Relationship of Body Mass Index and Waist Hip Ratio with Insulin Resistance in Polycystic Ovarian Syndrome Patients

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Key words: BMI; Fasting Insulin; HOMA-IR; Polycystic ovary; Waist hip ratio.

ABSTRACT

Background: Polycystic Ovarian Syndrome (PCOS) is the most common endocrinopathy among young women. Insulin resistance is a key feature in the pathogenesis of PCOS. Obesity, which is frequently associated with PCOS women, seems to amplify the degree of insulin resistance. The aim of the study is to investigate the relationship of insulin resistance with obesity in PCOS patients.

Materials and methods: This was a hospital based cross-sectional study comprising fifty (50) diagnosed PCOS patients aged between 20 and 40 years. This study was carried out in the Department of Biochemistry, Chittagong Medical College (CMC) and inpatients, outpatient Department of Gynaecology and Obstetrics, Chittagong Medical College Hospital (CMCH). Samples were taken by non-probability purposive sampling.

Results: The percentage of Insulin Resistance (IR) was 60% in this study. Mean age of PCOS patients was 30.6±0.65 years. Obese PCOS patients with insulin resistance were 46% and overweight PCOS patients with IR were 48% in this study. There were also significant positive association of IR with increased BMI and waist hip ratio. Additionally 06% non-obese PCOS patients showed IR in this study cases.

Conclusions: This study suggested that abdominal obesity was a good predictor of IR among PCOS patients. So, waist circumference or waist hip ratio may be used as a screening tool for IR risk assessment among PCOS patients as an inexpensive, noninvasive and easy-to-detect marker. Hence early diagnosis and proper preventive management of these patients will reduce the reproductive complications.

Introduction

Poly Cystic Ovary Syndrome (PCOS) is a common hormonal disorder that occurs in 5-10% of reproductive age group women.1 It is the most prevalent endocrinopathy and common cause of infertility. Polycystic Ovarian Syndrome (PCOS) has also been known by the name Stein-Leventhal Syndrome. The syndrome was officially recognized in the 1930’s by Stein and Leventhal who associated Polycystic Ovaries (PCO) to the clinical features and includes a multisystem presentation, having its effects on the endocrine and reproductive systems, body weight, skin and hair.2 This syndrome was characterized by oligomenorrhea, infertility, heavy build and hirsutism in association with polycystic ovaries.2 The syndrome is seen in the second and third decades of life and in about 50 percent of cases, includes obesity, hirsutism and acne.3 PCOS is not only a leading cause of infertility. It can also be a risk factor for other health problems like type 2 diabetes mellitus, psychological disorders, cardiovascular diseases and various gynecological cancers like endometrial and ovarian cancer at an advanced stage of this disorder.4

The current definition of PCOS is based on Rotterdam Consensus Meeting in 2003. It defines the syndrome as presence of any two of the following three criteria: i) Menstrual disturbance, oligomenorrhea/anovulation. ii) Clinical and/or biochemical signs of hyperandrogenism like acne, hirsutism etc., after other causes of hyperandrogenism have been ruled out. iii) Ultrasound appearance of polycystic ovary (At least one ovary with 12 follicles or more, size: 2-9 mm, volume 10 ml).5-6

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Materials and methods

This cross-sectional study was carried out in the Department of Biochemistry and Department of Gynaecology and Obstetrics of Chittagong Medical College Hospital from July 2016 to June 2017. Permission of the study was taken from the ethical review committee of CMC and concerned departments. Fifty (50) woman aged between 20 to 40 years fulfilling the enrollment criteria were included by nonprobability purposive sampling.

Inclusion Criteria:
PCOS patient diagnosed on the basis of Revised Rotterdam Consensus 2003 criteria, patient having 2 out of 3 following criteria:

i) Chronic anovulation or amenorrhea
ii) Clinical or biochemical hyperandrogenism
iii) Polycystic ovary (By USG).

Exclusion Criteria:

i) Type 2 Diabetes Mellitus
ii) Hyperprolactinemia
iii) Thyroid disorder
iv) Refuse to give consent.

Serum insulin assay was carried out in ADVIA Centaur XP systems. Plasma glucose was estimated by glucose oxidase method in an automated Siemens analyzer. Insulin resistance was calculated using the HOMA model [HOMA-IR = fasting insulin (mIU/L) × fasting glucose (mmol/L)/22.5]. Those with HOMA-IR value > 2.6 were categorized as insulin resistant. Serum FSH, LH, Free Testosterone were measured by AdviaCentaur XP analyzer. All the data were processed and analyzed using computer-based statistical software. Confidence level was fixed at 95% and p value £ 0.05 was considered to be statistically significant. Different tests of statistical significance were done as appropriate.

Results

Table I shows the mean values of age, BMI, waist hip ratio, serum LH, serum FSH, serum testosterone, FPG,fasting serum insulin and HOMA-IR (4.9 ± 0.49) in this study cases.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean ± SEM</th>
<th>Range</th>
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<tbody>
<tr>
<td>Age (Years)</td>
<td>30.6 ± 0.65</td>
<td>20 - 35</td>
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<tr>
<td>BMI (kg/m²)</td>
<td>25.89 ± 0.38</td>
<td>21.15 – 31.51</td>
</tr>
<tr>
<td>Waist hip ratio</td>
<td>0.76 ± 0.01</td>
<td>0.62 - 0.87</td>
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<tr>
<td>Serum LH (mIU/ml)</td>
<td>8.78 ± 0.62</td>
<td>2.18 – 16.2</td>
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<tr>
<td>Serum FSH (mIU/ml)</td>
<td>4.77 ± 0.26</td>
<td>1.33 – 10.2</td>
</tr>
<tr>
<td>Serum Testosterone(mIU/ml)</td>
<td>3.79 ± 0.64</td>
<td>0.13 – 17.5</td>
</tr>
<tr>
<td>FPG (mmol/L)</td>
<td>5.73 ± 0.22</td>
<td>3.9 – 11.5</td>
</tr>
<tr>
<td>Serum Insulin (mIU/L)</td>
<td>17.86 ± 1.24</td>
<td>9 – 39.28</td>
</tr>
<tr>
<td>HOMA-IR</td>
<td>4.9 ± 0.49</td>
<td>2.09 – 15.12</td>
</tr>
</tbody>
</table>

Table I shows the mean values of age, BMI, waist hip ratio, serum LH, serum FSH, serum testosterone, FPG,fasting serum insulin and HOMA-IR (4.9 ± 0.49) in this study cases.
Distribution of Cases | Percentage (%)
--- | ---
Presence of Insulin Resistance | 30 (60%)  
Obese | 27 (54%)  
Oligomenorrhea | 46 (92%)  
Amenorrhea | 04 (08%)  
Hirsutism | 11 (22%)  

Table II shows that, insulin resistance, obese, oligomenorrhea, amenorrhea and hirsutism were present in 60%, 27%, 46%, 08% and 22% cases respectively in this study subjects.

Table III shows that, obese PCOS patients with insulin resistance were 46% and non-obese PCOS patients with insulin resistance were 06% in this study.

Table IV demonstrates that increased BMI was significantly associated with insulin resistance cases.

Table V demonstrates that increased waist hip ratio was significantly associated with insulin resistance cases.

**Discussion**

PCOS is an endocrine disorder with chronic anovulation, hyper androgenism and polycystic ovaries, with or without obesity. Hyperinsulinemia/insulin resistance may be the primary feature of PCOS but some researchers proposed hyper androgenism as the key feature.\(^{20}\) The co-existence of hyperinsulinemia and hyper androgenism was suggested by some other investigators.\(^{21,22}\)

In this study PCOS was diagnosed by ultrasonography. Insulin resistance is a condition in which a given concentration of insulin produces a less than expected biological effect. The percentage distribution of Insulin Resistance (IR) in our sample population was found to be 60%. In a study from Baghdad the prevalence of insulin resistance showed 76.5% where the insulin resistance was calculated by HOMA model.\(^{23}\) Insulin resistance was also reported 52.8% in North Indian and 31% in Pakistani women with PCOS.\(^{24,25}\) On the other hand, a study from Pakistan the mean age of woman with PCOS was reported 27.1 ± 33.5 years which is close to our study.\(^{26}\)

Though a woman may be genetically predisposed to developing PCOS, it is only the interaction of environmental factor (Obesity) with the genetic factors that results in clinical expression of the PCOS. Women with PCOS showed increased prevalence of overweight, obesity and central obesity compared with women without PCOS.\(^{27}\) Abdominal or visceral adiposity and obesity might contribute to ovarian and adrenal hyperandrogenism by mechanism independent of insulin resistance including low-grade chronic inflammation, secretion of adipokines such as leptin that exert direct effects on the ovary and local metabolism of sex steroids and cortisol in visceral fat.\(^{28}\)

In this study, 46% obese PCOS Patients and 48% overweight PCOS patients showed Insulin Resistance. Additionally, increased BMI and waist hip ratio were significantly associated with insulin resistance in cases. Fouzia Adil et al showed in their study that 50% cases were obese in PCOS patients that was similar to our study result.\(^{29}\) Besides a Korean study showed that, 10.3% PCOS patients were overweight and 28.4% were obese.\(^{30}\) This result was lower than that of our study.

Although obesity is a common and major pathogenic characteristic in PCOS, it is not present in all cases. In a previous report, we also found that non-obese women with PCOS showed significant insulin resistance compared to their age and BMI comparable control subjects\(^ {31}\). Additionally it is observed in this study that 06% non-obese PCOS patients have insulin resistance. S. Toprak, et al suggested in their study that insulin resistance in non-obese PCOS patients are related to LH and free testosterone levels.\(^ {32}\)
Conclusion
This study suggested that abdominal obesity is a good predictor of insulin resistance and metabolic syndrome among PCOS patients. Waist circumference or waist hip ratio may be used as a screening tool for insulin resistance and metabolic syndrome risk assessment among PCOS patients as a sensitive, inexpensive, noninvasive and easy-to-detect anthropometric marker.

Recommendation
We recommend large-scale studies to validate our observations.

Disclosure
All the authors declared no competing interest.

References


