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The Impact of Obesity on The Physiological and Hormonal Status of Iraqi Women

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Abstract:

This study has focused on obesity and its relation to the physiologic and hormonal status of some Iraqi women. This is considered as one of the serious conditions that affect women, where coronary heart disease, osteoporosis, diabetes mellitus, infertility, and psychological disturbances, considered are the most important complications. The study was conducted on 69 serum samples from infertile patients, aged (16-44) years. The levels of FSH, LH, PRL, testosterone, progesterone, and TSH were estimated in the laboratory, in addition to pelvic ultrasonic examination was tested clinically. Some chemical parameters were measured in the sera of patients and control groups like fasting blood glucose, blood urea, and blood cholesterol. Other data included Body Mass Index (BMI), age, marital status, drug intake, family history, and the age at which menarche had started were installed. In our study, the results show significant differences in BMI, 0.0% of women had BMI less than 19.2% between 19 and 25, and 98% above 25. Notable risen (P<0.05) have achieved in serum total cholesterol for the patients' group when compared with the control group. While non-notable risen (P>0.05) have achieved in the rest parameters (Fasting blood glucose, and blood urea) when compared with the control group. Considerable differences ($P < 0.01$) between the levels of FSH, PRL, testosterone, progesterone, and TSH in the patients when compared with the control group (20 women). And significant differences ($P < 0.01$) between the level of testosterone and progesterone in the patients who have no children ($No. = 54$) when compared with patients who have children ($No. = 15$).

Keywords: obesity, overweight, infertility, hirsutism, body mass index

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تاثير السمنة على الوضع الفسيولوجي والهرموني للمراة العراقية

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مستخلص البحث:
ركزت هذه الدراسة على عينات بعض النساء العراقيات المصابات بالسمنة وعلاقتها بالحالة الفسلجية والهرمونية . اذ تعتبر السمنة من العوامل المهمة والمسببة لأمراض القلب ،هشاشة العظام ،داء السكري ،العقم وبعض التغيرات الفسلجية وما تسببة من مضاعفات خطيرة. ادرج في هذه الدراسة 69 عينة من امصال نساء مصابات بمشاكل بالخصوبة ،يتراوح اعمارهن (16-44) سنة ومجموعة سيطرة من نساء سليمات مؤشر كتلة الجسم لديهن طبيعي عددهن (20) . وتم قياس بعض المعايير الهرمونية اضافة الى اجراء السونار وبعض الاختبارات السريرية. اما التحاليل الكيميائية التي تم اجراءها هي: كلوكوز مصل الدم الصيامي ، اليوريا، الكولسترول. تم حساب مؤشر كتلة الجسم لكل عينة وتثبيت العمر والحالة الاجتماعية ، الادوية التي تتناولها المشتركات في هذه الدراسة وكذلك اذا كان للمساهمه في هذه الدراسة تاريخ عائلة مرضي للاصابة بالامراض الوراثية كذلك تم تثبيت سن البلوغ ضمن البيانات المدرجة للدراسة. اظهرت النتائج فروقات معنوية مؤثرة لمؤشر كتلة الجسم بين مجاميع الدراسة وفرق معنوي كبير لكولسترول الدم مقارنة بمجموعة السيطرة من ذوات الاوزان الطبيعيه (مؤشر كتلة الجسم يتراوح بين 21-24). بينما لايوجد اختلاف معنوي في بقية التحاليل الكيميائية (اليوريا، السكر الصيامي) مقارنة بمجموعة السيطرة. وجد اختلاف معنوي كبيروجد لبقية التحاليل الهرمونية بين مجموعة المصابات باضطرابات هرمونيه من ذوات الاوزان العالية مقارنة بمجموعه السيطرة. واحصائيا كان عدد المساهمات اللواتي لايملكن اطفال (54) من اصل (69).

الكلمات المفتاحية: السمنة، زيادة الوزن، العقم، الشعرانية، مؤشر كتلة الجسم

1. Introduction

There are different causes of obesity all of which can make a person obese. The commonly held belief is that to become obese, a person must have an unfavourable lipid profile or reduced physical activity, such that an individual would consume more calories than he or she burns, leading to a gain in body mass in the form of fat (Leisegang et al, 2021; Sun et al, 2020). Although rarely recognized, sleeping fewer than 7 hours a day increases hormonal imbalances that lead to appetite boosts (Idrees, K., and Ahmed Elhaj 2024). This may lead to desire to take high-calorie foods with carbohydrates in the hope of putting back the energy used in their execution to gain more weight. In women, pregnancy is another possible cause of obesity (Vozova et al, 2024). Pregnancy is a physiological process that requires weight gain to support fetal growth and development but putting off this weight after delivery may result in obesity. Some of the drugs also cause weight gain; these include antidepressants, anti-seizure medications, diabetes drugs, and corticosteroids (Laganà AS et al, 2016; Pandey et al, 2010). Obesity can arise from diseases such as Cushing's syndrome (Pasquali et al, 2007). For instance, arthritis affects health by limiting physical movements, which over time leads to weight gain (Wendy S et al, 2022). Although

data does not support the belief that low metabolism may be responsible for obesity, other works reveal the close link between hypothyroidism, thermogenesis, lipid metabolism, and obesity (Baird DT et al, 1981; Gutam et al, 2023).

Estrogen in the body is produced by two primary sources: the ovaria and the adrenal glands of the body (Pavli P. et al, 2024). Ovarian estrogen synthesis is also influenced by the menstrual cycle phases (Ou XH et al, 2022). At the same time, adrenal glands secrete the hormone androstenedione which is associated with cholesterol. As in all overweight individuals, the fat tissue metabolizes androstenedione to an estrogen namely the estrone. In a woman, who is considerably overfat, this extra estrone can upset the normal ovarian activity and fecundity is often impaired by the failure of ovulation (Nikanfar et al, 2021).

2. Subjects and Methods

Inclusion criteria: Sixty-nine Iraqi female volunteers were selected from people who attended the Infertility Center of Al-Yarmouk Teaching Hospital, From May to August 2024 with a mean age value of (29.6±5.4) and an age range between (16-44) years. Twenty healthy fertile subjects (age range=15-40) were included throughout this study, as a control group. Careful information was obtained from each volunteer in this study.

Methods: Ninety-five millilitres of venous blood were withdrawn from the subjects and anticoagged with a plain tube and the blood was allowed to clot at room temperature. The clear solution was then centrifuged at three thousand revolutions per minute for ten minutes and the serum separated. After centrifugation, the serum was meant to be refrigerated at 20 degrees below zero until the hormones were analyzed. The hormonal assays were carried out on the VIDAS system (Mini VIDAS, model 12, 1992); the manufacturer is Biomerieux, France; the method employed was the enzyme-linked fluorescent assay (ELFA). Other chemical parameters were done using kits from
a linear kit manufacturer or by standard principles. FSH, LH, PRL, testosterone, progesterone, and TSH levels were estimated, and pelvic ultrasonic examinations were tested clinically and in the laboratory. Some chemical parameters were measured in the sera of patients and control groups like fasting blood glucose, blood urea, and blood cholesterol. Other data included body mass index (BMI) weight in $kg/[Height\ in\ m]^2$, age, marital status, drug intake, family history, and the age at which menarche had started were installed.

Statistical Analysis: Data analysis was done by Duncan multiple range test with probabilities adjusted at $p < 0.05$ which was considered significant while $p < 0.001$ was considered highly significant. Data from the study were analysed blindly using the Statistical Package for the Social Sciences (SPSS) with all the analyses done three times for quality check.

3. Results and Discussion

The mean ages of the patients that have been utilized in this study are $(29.6y \pm 5.4)$ with age within the range $(16 - 44)$ years, while it was $(27.32y \pm 3.06)$ with the age in the range $(15 - 40)$ years for the control group. The duration of infertility for the patients' group was (7.34 ± 2.56).

Table 1- Distribution of patients according to age group, duration of marriage, and duration of infertility

Cases	N	Age (mean±SD)	Duration of marriage (mean years)	Duration of infertility (mean years)
patients	69	29.6±5.4(16-44)	8.3±2.43	7.34±2.56
controls	29	27.32±3.06(15-40)	4.75±1.51	---------
Total	89			

The distribution percentage of patients based on their family history of hirsutism and overweight, respectively, was displayed in Tables 2 and 3.

Table 2- Distribution of patients with fertile disturbance according to Family history of overweight

Family history	N	%	Comparison of significance by Binomial test
Positive	3	4.34	(P<0.05)
Negative	66	95.66	
Total	69	100	

Table 3- Distribution of patients with fertile disturbance according to hirsutism

Hirsutism	N	%	Comparison of significance by Binomial test
Positive	13	18.88	(P<0.05)
Negative	56	81.12	
Total	69	100	

Table 4 displayed the distribution of patients by body mass index (kg/m^2), indicating that 35.5% of patients were overweight and 62.5% of patients were obese.

Table 4- Distribution of patients with fertile disturbance according to Body mass index BMI (Kg/m^2)

BMI (Kg/m^2)[44] [97]	**N**	**%**	**Comparison of significant by Kruskal-Wallis Test**
<18.5	0	0.0	**(P<0.01)**
18.5-24.9	2	2	
25-29.9	24	35.5	
≥30	43	62.5	
Total	69	100	

Table 5 presents the changes in a few biochemical markers that were measured in this study. The results show that the patients' group had significantly higher serum total cholesterol levels (p<0.05) than the control group did. In contrast to the control group, there were non-significant increases (p>0.05) in the rest parameters (blood urea and fasting blood glucose).

Table 5- The mean value of some chemical parameters for the patients with fertile disturbance and the control groups under study

	Mean±SD Patients (69)	**Range**	**Mean±SD Controls (20)**	**Range**
Fasting blood glucose	123±34mg/dl	(86-153) mg/dl	81±12.3 mg/dl	(69-99) mg/dl
Blood urea	5.3±2.21mmol/l	(4.9-6.9) mmol/l	7.0±1.74 mmol/l	(3.9-9) mmol/l
Total cholesterol	258.2±20.66mg/dl	(232-278) mg/dl	200±22 mg/dl	(167-222) mg/dl

Significant differences ($P < 0.01$) between the levels of FSH, PRL, testosterone, progesterone, and TSH in the patients when compared with the control group (20 women). Whereas, notable differences ($P < 0.01$) between the level of testosterone and progesterone in the patients who have no children ($No. = 54$) when compared with patients who have children ($No. = 15$) as illustrated in Tables 6 and 7 respectively.

Table 6- The mean values of Reproductive hormones assay on cycle day (3) of the menstrual cycle and thyroid hormone for the patients and the control groups

Hormones	Mean±SD Patients (69)	Range	Mean±SD Controls (20)	Range	P value
Luteinizing hormone (LH)	3.28±2.37mIU/ml	(0.5-8.4) mIU/ml	3.9±1.2mIU/ml	(1.5-8) mIU/ml	P>0.01
Follicle stimulating Hormone (FSH)	4.23±2.21mIU/ml	(1.3-8.9) mIU/ml	7.0±1.74mIU/ml	(3.9-12) mIU/ml	P<0.01
Prolactin	22.6±11.1ng/ml	(3.8-53.0) ng/ml	13.1±2.3ng/ml	(1.3-25) ng/ml	P<0.01
Thyroid Stimulating Hormone (TSH)	1.62±0.7nmol/L	(0.6-3) nmol/L	2.6±0.76 nmol/L	(0.25-5) nmol/L	P<0.01
Testosterone	0.96±0.7ng/ml	(0.08-3) ng/ml	0.5±0.09ng/ml	(0.1-0.9) ng/ml	P<0.01
Estrogen (E2)	78.45±56.1pg/ml	(13-232) pg/ml	20.43±12.3pg/ml	(18-147) pg/ml	P<0.01
Progesterone ng/ml	0.72±0.61ng/ml	(0.04-1.5) ng/ml	0.27±0.1 ng/ml	(0.1-0.54) ng/ml	P<0.01

Table 7- The mean values of Reproductive hormones assay on cycle day (3) of the menstrual cycle and thyroid hormone for Secondary and primary infertile women

Hormones levels Mean±SD (range)	Patients have not children (54)	Patients have children (15)	P value
Luteinizing hormone (LH)	3.5±1.2 mIU/ml (0.5-8.4) mIU/ml	3.7±1.8mIU/ml (0.6-6.3) mIU/ml	P>0.01
Follicle stimulating Hormone (FSH)	4.7±2.43mIU/ml (1.5-8.9) mIU/ml	4.69±2.21mIU/ml (1.3-7.6) mIU/ml	P>0.01
Prolactin	22.4±11.1ng/ml (3.8-53) ng/ml	23.2±11.8ng/ml (4.2-43.6) ng/ml	P>0.01

Thyroid Stimulating Hormone (TSH)	1.5±0.67nmol/L (0.08-3) nmol/L	1.1±0.45nmol/L (0.6-1.6) nmol/L	P>0.01
Testosterone	1.1±0.14ng/ml (0.08-8) ng/ml	0.6±0.8ng/ml (0.06-2.8) ng/ml	P<0.01
Estrogen (E2)	55±51pg/ml (15-230) pg/ml	60±51pg/ml (13-232) pg/ml	P>0.01
Progesterone ng/ml	0.42±0.21ng/ml (0.04-1.3) ng/ml	1.32±0.61ng/ml (1.2-1.5) ng/ml	P<0.01

Obesity has become a major issue in the contemporary society, and the consequences have had a disastrous impact on female fertility. Obesity has been defined by a BMI of greater than $27\ kg/m$ and has a close association with ovulatory subfertility and anovulatory infertility (Parker JE ,and Arscott GH, 1972). Overweight and obese women suffered a worse prognosis that reduced their response to clomiphene citrate for ovulation induction and had higher steeply doses of gonadotrophins for both ovulation induction and superovulation. In assisted reproduction, ovarian stimulation in obese women as a rule is associated with fewer numbers of follicles and, therefore, oocytes upon retrieval. Furthermore, the rates of fertilization capacity are usually low, and embryo development is frequently affected, especially in young women with obesity (Medeiros, L. et al, & Zatra Yamina et al, 2023). Several have indicated decreased pregnancy rates and an increased incidence of early pregnancy loss. Liposolutive has an impact in correcting menstrual cycles and increasing the chances of spontaneous ovulation and conception of anovulatory overweight and obese women. A slow, slow rate of losing weight is healthy while diets which are low in calories are not healthy (World Health Organization, 2016).

Adverse effects such as obesity in women have been shown to delay the period of conception. Obese women with a BMI of $32\ kg/m^2$ or more in the last measured age of 18 had an increased risk of anovulatory infertility 2.7 $(95\%CI, 2.0 - 3.7)$ (Pasquali R et al, 2017) Moreover, in ovulating but subfertile women, the chance of becoming pregnant naturally goes down by 5 per cent for every unit change in BMI

(Pasquali R et al, 2007) .

The pathways through which obesity impacts or exacerbates subfertility, are complex. There is evidence that people with higher BMI have higher serum and follicular fluid leptin levels and lower serum adiponectin levels. Leptin acting via the leptin receptors present on theca

and granulosa cells of the ovary suppresses ovarian steroidogenesis. Decreased adiponectin levels correlate with elevated levels of circulating insulin which may cause hyperandrogenemia, at least in part by the down-regulation of the hepatic synthesis of SHBG (Brannian JD, 2011) . Further, insulin stimulates the secretion of Luteinizing Hormone (LH)-induced steroids through the insulin-like growth factor I (IGF- I) in the theca cells of the ovary, thus increasing ovarian androgen synthesis. The high level of androgens in Hyperandrogenemia induced apoptosis in granulosa cells, while the peripheral conversion of androgens to estrogens via remodelling of lipids in adipose tissue reduces gonadotropin secretion. Obesity is also closely related to polycystic ovary syndrome (PCOS), an adrenal state that is characterized by anovulatory cycles, hyperandrogenism, hirsutism and infertility (Mitchell M, 2005) . Hormonal dysfunction in women with PCOS is common and the experience rate of obesity ranges from $30-75\%$ the metabolic derangement featured by obesity worsens PCOS (Vander Borght M, and Wyns, 2018) .

One important thing to remember is that obesity that decreases the levels of fertility, is best recognized if the accumulated fat is localized around the abdominal cavity. Reduced sex hormone levels are thought to be largely responsible for reduced fertility in patients. These changes usually manifest especially in increased androgen production known as hyperandrogenism (high levels of androgens) which is not uncommon in overweight women who develop amenorrhea. Obesity also results in insulin hypersecretion and insulin insensitivity, which all lead to hyperandrogenism. Insulin is involved in sex hormone secretion, and in fatty women especially those with PCOS, excess weight gain triggers an overproduction of insulin which leads to increased secretion of androgen and the formation of abnormal ovarian follicles (Fanchin, R et al, 2023). Due to this disruption of ovarian function and menstrual cycles, the female perception faces fertility difficulties. The study investigated the various challenges faced by obese women, especially those seeking help from reproductive technologies (ART), and the study discovered that such women are subjected to more challenges than their non-obese counterparts. The study has found that obesity decreases the chances of making In Vitro Fertilization (IVF) treatment fertile (Hahn, S, 2005).

4. Conclusion

Obesity's effects on reproductive function have a complicated mechanism. Additionally, obesity has been linked to hormonal imbalances such as hypertrophyolemia, which may be the mechanism through which obesity contributes to certain reproductive disorders.

Conflicts of Interest: None

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