson M,Larsson A,Berne C,Poromaa IS. Diabetes and impaired glucose tolerance in patients with polycystic ovary syndrome- a long term follow-up .Hum Reprod 2011; 26:1462-8.
7. Weerakiet S, Srisombut C, Bunnag P, Sangtong S, Chuangsoongnoen N, Rojanasakul A. Prevalence of type 2 diabetes mellitus and impaired glucose tolerance in Asian women with polycystic ovary syndrome. Int J Gynaecol Obstet 2001; 75:177-84.
8. Yildiz BO, Gedik O. Assessment of glucose intolerance and insulin sensitivity in polycystic ovary syndrome. Reprod Biomed Online.2004; 8:649-56.
9. Wongwananuruk T, Ratthanachaiyanont M, Indhavivadhana S,Leerasiri P ,Techatraisak K,Angsuwathana S,et al. The usefulness of Homeostatic Measurement Assessment-Insulin Resistance (HOMA-IR) for detection of glucose intolerance in Thai women of reproductive age with polycystic ovary syndrome. Int. J. Endocrinol 2012; 2012:5710-35.
10. Wongwananuruk T, Ratthanachaiyanont M, Indhavivadhana S,Leerasiri P,Techatraisak K,Tanmahasamut P,et al. Prevalence and clinical predictors of insulin resistance in reproductive-aged Thai women with polycystic ovary syndrome. Int J Endocrinol 2012;2012:529184.
11. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC. Homeostasis model assessment: insulin resistance and fl-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia 1985; 28:412-9.
12. Ketel IJ,Stehouwer CD,Serne EH,Korsen TJ,Hompes PG,Smulder YM,et al. Obese but not normal-weight women with polycystic ovary syndrome are characterized by metabolic syndrome and microvascular insulin resistance. J Clin Endocrinol Metab 2008;93:3365-72.
13. Gambineri A,Pelusi C,Vicennati V,Pagotto U,Pasquali R. Obesity and the polycystic ovary syndrome. Int J Obes Relat Metab Disord 2002; 26: 883–96.
14. Dunaif A , Segal K, Futterweit W, Dobrjansky A. Profound Peripheral Insulin Resistance, Independent of Obesity, in Polycystic Ovary Syndrome. Diabetes 1989; 38:1165-74.

การศึกษาเปรียบเทียบความสัมพันธ์ระหว่างดัชนีมวลกายและอัตราส่วนของความยาวเส้นรอบเอวต่อความยาวเส้นรอบสะโพก กับภาวะดื้อต่ออินซูลินในสตรีไทยวัยเจริญพันธุ์ที่เป็นโรคกลุ่มอาการถุงน้ำรังไข่

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วัตถุประสงค์:   เพื่อเปรียบเทียบความสัมพันธ์ระหว่างดัชนีมวลกายและอัตราส่วนของความยาวเส้นรอบเอวต่อ ความยาวเส้นรอบสะโพกกับภาวะดื้อต่ออินซูลินในสตรีไทยวัยเจริญพันธุ์ที่เป็นโรคกลุ่มอาการถุงน้ำรังไข่

วัสดุและวิธีการ: การศึกษาแบบภาคตัดขวางย้อนหลัง ในสตรีไทยวัยเจริญพันธุ์ 205 ราย ที่ได้รับการรักษาโรคกลุ่มอาการถุงน้ำรังไข่ ที่หน่วยต่อมไร้ท่อทางนรีเวช โรงพยาบาลศิริราช ระหว่าง กรกฎาคม 2548 – ธันวาคม 2553 โดยรวบรวมข้อมูล ได้แก่ อายุ, น้ำหนัก, ส่วนสูง, ความยาวเส้นรอบเอว, ความยาวเส้นรอบสะโพก และค่า HOMA-IR ซึ่งค่า HOMA-IR ที่มากกกว่า 2 แสดงถึงภาวะดื้อต่ออินซูลิน

ผลการศึกษา: ในสตรี 205 ราย พบสตรีที่มีภาวะดื้อต่ออินซูลินร้อยละ 47.3 พบว่าค่าเฉลี่ยดัชนีมวลกาย และอัตราส่วนของความยาวเส้นรอบเอวต่อความยาวเส้นรอบสะโพก ในรายที่มีภาวะดื้อต่ออินซูลินสูงกว่ากลุ่มที่ไม่ดื้ออย่างมีนัยสำคัญทางสถิติ (P < 0.001) จากกราฟ ROC พบว่าทั้งดัชนีมวลกาย และอัตราส่วนของความยาว เส้นรอบเอวต่อความยาวเส้นรอบสะโพก มีความสัมพันธ์กับภาวะดื้อต่ออินซูลิน (AUC เท่ากับ 0.9 และ 0.82 ตามลำดับ) และเมื่อเปรียบเทียบระหว่างสองปัจจัย ค่าดัชนีมวลกายจะสัมพันธ์กับภาวะดื้อต่ออินซูลินมากกว่าอย่างมีนัยสำคัญ (P = 0.006)

สรุป: สตรีไทยวัยเจริญพันธุ์ที่เป็นโรคกลุ่มอาการถุงน้ำรังไข่ที่มีภาวะดื้อต่ออินซูลิน มีค่าเฉลี่ยดัชนีมวลกายและอัตราส่วนของความยาวเส้นรอบเอวต่อความยาวเส้นรอบสะโพกสูงกว่ากลุ่มที่ไม่มีภาวะดื้อต่ออินซูลิน ทั้งดัชนีมวลกายและอัตราส่วนของความยาวเส้นรอบเอวต่อความยาวเส้นรอบสะโพก มีความสัมพันธ์กับภาวะดื้อต่ออินซูลิน แต่ดัชนีมวลกายจะสัมพันธ์ต่อการทำนายภาวะดื้อต่ออินซูลินมากกว่า