Impact of Body Mass Index on Clinical, Hormonal, Metabolic Parameters in Polycystic Ovary Syndrome

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Abstract

Background: Due to functional hyperandrogenism, hyperinsulinaemia, and concomitant insulin resistance, which result in androgen excess and increased free androgen availability, altered granulosa cell activities, and altered follicular development, obesity has an impact on fertility. One of the most prevalent reasons of infertility in women related to anovulation is PCOS. From youth to post-menopausal age.

Objectives: To assess clinical parameters, metabolic and hormonal as hirsutism and menstrual irregularities in PCOs patient based on their body mass index.

Patients and methods: This study was done on 100 PCOs patients attending the outpatient clinic of the Department of Obstetrics and Gynecology South Valley University hospital. The patients were divide into 4 groups: Group A = females with BMI <18.5 (N= 16), Group B= females with BMI (18.5-25) (N= 28), Group C= females with BMI (25-30) (N= 28) and Group D= females with BMI >30 (N= 28).

Results: Regarding mean age, there was no statistically significant difference between the four groups, however there was a statistical difference in the four groups' height and weight. Regarding hormonal profile, there was no statistically significant difference between the four groups (FSH, TSH, PRL and LH). Regarding the impact of BMI on lipid profile, there was a statistically significant difference between the four groups (specially on LDL level). With increasing body mass index, like in group D, it was seen that random blood sugar, HA1c, and HOMA rose. saw no discernible relationship between BMI and the prevalence of oligomenorrhea and acne in PCOS women.

Conclusion: In conclusion, the result of the present study showed that there is significant effect of BMI on metabolic parameters in PCOs patients so there is significant effect of BMI on insulin resistant which is increased by increasing BMI which lead to hyperandrogenism and increasing blood glucose level. As regard clinical state there is no significant effect on acne, hirshutism and menstrual irregularity.

Keywords: Obesity; Body-mass index; PCOS; Serum LH; FSH; Prolactin.

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Introduction

The majority of adult females who have PCOS, also known as polycystic ovarian syndrome (PCOS), are females of reproductive age. Following the exclusion of other causes, the Rotterdam criteria is used to diagnose this syndrome, which is the presence of two of the following three criteria: oligo- or anovulation, clinical and/or biochemical hyperandrogenism, and the presence of polycystic ovarian syndrome on ultrasound examination **(Teede et al.,2018)**.

Patients with PCOs make up a diverse group with a range of clinical manifestations, including anovulatory infertility, obesity, type II diabetes, metabolic syndrome, and dyslipidemia**(Wild et al., 2010).** Body mass index (BMI), one of the variables influencing PCO patients' prognoses and treatment outcomes**(Bruno et al., 2007)**.

Nevertheless, the clinical parameters such as hirsutism, menstrual irregularities, hormonal parameters such as hyperprolactinemia and subclinical hypothyroidism, and metabolic parameters such as insulin resistance and impaired glucose tolerance in thin and obese PCOs women are not well defined in the literature with inconsistent findings of correlation **(Saxena et al .,2012).**

A woman's physical self-perception, social and emotional wellbeing, and quality of life can be significantly harmed by a PCOS diagnosis and its accompanying phenotypic traits, such as hirsutism and oligomenorrhea **(Tan et al.,2010; Orvieto et al .,2009)** In recent decades, the global epidemic of obesity has spread **(Jameson et al., 2010).**

An elevated body mass index (BMI) is a known risk factor for type 2 diabetes, coronary artery disease, and stroke **(Jameson et al., 2010).**

Overweight and obese women's reproductive systems are more prone to infertility and irregular menstruation**(Bozdag et al., 2016).** Additionally, a close connection exists between PCOS, which affects 6-12% of women of reproductive age, and obesity **(Ehrmann et al .,2005).**

The disorder is defined by three characteristics: oligomenorrhea/anovulation, hyperandrogenism (high serum androgens and/or hirsutism), and polycystic ovarian morphology (abnormally high antral follicle counts (AFC) or increased ovarian volume). According to the Rotterdam 2003 criteria, two of these three symptoms must be present in order to diagnose PCOS **(Azziz et al .,2004).**

The association between obesity and specific phenotypic features of PCOS as established by the Rotterdam criteria is unknown. A meta-analysis of women with PCOS, for example, found that hirsutism, as measured by the modified Ferriman-Gallwey score (mFG), was higher only when obese women were compared to overweight women, but not when obese women were compared to normal weight women **(Welt et al .,2006)**. Particularly in healthy women, the effects of obesity on characteristics like menstrual cycle length and AFC are still unknown. We propose that PCOS may worsen the effects of increasing body weight on these specific phenotypic characteristics.

The present study aim to assess clinical parameters as hirsutism and menstrual irregularities in PCOs patient based on their body mass index, as well as to assess hormonal parameters as serum LH, FSH, Prolactin and TSH, and to assess metabolic parameters as insulin resistance and impaired glucose tolerance in PCOs based on their body mass index.

Patients and methods

This was across sectional study was done on 100 PCOs patients attending the outpatient clinic of the Department of Obstetrics and Gynecology South Valley University hospital.

Inclusion criteria :PCOs patients from age range (25-45) year based on Rotterdam Criterian and according to their BMI were divided in to four groups,

- Groups A: women with BMI <18.5 Kg/m^2.
- Groups B: BMI 18.5- 25 Kg/m^2.
- Groups C: BMI > 25-30 Kg/m^2.
- Groups D: BMI > 30 Kg/m^2.

The uterus was normal and tubes are patent by histosalpingography in all patients of the studied groups: Normal serum prolactin level (5-20 ng ml) in all groups.

For all women the following was done :

1. **Verbal consent after explanation of nature of study.**
2. **Complete history:**

At the first visit detailed history was taken and it included

- Personal history: age, body mass index, height in metres, marital status, unique habits, and profession.
- Menstrual history: Menarche, menstrual cycle (length, frequency, and duration), dysmenorrhea, mid-cycle pain, discharge, intermenstrual bleeding, and the last menstrual period's date.
- History of chronic diseases, such as diabetes mellitus and hypertension, as well as symptoms and signs of endocrine disorders.
- Surgical history: laparotomy or laparoscopy.

3. **Clinical examination:**

General examination, height, weight, and for assessment of BMI and for any sign of endocrine disorder, breast examination for galactorrhea, abdominal examination, and pelvic examination for uterine or adnexal masses.

4. **Investigation:**

Serum FSH, LH, serum prolactin, lipid profile, Blood glucose level, thyroid function test, and pelvic ultrasound.

After enrollment, participants were divided in to four groups according to body mass index.

Ethical consent: The academic and ethical committee of South Valley University approved the project **(SVU-MED-OBG024-1-20-11-96).** Each patient signed a written informed consent form to agree to participate in the study. The Declaration of Helsinki, the World Medical Association's code of ethics for studies involving humans, guided the conduct of this work.

Statistical analysis

Statistical Package for Social Sciences (SPSS) version 22 for Windows was used to code, process, and analyse the obtained data (IBM SPSS Inc, Chicago, IL, USA). Using the Shapiro Walk test, the distribution of the data was examined for normality. Frequencies and relative percentages were used to depict qualitative data. To determine differences between two or more sets of qualitative variables, use the chi square test (2). Quantitative information was presented as mean±SD (Standard deviation). Two independent groups of normally distributed variables were compared using the independent samples t-test (parametric data). P value less than 0.05 was regarded as significant.

Results

We displayed the results of our study, which was carried out on 100 females with polycystic ovary.

Group A = females with BMI <18.5 (N= 16), Group B= females with BMI (18.5-25) (N= 28), Group C= females with BMI (25-30)(N= 28) and Group D= females with BMI >30 (N= 28).

Table 1. Socio demographic data

Variables	BMI				P value
	Group A	Group B	Group C	Group D	
Age	37.1±6.2	32.7±6.1	37.9±6.5	34±6.2	107
Height	166.8±5.1	164.1±10	155.3±7.1	158.1±4.9	.001*
Weight	47.8±3.6	60.2±9.6	67±5.4	99.8±3.8	.01*

The mean age of the four groups did not statistically differ significantly, but there was a statistical difference in the four groups' height and weight, (**Table.1**).

Table 2. Hormonal profile and BMI

Variables	BMI				P value
	Group A	Group B	Group C	Group D	
FSH	5.3±1.7	9±3.6	15±4.7	13.7±8.3	.071
LH	5.9±3.8	9.6±6.3	16.6±14	9.4±2.5	.06
Prolactin	9.7±6.1	7.3±6	13.7±6.9	9.4±5.3	.06
TSH	3.9±1.1	2.8±1.1	3.1±2.2	2.1±1.4	.09

Between the four groups, there was no statistically significant difference in terms of the hormonal profile (FSH, TSH, PRL, and LH) (**Table. 2**).

Table 3. Lipid profile and BMI

Variables	BMI				
	Group A	Group B	Group C	Group D	
LDL	101.9±50	89.7±38	100.0±46	137.6±68	0.05*
HDL	51.5±9.7	30.4±5.6	70.70±7.7	46.8±10	0.05*
Cholesterol	162.1±27.9	170.3±17	140.3±18	169.7±40.3	0.05*

We also observe statistical significant difference between four groups as regards effect of BMI on lipid profile (specially on LDL level) (**Table.3**).

Table 4. Blood glucose level and BMI

Variables	BMI				
	Group A	Group B	Group C	Group D	
RBS	119.1±49	118±56	127.1±57	197.5±129	.05*
HbA1c	4.3±.3	4.8±1.2	4.4±.4	5.8±1.1	.021*
HOMA	2.1±.16	2.1±.17	2.2± .21	2.4±.24	.005*

We observed random blood sugar, HA1c and HOMA increased with increasing in body mass index as in group D which have BMI more than 30 (**Table.4**).

Table 5. Relation between BMI, acne and menstrual irregularity.

Variables		BMI				P value
		Group A	Group B	Group C	Group D	
Acne	Yes	2(12.5%)	10(35.7%)	6(21.4%)	10(35.7%)	.556
	No	14(87.5%)	18(64.3%)	22(78.6%)	18(64.3%)	
Menstrual irregularity	Yes	2(12.5%)	10(35.7%)	6(21.4%)	10(35.7%)	.556
	No	14(87.5%)	18(64.3%)	22(78.6%)	18(64.3%)	

We did not observe any significant effect of BMI on rates of oligomenorrhea and acne in PCOS women (**Table.5**).

Discussion

The prevalence of obesity is rising throughout the world. According to recent statistics, 60% of American women are overweight, 30% are obese, and 6% are severely obese; 50% of women aged 25 to 44 are overweight, and 20% are obese**(Hedley et al., 2004).**

To be able to reproduce effectively during pregnancy, women must have a particular minimum amount of body fat. Unhealthy levels of body fat can cause irregular menstruation, infertility, miscarriage, and issues with assisted reproduction. In this study, we examine how BMI affects clinical, hormonal, and metabolic parameters in PCOS patients. We divide our patient population into four categories based on BMI: Group A: BMI <18.5 Kg/m^2, Group B: BMI 18.5- 25 Kg/m^2, Group C: BMI > 25:30 Kg/m^2, and Group D: BMI > 30 Kg/m^2.

Due to functional hyperandrogenism, hyperinsulinaemia, and concomitant insulin resistance, which result in androgen excess and increased free androgen availability, altered granulosa cell activities, and altered follicular development, obesity has an impact on fertility **(Glueck et al .,2010).**

One of the most prevalent reasons of infertility in women related to anovulation is PCOS. From adolescent through post-menopausal age, PCOS's clinical characteristics can vary and are heterogeneous **(Hartz et al .,2003)**.

Depending on the criteria used to characterize the illness, polycystic ovarian syndrome (PCOS) has a prevalence of 4-9% in women of reproductive age**(Badawy et al., 2010).**

The underlying aetiology of this illness, which was first identified more than 50 years ago and is by far the most frequent cause of hyperandrogenic anovulatory infertility, is still unknown. The impact of BMI on clinical, hormonal, and metabolic markers in PCO patients has been the subject of numerous investigations.

Our study was across sectional study conducted on 100 women diagnosed as PCOS by Rotterdam criteria selected from patients attending the gynecological outpatient clinic of South Vally University hospital, faculty of medicine, according to inclusion and exclusion criteria. The patients were divided into four groups according to their body mass index

Regarding the patient demographic data:

In the current study there was no statistical significant difference between four groups as regards the mean age and there is a statistical difference between the 4 groups regarding Height and the weight.

Regarding to basal hormone profile:

There was no statistical significant difference between four groups as regards hormonal profile (FSH, TSH, PRL and LH).

This study's findings are in agreement with those of **(Anjali et al.,2010).** who performed a retrospective analysis of the medical records of 308 women and divided the patients into three categories: normal weight (BMI<25kg/m^2), overweight (BMI>25kg/m^2), and obesity (BMI>30kg/m^2), reported that the basal (day 2) hormonal profile, comprising FSH, LH, and TSH, did not significantly differ between the three study groups.

Three additional studies, including those by **(Fedorcsak et al., 2004;Van Swieten et al.,2005).** also came to the same conclusion as our study.

In the contrary to our results regarding the effect of BMI on hormonal profile in PCOs patient; **(Martinuzzi et al.,2008),** who observed the results of 217 patients (All < 35 years of age) had reported that elevated BMI adversely affect the hormonal profile in PCOs patient.

Also these results meet those obtained by **(Anjali et al.,2010; Luna et al.,2009).**

We also observe statistical significant difference between four groups as regards effect of BMI on lipid profile (specialy on LDL level) P-value < 0.05.

As regard results of our study in Group D LDL 137.6±68 HDL 46.8±10 cholesterol level 169.7±40.3, however in group A LDL 101.9±50, HDL 51.5±9.7 Cholesterol 162.1±27.9.

It mean that increasing in BMI lead to increase in LDL and cholesterol level in PCOs patients.

Our results also disagree with those of **(Anjali et al.,2010;Fedorcsák et al.,2004).** as they all came out with a conclusion that there is no statistically significant difference in lipid profile among the different BMI groups that was studied.

As was predicted, higher BMI was linked to poorer metabolic state in PCOS patients, with insulin resistance being more prevalent.

Group A RBS 119.1±49 Ha1c 4.3±.3 HOMA 2.1±0.16 , Group B RBS 118±56 Ha1c 4.8±1.2 HOMA 2.1±.17, Group C RBS 127.1±57 Ha1c 4.4±.4 HOMA 2.2± 0.21, Group D RBS 197.5±129 Ha1c 5.8±1.1 HOMA 2.4±.24)

As we observed random blood sugar, HA1c and HOMA increased with increasing in body mass index as in group D which have BMI more than 30.

As opposed to that, Increased BMI has no discernible impact on RBS, according to a retrospective case control research by (**Al-Azemi et al.,2004**). that was conducted from 2008 to 2010. The study's participants were

divided into four BMI groups **(Petanovska et al.,2011).**

Also these results meet those obtained by (**Zhang et al.**, **2010 ;Bellver et al.,2009)**.

Finally, we found no correlation between BMI and the prevalence of oligomenorrhea in PCOS women. Because mean BMI in our cross-sectional study was in Group A (87.5%), Group B (64.3%), Group C (78.6%), and Group D (64.3%), there was no influence of BMI on oligomenorrhea. Another cross-sectional investigation **(Stanczyk et al., 2006)**. whose average BMI was comparable to our study's, found that the severity of oligomenorrhea was similarly unaffected by BMI. In contrast, a another study found that women with an obese BMI of 31.2 4.4 had longer menstrual cycles **(Solomon et al .,2002)** . In fact, weight loss brought on by dietary changes or bariatric surgery has been shown to increase menstruation regularity in very obese people. A larger study is required to assess whether severely obese women's menstrual cycles will lengthen.

Increased FAI, a measure of bioavailable testosterone, was associated with higher mFG scores rather than an increase in androgen levels per se, highlighting the well-known effects of high BMI on the androgen-binding protein SHBG**(Wild et al., 2010)**. . It's important to note that PCOS women with high BMI have 1.51 times more DHT than healthy women of a similar weight, which may help explain how the androgen receptor is directly impacted in these women's hair follicles**(McCormick et al .,2008)**. The cumulative effects of BMI and PCOS status to enhance mFG score need further investigation, even though a cause and effect link cannot be inferred from this cross-sectional study. So, is losing weight a potential treatment for hairiness? Weight loss after changing one's lifestyle decreased total testosterone and hirsutism, according to a comprehensive evaluation by **(Adams et al.,1986**).

In addition, bariatric surgery-related weight loss was linked to decreased hirsutism and serum free testosterone levels**(Manal et al., 2012).**Further research into the use of the insulin sensitising drug metformin to lessen hirsutism is warranted given that PCOS women who use it have been shown to have lower BMI and testosterone levels**(Glueck et al .,2002).** The task of the future is to develop long-lasting strategies for achieving ideal weight and analysing how they affect hirsutism.

Conclusion

In conclusion, the result of the present study showed that there is significant effect of BMI on metabolic parameters in PCOs patients so there is significant effect of BMI on insulin resistant which is increased by increasing BMI which lead to hyperandrogenism and increasing blood glucose level. As regard clinical state there is no significant effect on acne, hirshutism and menstrual irregularity.

Lastly in our study we don't observe significant effect of BMI on hormonal state of PCOSS patients but we see convergent results to hormonal level of FSH , LH, prolactin and TSH in four groups of our study.

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