Comparison of Hypertension and Obesity Parameters in Healthy Adolescents and those with Polycystic Ovarian Syndrome

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Abstract

The prevalence of hypertension and obesity among the adolescents with Polycystic Ovarian Syndrome (PCOS) in Shiraz is a cross-sectional, descriptive study was conducted on 3200 high-school students in 2010. 146 adolescents were diagnosed with PCOS by an endocrinologist. Besides, 46 healthy adolescents were selected as the control group. Comparison of the prevalence of obesity and hypertension was made based on Ferranti scale. The results also revealed a significant difference between the two groups regarding the rate of android obesity above the 90th percentile (P=0.037). However, no significant difference was found between the study groups concerning systolic and diastolic blood pressure above the 90th percentile (P=0.551 and P=0.758, respectively). In Conclusion, the prevalence of hypertension, obesity, and android obesity was higher among the students suffering from PCOS compared to the healthy ones. They should also be screened and followed up regarding diabetes and dyslipidemia.

Keywords

Hypertension; Obesity; Polycystic ovary syndrome

Introduction

Polycystic Ovarian Syndrome (PCOS) is the most common endocrine disorder among the women of reproductive ages. Specialists believe that due to the probable similarity of PCOS symptoms to those of natural puberty [1,2] and lack of a unified diagnostic criterion among researchers, the actual prevalence of PCOS cannot be determined among adolescents. This rate was reported as 7% in one study [3] and between 6.1% and 15.3% in another [4]. The Endocrine Society suggested that PCOS in adolescents can be determined by presence of oligomenorrhea and clinical or biochemical androgenism after elimination of other disorders [5]. Considering Rotterdam criteria, four phenotypes of PCOS have been defined, each showing a different frequency of metabolic syndrome [6]. The prevalence of metabolic syndrome was two folds higher among the women with PCOS compared to U.S. general population (46% vs. 23%).

Previous studies revealed the central role of insulin in pathogenesis of this disorder. Besides, the high familial prevalence of PCOS suggests its genetic background. Yet, limited information is available regarding the involved gene or genes, and it is believed to transmit through x-linked dominant inheritance [7]. In addition to insulin resistance and diabetes [8], other symptoms of metabolic syndrome, including hypertension, high triglyceride, high total cholesterol, and micro-albuminuria, have genetic grounds [9].

Coviella et al. reported a higher prevalence of metabolic syndrome in girl adolescents with PCOS compared to healthy ones in the general population [10]. Moreover, Gluck et al. claimed that there would be a strong relationship between early stable obesity and metabolic syndrome in PCOS patients in 10 years [11]. Rossi et al. also stated that obese adolescents had a higher rate of metabolic syndrome [12]. Furthermore, Nur et al. conducted a study in Spain and indicated that based on Homeostasis Model Assessment Index (HOMA), Fasting Glucose/Insulin Ratio (FGIR), and Quantitative Insulin Sensitivity Check Index (QUICKI), insulin resistance was higher among obese patients with PCOS. Thus, they suggested that oral glucose tolerance test was the first step for the overweight adolescents suffering from PCOS [13]. Similarly, Fruzetti et al. investigated the prevalence of metabolic syndrome in 53 adolescents with PCOS. According to the results, the prevalence of metabolic syndrome was 9.4%, 22.7%, and 32.1% among the adolescents with 3, 2 and no criteria, respectively. In addition, obesity, insulin resistance, and total and free testosterone levels were significantly higher among the adolescents with PCOS and metabolic syndrome [14].

Considering the limited number of studies conducted on metabolic syndrome parameters in Iranian adolescents, the present study aims to determine the prevalence of hypertension and obesity in 14-18-year-old girls with PCOS in Shiraz. In case of high prevalence of these parameters, interventional programs can be developed and steps can be taken towards prevention and treatment of this disorder.

Materials and Methods

In this analytical case-control study, based on a previous study [15] and considering 20% loss rate, the sample size was estimated as 3200 subjects. The inclusion criteria of the study were being 14-18 years old, not having adrenal and thyroid problems, and not showing increase in prolactin level. After getting permission from the Department of Education and schools and obtaining written informed consents, face-to-face interviews and examinations were performed.

The girls with clinical hyper androgenism (acne, hirsutism, and alopecia) and oligomenorrhea underwent ultrasound based on the criteria proposed by Adams et al. [16]. Accordingly, 146 individuals were diagnosed with PCOS by an endocrinologist and 46 ones without symptoms were considered as the control group.

In both groups, hypertension and obesity were evaluated using Ferranti criteria; waist circumference ≥ the 75th percentile based on age/sex and blood pressure ≥ the 95th percentile based on age/sex [17]. In the participants between 14 and 17 years old, blood pressure levels < the 90th percentile and ≥ the 90th percentile were considered normal and hypertension, respectively. Besides, blood pressure levels...
≥ the 95th and 99th percentiles were considered as grade I and II hypertension, respectively [18,19]. In above-18-year-old participants, based on JNC-7 index, systolic and diastolic blood pressure ≥ 90/140 mmHg was considered hypertension. It should be noted that blood pressure was measured on the right arm twice with a 10-minute interval and the mean was recorded [20].

Using waist circumference based on Ferranti scale, > 75th percentiles were considered as android obesity [17]. Moreover, Body Mass Index (BMI) presented by Center for Disease Control and Prevention (CDC) was used to evaluate obesity. Accordingly, BMI between the 0th and 58th percentiles, between the 85th and 95th percentiles, and ≥ the 95th percentile were identified as normal, overweight, and obese, respectively [21].

Data analysis
The data were entered into the SPSS statistical software, version 16 and were analyzed using t-test. All the tests were performed with Confidence Interval (CI) = 95% and α = 0.05.

Results
Based on BMI, 50.5% and 35.3% of the adolescents in both groups were overweight and obese, respectively. Besides, obesity above the 95th percentile was 4 folds higher among the participants with PCOS (P<0.001). Android obesity was above the 75th percentile in 13.2% of the total study population. Yet, the frequency of android obesity > the 90th percentile was 7.6% in the case group and 0% in the control group, and the difference was statistically significant (P=0.037) (Table 1).

However, no significant difference was found between the two groups regarding systolic and diastolic blood pressure > the 90th percentile (P=0.551 and P=0.758, respectively) (Table 2).

Discussion
In the present study, BMI of the PCOS participants was 4 folds higher than that of the healthy ones. In a previous study, the prevalence of obesity (BMI>25 kg/m2) was 28% in the women with PCOS and 5.5% in non-obese individuals [22]. In another study, women with BMI ≥ 35 comprised 12% of the PCOS patients, while 9% of the patients had lower BMIs [23]. Similarly, a meta-analysis of 35 studies revealed that the prevalence of overweight (BMI=25-30 kg/m2) and obesity was respectively 2 and 2.8 folds higher among the patients with PCOS [24]. One other study also indicated that PCOS increased among obese individuals. Indeed, Polycystic Ovarian Morphology (PCOM) and paratubal cysts were more common among obese adolescents in puberty. In fact, PCOM was detected in 61.1% of obese girls compared to 32.1% of those with normal weight. This implied that obesity helped incidence of this ovarian pattern [25]. In contrast, some studies have reported similar prevalence rates of obesity in patients with and without PCOS [26].

Evidence has indicated that many, but not all, PCOS women are overweight or obese, depending on the study design or population. The prevalence of obesity has been reported as 42-58% in adult PCOS patients [27,28]. In addition, the prevalence of class III obesity was 33% in PCOS patients and 8.4% in normal individuals [29]. In our study, the prevalence of android obesity > the 90th percentile was 5.8%, which is lower compared to the measures reported by Salem and Halley Castillo et al. [30]. Although this rate was low in our study, it can be considered as an alarm because obesity, as one of the main components of metabolic syndrome, can increase the probability of this disorder in future. In fact, this factor can cause resistance in using peripheral glucose, create hyper insulinemia, and lead to hypertension and metabolic consequences [31].

In the study by Menghetti et al., the prevalence of overweight and obesity was 31.7% and 10.3%, respectively among adolescents [32]. According to Hekimsoy, obesity is an important risk factor for type II diabetes, arterial hypertension, and hyperlipidemia. However, controversial results have been obtained regarding the relationship between duration of obesity and these disorders [33].

Visceral fat produces inflammatory cytokines, which are effective in insulin resistance and reduction of ovulation [25,34,35].

The relatively low prevalence of android obesity in our study might be attributed to the study participants’ age; adolescents

| Percentile | Case (affected PCOS) | Control(without PCOS) | Total | PV
|-------------|----------------------|-----------------------|-------|---
| Systolic pressure |                     |                       |       |   
| < 90th percentile | 139(96.5) | 6(2.2) | 6(3.2) | Chi-square:192 DF:1 P=0.551
| 95 ≥ percentile | 5(3.5) | 46(100) | 184(96.8) | 190(100)
| total | 144(100) | 46(100) | 199(100)
| Diastolic pressure |                  |                       |       |   
| < 90th percentile | 143(99.3) | 1(0.7) | 189(99.5) | Chi-square:321 DF:1 P>758
| 95 ≥ percentile | 1(0.7) | 46(100) | 190(100)
| total | 144(100) | 46(100) | 190(100)

Table 2: The mean of systolic & diastolic pressure in case and control groups.

| Percentile | Case (affected PCOS) | Control(without PCOS) | Total | PV
|-------------|----------------------|-----------------------|-------|---
| BMI         |                      |                       |       |   
| < 85th percentile | 15(10.4) | 27(14.2) | Chi-square:18.148 DF:2 P ≤ 0.001
| >85-95* percentile | 67(46.5) | 96(60.5) | 67(43.1) | 75(45.9) | 163(100)
| 95 ≥ percentile | 62(43.1) | 67(43.1) | 163(100)
| total | 144(100) | 62(43.1) | 206(100)
| Android obesity |                  |                       |       |   
| < 75th percentile | 120(83.3) | 165(86.8) | Chi-square:18.148 DF:2 P ≤ 0.001
| >75-90 ≤ percentile | 13(9) | 14(7.4) | 117(8.6) | 165(86.8) | 190(100)
| ≥ 95 percentile | 11(7.6) | 11(6.8) | 11(7.6) | 165(86.8) | 190(100)
| total | 144(100) | 117(8.6) | 261(100) | 165(86.8) | 190(100)
are highly concerned about android obesity. Economic, social, and geographical status as well as lifestyle might have played a role, as well.

In the study by Coviello et al. the prevalence of metabolic syndrome was higher in the adolescents with PCOS and was directly related to hyperandrogenism, but not to obesity and insulin resistance [10].

In the present study, high testosterone level had a role in increase of android obesity, which is consistent with other studies conducted on the issue [36]. In general, adolescents are unaware of or careless about long-term hyperandrogenic outcomes accompanied by insulin secretion. Nonetheless, this issue has attracted a lot of attention recently, since it may endanger their general health after the age of 40 years [37].

Blood pressure

The results of the present study showed no significant relationship between systolic and diastolic blood pressure above the 90th percentile. Shabanian also conducted a study on the children between 6 and 13 years old and reported that 3.5% and 3.3% of the girls had systolic and diastolic hypertension, respectively [38]. In Marit’s study, the prevalence rates of systolic hypertension and hypertension were 29.1% and 16.6% in Norwegian girls compared to the Argentinian ones. In that study, obesity showed a significant mild relationship with both systolic and diastolic blood pressure. It should be noted that Marit’s study was performed on the adolescents without PCOS, and the participants’ blood pressure was higher compared to the current study.

Rao carried out a research on overweight adolescents and indicated that 9.7% of the girls and 12% of the boys suffered from systolic hypertension, which was associated with increase of BMI, weight, and body fat [39].

Moreover, My et al. revealed that hyper androgenemia in the women with PCOS was accompanied by increase in systolic and diastolic blood pressure, irrespective of age, insulin resistance, obesity, and dyslipidemia [40].

A large number of studies have also demonstrated that metabolic disorder in PCOS women was accompanied by the risk of cardiovascular diseases and hypertension, and that reduction of vascular compliance and vascular endothelial dysfunction resulted in hypertension [41-43]. Yet, there is still debate on the role of testosterone in increasing blood pressure, particularly in the women with PCOS who are prone to obesity and insulin resistance.

Chen et al. [43] reported that PCOS was associated with the risk of hypertension (SBP > 130 mmHg and/or DBP > 85 mmHg) (odds ratio: 3.817, P=0.029, 95% CI: 1.14-12.74) irrespective of age, insulin resistance, obesity, and dyslipidemia. These results were in contrast to those of the present study, which might be attributed to the sample size as well as to duration of exposure to testosterone.

One of the limitations of the present study was lack of students’, and mostly mothers’, cooperation at the first stage of PCOS screening and not referring for laboratory tests and sonography. One other study limitation was lack of budget for referring the students and their families to treatment centers for doing the laboratory tests and sonography.

Conclusion

The findings of this study revealed the high prevalence of obesity (> the 90th percentile) among the PCOS patients. Although the frequency of hypertension was also higher among the patients, it was not significantly different from the control group. These findings indicate that controlling metabolic variables is essential in PCOS women for prevention of cardiovascular diseases and hypertension. Yet, future studies are required to be conducted on above-18-year-old population to assess the incidence of hypertension in the society. Studies on the relationship between obesity and incidence of hypertension are also warranted.

Secretion of insulin and SHBG from pancreas, increases the concentration of circulating free testosterone. Through HI, hypothalamus and pituitary remain sensitive to insulin and increase in the pulse frequency of GNRH increases LH/FSH ratio, leading to ovarian androgen production. Insulin also stimulates production of ovarian hormones directly. All these mechanisms help HA development.

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Funding Statement Interest: Research is showed high prevalence of obesity (> the 90th percentile) among the PCOS patients. Although the frequency of hypertension was also higher among the patients but not significant.

References
