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Endocrine Profile of Obese Fertile and Obese Infertile Women of Childbearing Age A Multicenter Case-Control Study in Peshawar.

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ABSTRACT:

OBJECTIVES: A multicenter case-control study was aimed to compare the endocrine profile of obese fertile and obese infertile women of childbearing age.

METHODOLOGY: There were 100 participants in this study, of which 50 were fertile and 50 were infertile. The information was gathered on menstrual history, years of marriage, and years of trying to conceive. Each case and control underwent a thorough examination, and investigations, including ultrasound and hysterosalpingogram, were performed to determine any other causes of infertility and to exclude polycystic ovary syndrome. Lab tests were conducted for the following hormone levels: luteinizing hormone (LH), follicle-stimulating hormone (FSH), prolactin, insulin, and thyroid-stimulating hormone (TSH).

RESULTS: For the fertile group, the average or mean age was 34.88 years, whereas for the infertile group, the average or mean age was 30.48 years. All the participants had a history of normal, regular menstrual cycles. The mean for both the cases and controls was 30 days. The majority (60-92%) of the patients had normal LH, FSH, prolactin, insulin, and TSH levels. However, the insulin levels in both the cases and controls were more significant than the typical values in over 30% of the subjects. The rest of the hormone levels were more important than usual in only 4-18% of patients of both groups. Both groups found all mean values of LH, FSH, TSH, prolactin and insulin within the normal range. The Chi-square test revealed an insignificant difference in three categories (< normal, regular, and > routine) in each hormone level in fertile and infertile groups. The t-test showed a negligible association with each hormone parameter's mean values between fertile and infertile women.

CONCLUSION: The study showed that the hormone insulin must have some relation to obesity but not necessarily to infertility. We found no significant difference between fertile and infertile groups in hormonal profiles.

KEYWORDS: Endocrine Profiling, Fertility, Obesity, Insulin, luteinizing hormone (LH), Follicle-Stimulating Hormone (FSH), prolactin, Thyroid Stimulating Hormone (TSH).

INTRODUCTION

Obesity is a global health concern with rising incidence and prevalence, increasing expenditures, and poor outcomes. Due to a more significant incidence of these women presenting with infertility or pregnancy concerns, gynaecologists are more frequently confronted with obesity-related issues [1]. The multicenter current case-control study was conducted to compare the endocrine profile of obese fertile and obese infertile women of childbearing age in the hospitals of Peshawar, Pakistan. Although many obese women are not infertile, obesity has been linked to decreased fertility [2]. It has been suggested that obesity decreases fertility by affecting ovulation, development of ova, embryo and endometrium, implantation and miscarriage [2]. A complicated hormonal setting controls the menstrual cycle, ovulation, and development of the endometrium. The sex hormone production and availability have been disrupted by adipose tissue [2]. In obese women, the conversion of androgens to estrogens in the peripheral tissues will be higher. This will affect the gonadotropin secretion. Increased levels of androgens in the blood will increase due to increased insulin levels and insulin resistance. The levels of insulin-like growth factor-binding proteins, growth hormone, and sex hormone-binding globulin will be decreased [3].The anterior pituitary produces luteinizing hormone (LH) and follicle-stimulating hormone (FSH). LH stimulates the production of estrogens and progesterone from the ovary, increasing just before ovulation, and is
Responsible for the release of the OVA. FSH stimulates the maturation of germ cells, follicular development, and estradiol synthesis [4]. Increased LH secretion and LH: FSH ratio is adverse for the production and development of follicles in obese women [5]. Insulin stimulates the theca and granulosa cells to produce ovarian steroids and increases the effects of LH by the upregulation of the LH receptor [6]. Fat, particularly obesity around the belly, is a common cause of increased insulin secretion and resistance [7]. Prolactin is a hormone that inhibits FSH and is a gonadotrophin-releasing hormone that helps with fertility. High prolactin levels inhibit FSH secretion, which may suppress ovulation. Thyroid problems can interrupt the complex process of menstruation by causing irregular menstrual cycles or even stopping it altogether. If thyroid levels are not ideal, they cannot support LH to release the ovum from the ovary, therefore making pregnancy impossible [6]. Adipose tissue can be considered an endocrine organ, and the fat cell is a cell of this organ. The increase in the number or size of this organ causes the abnormality. Leptin is the most critical secretory peptide associated with adipocytes and adipose tissue [1].

Several endocrine changes are related to obesity, including elevated levels of leptin, TSH, insulin, androgens, progesterone, adrenocorticotropic hormone, and sympathetic nervous system activity. Abnormalities in the release of the gonadotropic releasing hormone, follicle-stimulating hormone, and luteinizing hormone can induce anovulatory cycles [8]. Data from a few studies in the National Health and Nutrition Examination showed that in adults between the ages of 20-74, the prevalence of obesity has increased by 17.9% within the last 25 years [9]. Similar data is being reported from other parts of the world, including developing countries. Levels of obesity in the Middle Eastern countries have exceeded 40% [1]. A sufficient quantity of preovulatory surge of the luteinizing hormone is needed. When this does not occur, anovulatory cycles occur. Because of this, the corpus luteum fails to develop, and hence, there is no progesterone secretion in the second phase of cycle [10].

Another problem could be luteal phase deficiency. In these cases, there would be

inadequate progesterone secretion in the cycle's luteal phase compared to a regular menstrual cycle. Due to insufficient progesterone secretion, the endometrium is incapable of supporting the embryo's implantation. Fertilization will occur in these cases but will be followed by early miscarriage [11].

The adipokines regulate several physiological processes, including reproduction, immunity, and metabolism [12]. Because of excess adipose tissue in women, the polycystic ovarian syndrome is increased, anovulation will occur, and there may be hypothalamic hypogonadism. According to some studies, leptin levels will also increase in the blood and follicular fluid as the body mass index rises [13]. Leptin acts on the theca and granulosa cell receptors and inhibits ovarian steroid production, which insulin induces. It also inhibits estradiol synthesis, which is stimulated by luteinizing hormone [14]. The underlying causes of obesity include increased insulin levels, insulin resistance, and androgen levels. According to some studies, insulin also stimulates changes in steroidogenesis. It stimulates the production of estrogen, androgens, and progesterone by the theca cells [15]. Due to increased steroid production and the interaction between LH and insulin, the environment becomes unfavourable, and the follicular growth stops. This leads to disturbances in the menstrual cycle and oligo-anovulation induced by obesity [16].

MATERIALS AND METHODS

Study Design & Setting:

A case-control study was conducted in the following three hospitals in Peshawar: Mercy Teaching Hospital, Kuwait Teaching Hospital, and Hayatabad Medical Complex. The study was conducted from 1st November 2015 to 1st May 2016.

Sample Size & Technique:

The sampling technique applied was consecutive sampling. Sample size determined by the statistical formula:

$$N=z^2p\ (1-p)\ /\ d^2$$

Where, N= sample size, z= statistical level of confidence, p= prevalence/ proportion, and d= precision

Groups of Patients:

A total of 100 participants were included as per the study protocol. All the subjects included in the study were obese. Fifty fertile and fifty infertile patients were included in the study. In a sample of 100 subjects, 50 were the cases that were obese, fertile women of childbearing age. The 50 patients were controls, which were obese infertile women of childbearing age. These subjects and controls were age-matched and had the same socioeconomic background.

Sample Selection:

All the patients fulfilling the selection criteria attending the three selected hospitals were included in the study.

Inclusion Criteria:

According to the World Health Organization, women of childbearing age are between 15 and 49. Obese, fertile women with no other co-morbidities associated with obesity, such as hypertension. Obese infertile women for more than twelve months of trying to conceive. Women with regular menstrual cycles. Obese women with a body mass index equal to or more than 30kg/m^2.

Exclusion Criteria:

Women are pregnant at the time of the study. Women infertile due to polycystic ovarian syndrome confirmed by ultrasound and history. Women are infertile due to past pelvic surgeries. Women are infertile due to any tubal, uterine, or cervical obstruction, which will be ruled out by performing a hysterosalpingogram. Women are infertile due to medical disorders which affect fertility, such as thyroid diseases or adrenal diseases.

Sample Collection:

Detailed information regarding the study procedure and purpose was provided to all the subjects included in the study. Written consent was taken from all the subjects. The subjects were interviewed using a questionnaire to gather information about their menstrual history, years of marriage, years of trying to conceive, and their past medical and surgical histories. The weight in kilograms and height in meters were used to calculate the body mass index. Each case and control underwent a thorough examination, and investigations, including ultrasound and hysterosalpingogram, were performed to determine any other causes of infertility and to exclude polycystic ovary syndrome.

Blood Sample Collection:

In both groups, 5 ml of venous blood was drawn from the cubital fossa under sterile conditions. It was transferred to gel tubes. Coagulated blood was centrifuged at 4000 revolutions per minute for 5 minutes to obtain clear serum and to determine the hormonal assay.

Determination of Insulin:

Insulin immunoradiometric test is a "sandwich" kind of assay. Mouse antibodies against two separate insulin epitopes were employed in this kit. This method measured immunoreactive insulin (free insulin + insulin bound to anti-insulin antibodies) directly in the serum or plasma. After pre-treating samples with
Precipitation reagent, free insulin was obtained (CAT. No. A09775). Serum and plasma samples (pre-treated or untreated with precipitation reagent), controls (pre-treated or untreated with precipitation reagent), and calibrators were placed in tubes coated with the first antibody with the second antibody and labelled with iodine 125. After incubation, the tubes were washed to remove the unbound ^{125}I-labeled antibody. The bound radioactivity was then determined in a gamma counter. The insulin concentrations in the samples were attained by interpolation from the standard curve. The concentration of insulin in the samples was directly proportional to the radioactivity. Following reference, values were considered: between 0.93 – 26.5 micro-unit/ml.

Determination of Prolactin:

The prolactin levels were measured using the immunoradiometric assay technique using the Prolactin IRMA kit. LOT NO. IM2121 – IM3303 (France). Prolactin immunoradiometric essays are a form of sandwich test. The kit uses mouse monoclonal antibodies directed against two separate prolactin epitopes and did not compete. The assay determined the biologically active, monomeric form of prolactin (22-23 kDa) and, to a certain extent, also other forms known as big prolactin (50-60 kDa) and big-big prolactin (or macroprolactin; >150 kDa). The assay also enabled the facultative determination of prolactin after macroprolactin precipitation. In the presence of the second ^{125}I-labeled monoclonal antibody, samples or calibrators were incubated in tubes coated with the first monoclonal antibody. After incubation, the liquid content of the tubes was washed, and

binding radioactivity was measured. Interpolation from the standard curve was used to calculate the values. The amount of radioactivity bound was proportional to the amount of prolactin in the sample. Following reference, typical values were Cyclic: 1-27 ng/ml and Postmenopausal: 2-13 ng/ml.

Determination of Thyroid Stimulating Hormone:

The levels of the thyroid-stimulating hormone were determined using the immunoradiometric assay technique using the IRMA kit. LOT NO. IM3712, IM3713. Thyroid-stimulating hormone (TSH) immunoradiometric test is a 'sandwich' type assay. Mouse monoclonal antibodies were utilized, directed against two separate epitopes of TSH; hence, they did not compete. In the presence of the second monoclonal antibody tagged with iodine 125, the samples or calibrators were incubated in tubes covered with the first monoclonal antibody. Following incubation, the tubes' contents were evacuated and cleaned to eliminate any unbound ^{125}I-labeled antibodies. A gamma counter was then used to determine the bound radioactivity. A gamma counter was then used to determine the bound radioactivity. Interpolation from the standard curve yielded the TSH concentrations in the samples. The radioactivity was proportional to the concentration of TSH in the samples. The normal range was considered between 0.3-5.0 uIU/ml.

Determination of Luteinizing Hormone:

The levels of luteinizing hormone were determined using the immunoradiometric assay technique using the IRMA kit. LOT NO. IM1381, IM3302 (France). The luteinizing hormone (LH) immunoradiometric test is a sandwich-type assay, similar to the Prolactin immunoradiometric assay. The kit used mouse antibodies directed against two separate epitopes of LH, ensuring they do not compete. In the presence of the second ^{125}I-labeled monoclonal antibody, samples or calibrators were incubated in tubes coated with the first monoclonal antibody. After incubation, the tubes' contents were aspirated and cleaned, and the bound radioactivity was measured. Interpolation from the standard curve was used to calculate the values. The amount of radioactivity bound was proportional to the amount of LH in the sample. Following reference normal ranges were considered: Follicular phase: 0.8-27IU/L, Preovulatory: 9.6-155IU/L, Luteal phase: 0.7-24IU/L and Postmenopausal: 13.5-96IU/L

Determination of Follicle Stimulating Hormone:

The immunoradiometric assay technique and the IRMA kit determined the follicle-stimulating hormone levels. LOT NO. IM2125 – IM3301 (France). FSH immunoradiometric assay is of the sandwich kind. Mouse monoclonal antibodies directed against two distinct epitopes of FSH were employed in the kit, so they do not compete. In the presence of the second monoclonal antibody tagged with iodine 125, samples or calibrators were incubated in tubes covered with the first monoclonal antibody. The contents of the tubes were washed after incubation to eliminate any unbound ^{125}I labelled antibody. A gamma counter was then used to determine the bound radioactivity. Interpolation from the standard curve yielded the FSH concentrations in the samples. The radioactivity was proportional to the concentration of FSH in the samples. Following reference, normal ranges were considered: Follicular phase: 2.2-15 IU/L, Preovulatory: 2.6-100 IU/L, Luteal phase: 1.3-10 IU/L, and Postmenopausal: 27-129 IU/L.

Data Analysis:

All the data were analyzed for frequencies, mean values, percentages, and ranges by SPSS version 25. The Kolmogorov test analyzed the distribution data. An unpaired t-test was applied between two groups (fertile/infertile) to evaluate significant/insignificant

differences for each hormone parameter. A Chi-square test was applied to see if there is a significant/insignificant difference between fertile and infertile groups in the following categories of LH values: below normal, regular, and greater than usual. A p-value of less than
0.050 was considered significant.

RESULTS

Age Distribution:

There were 100 participants in this study, 50 of whom were fertile and 50 of whom were infertile. The average or mean age for the fertile group was 34.88 years, whereas for the infertile group, it was 30.48 years (**Table 1**).

Table 1: Mean Age Distribution in both groups

Group	Total No	Mean ± S.D
Fertile	50	34.88 ± 5.46
Infertile	50	30.48 ± 5.47

All the participants had a history of normal, regular menstrual cycles. The mean for both the cases and controls was 30 days. Table 2 gives the mean hormone levels for all the hormones: luteinizing hormone (LH), follicle-stimulating hormone (FSH), prolactin, insulin, and thyroid-stimulating hormone (TSH).

Table 2: Mean Hormone Levels with Standard Deviation

Hormones	Mean	SD.
LH (IU/L)	7.73	12.79
FSH (IU/L)	9.93	13.81
PROLACTIN (ng/ml)	13.92	23.11
INSULIN (µU/ml)	27.46	34.92
TSH (ulU/ml)	2.72	1.93

The LH was normal in 80% of fertile subjects, below normal in 12%, and above normal in 8% of fertile patients. Among the infertile group, 90% had normal levels, 6% below normal, and 4% above typical values (**Figure 1 & Table 3**). The Chi-square test revealed an insignificant difference (p-value: 0.3751) between fertile and infertile groups in the following categories of LH values: below normal, standard, and greater than usual (see **Table 3**).

Table 3: Percentage of LH in two groups

Groups	Below normal	Normal	Greater than normal	Chi-Square	P value
Fertile (n=50)	6(12%)	40(80%)	4(8%)	1.9608	0.3751
Infertile (n=50)	3(6%)	45(90%)	2(4%)		(insignificant)

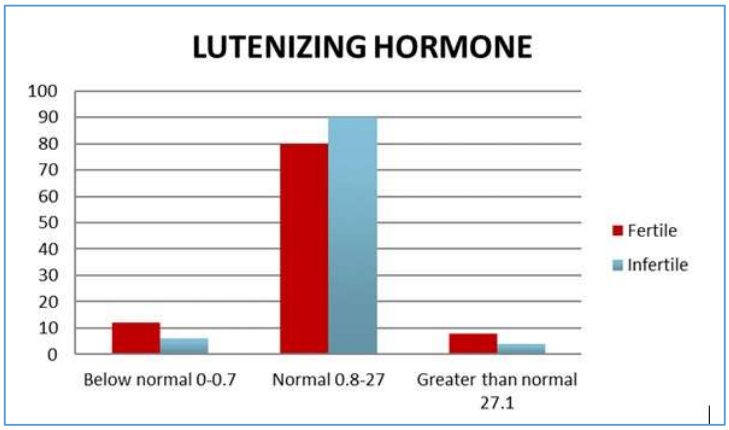

Figure 1: Comparison of LH between fertile and infertile groups

FSH was normal in 66% of fertile subjects, below normal in 20% and above normal in 14% of fertile patients. Among the infertile group, 66% had normal levels, 16% below normal, and 18% above typical values (**Figure 2 & Table 4**). The Chi-square test revealed an insignificant difference (p- value:0.789) between fertile and infertile groups in the following categories of FSH values: below normal, standard, and greater than usual (see **Table 4**).

Table 4: Percentage of FSH in two groups

Groups	Below normal	Normal	Greater than normal	**Chi-Square**	**P value**
Fertile (n=50)	10(20%)	33(66%)	7(14%)	0.4722	0.789
Infertile (n=50)	8(16%)	33(66%)	9(18%)		(insignificant)

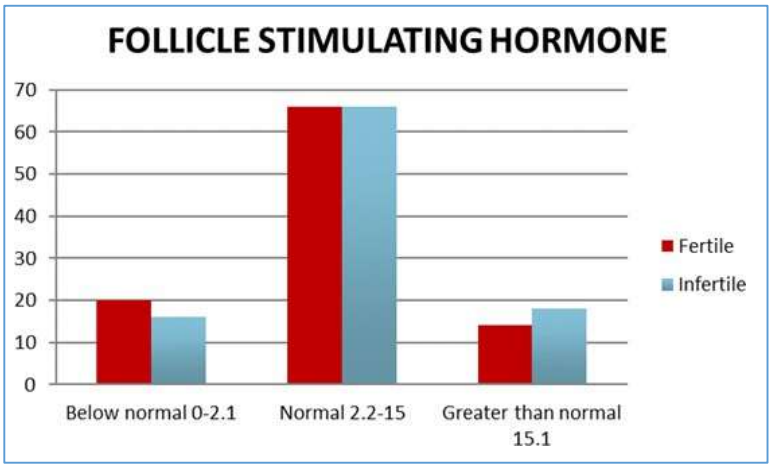

Figure 2: Comparison of FSH between fertile and infertile groups

Prolactin was normal in 88% of fertile subjects, below normal in 2% and above normal in 10% of fertile patients. Among the infertile group, 82% had normal levels, 2% below normal, and 16% above typical values (**Figure 3 & Table 5**). The Chi-square test revealed an insignificant difference (p-value:0.670) between fertile and infertile groups in the following categories of prolactin values: below normal, regular, and greater than usual (see **Table 5**).

Table 5: Percentage of Prolactin in two groups

Groups	Below normal	Normal	Greater than normal	Chi-Square	P value
Fertile (n=50)	1(2%)	44(88%)	5(10%)	0.7982	0.670
Infertile (n=50)	1(2%)	41(82%)	8(16%)	(insignificant)	(insignificant)

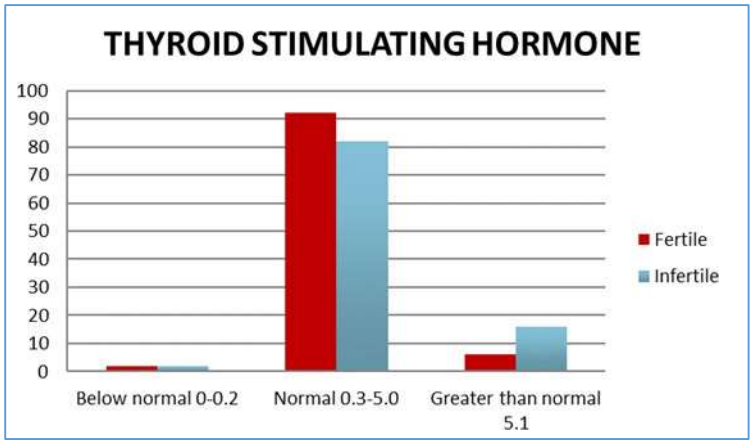

Figure 3: Comparison of TSH between fertile and infertile groups

Insulin was regular in 62% of fertile subjects, below normal in 4% and above normal in 34% of fertile patients. Among the infertile group, 60% had normal levels, 10% below normal, and 30% above typical values (**Figure 4 & Table 6**). It showed that the insulin levels in the cases and controls were more significant than the usual values in over 30% of the subjects. The Chi-square test revealed an insignificant difference (p-value:0.4899) between fertile and infertile groups in the following categories of insulin values: below normal, regular, and greater than usual (see **Table 6**).

Table 6: Percentage of Insulin in two groups

Groups	Below normal	Normal	Greater than normal	Chi-Square	P value
Fertile (n=50)	2(4%)	31(62%)	17(34%)	1.4271	0.4899
Infertile (n=50)	5(10%)	30(60%)	15(30%)		

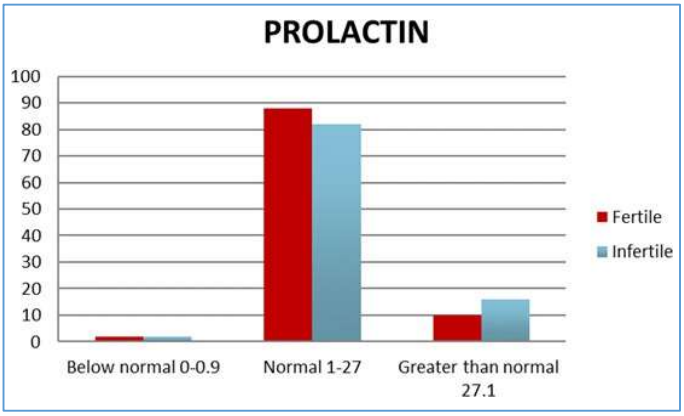

Figure 4: Comparison of Prolactin between fertile and infertile groups

TSH was normal in 92% of fertile subjects, below normal in 2% and above normal in 6% of fertile patients. Among the infertile group, 82% had normal levels, 2% below normal, and 16% above typical values (**Figure 5 & Table 7).** The Chi-square test revealed an insignificant difference (p- value:0.278) between fertile and infertile groups in the following categories of TSH values: below normal, standard, and greater than usual (see **Table 7**).

Table 7: Percentage of TSH in two groups

Groups	Below normal	Normal	Greater than normal	Chi-Square	P value
Fertile (n=50)	1(2%)	46(92%)	3(6%)	2.5601	0.2780
Infertile (n=50)	1(2%)	41(82%)	8(16%)		

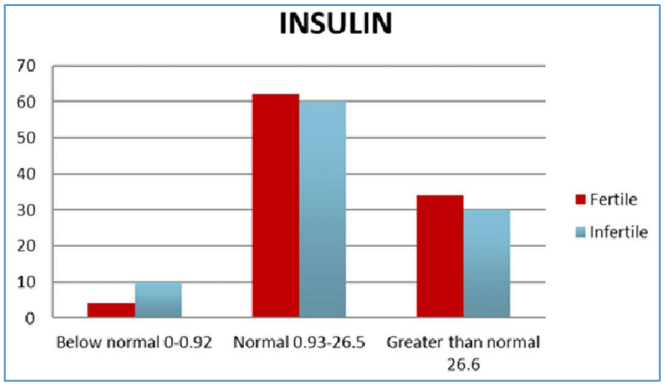

Figure 5: Comparison of insulin between fertile and infertile groups

Comparison of Hormone Levels in Fertile/Infertile Groups:

The mean and standard deviations of the following parameters: LH, FSH, TSH, prolactin, and insulin, the mean difference between the two groups, and the range of observed values are mentioned in **Tables 8-12**. All mean values were found within the normal range in both groups.

The t-test revealed an insignificant association between fertile and infertile groups for each hormone parameter [LH (p-value: 0.9567), FSH (p-value: 0.3253), TSH (p-value:

0.3021), prolactin (p-value: 0.49), and insulin (p-value: 0.205)]. See **Tables 8-12** for detailed information on the t-test.

Table 8: Comparison of LH levels among fertile and infertile groups (in IU/L)

Groups	Mean ± SD	Mean± SD Diff	Reference range	t- test/df	95% CI	P – value
Fertile (n=50)	7.66 ± 14.83	0.14±4.31	0.8 – 27	0.0544/98	-5.2428 to 4.9628	0.9567 (insignificant)
Infertile (n=50)	7.80 ± 10.52					

Table 9: Comparison of FSH levels among fertile and infertile groups (in IU/L)

Groups	Mean ± SD	Mean ± SD Diff	Reference range	t- test/df	95% CI	P – value
Fertile (n=50)	8.56 ± 10.41	2.73±6.11	2.2 – 15	0.9886/98	-8.2100 to 2.7500	0.3253 (insignificant)
Infertile (n=50)	11.29 ± 16.52					

Table 10: Comparison of TSH levels among fertile and infertile groups (ulU/ml)

Groups	Mean ± SD	Mean ±SD Diff	Reference range	t- test/df	95% CI	P – value
Fertile (n=50)	2.52 ± 1.51	0.4±0.76	0.3 – 5.0	1.0374/98	-1.1651 to 0.3651	0.3021 (insignificant)
Infertile (n=50)	2.92 ± 2.27					

Table 11: Comparison of Prolactin levels among fertile and infertile groups (ng/m)

Groups	Mean ± SD	Mean ±SD Diff	Reference range	t- test/df	95% CI	P – value
Fertile (n=50)	12.31 ± 25.69	3.21±5.36	1- 27	0.6928/98	-12.4043 to 5.9843	0.4900 (insignificant)
Infertile (n=50)	15.52 ± 20.33					

Table 12: Comparison of Insulin levels among fertile and infertile groups (µU/ml)

Groups	Mean ± SD	Mean ±SD Diff	Reference range	t- test/df	95% CI	P – value
Fertile (n=50)	31.8 ± 42.26	8.69±16.97	0.93 – 26.5	1.2757/98	-4.8276 to 22.2076	0.2051 (insignificant)
Infertile (n=50)	23.11 ± c					

DISCUSSION

Obesity leads to many problems, such as health issues and social and psychological problems. The health risks include hypertension, diabetes, bone disorders, and heart

disease. It is also associated with several malignancies, especially those of the colon, endometrium, and breast. Obesity is also an essential factor in causing reproductive issues, especially in women. It may be associated with menstrual irregularities, infertility, anovulation, and adverse pregnancy outcomes [16]. Obesity has been shown to cause infertility through different pathways, including abnormal follicular development, development of the oocyte, fertilization, implantation, and development of the embryo [12]. Obesity increases estrogen levels due to the increased conversion of androgens to estrogens in the adipose tissue, disrupting the hypothalamic-pituitary axis [16]. According to studies from Western nations, an individual's BMI affects the hypothalamic-pituitary-gonadal axis's delicate and complicated hormonal balance. Obesity has been linked to menstruation irregularities and infertility. Obese and overweight women have been reported to have lower fertility therapy results. Obesity severity and fat tissue distribution are significant variables that affect the female reproductive system. Obesity is becoming more prevalent among women of childbearing age, with a threefold increased risk of infertility. Ovulatory subfertility and anovulatory infertility are linked to a higher BMI. Obesity is linked to hormonal imbalances that can lead to infertility. Thus, it should be addressed first in the treatment of these people before beginning any medication to rectify their hormonal imbalance [17].

An endocrine profile of obese fertile and obese infertile women of childbearing age was compared in the current multicenter case-control study. This was done to determine whether the infertility is due to any hormonal abnormality or whether there is any other underlying cause for infertility. All of the women in the present study had regular, consistent menstrual cycles in the past. Both the cases and controls had a 30-day mean. Most patients (60-92 per cent) had normal LH, FSH, prolactin, insulin, and TSH levels. However, over 30% of the participants had higher insulin levels than usual in both the cases and the controls. This shows that the hormone insulin must have some relation to obesity but not necessarily to infertility. The rest of the hormone levels were more significant than usual in only 4-18% of patients of both groups. In both groups of our patients, the mean levels of LH, FSH, TSH, prolactin, and insulin were all within the normal range. The Chi-square test revealed an insignificant difference in three values (below expected, regular, and greater than usual) in each parameter (LH, FSH, TSH, prolactin, and insulin) in infertile and infertile groups. The t-test revealed that an insignificant association exists with each hormone's mean value between fertile and infertile groups. Research has shown a link between body mass index (BMI) and thyroid-stimulating hormone (TSH) levels. Thyroid function is also linked to female fertility and has some implications for infertility. As a result, Dai et al. (2020) investigated the association between BMI and TSH levels in infertile patients. They discovered that when the BMI was more significant than 25.3 kg/m2, the TSH level rose with the rise in BMI ($p = 0.0028$) using multivariate piecewise linear regression. However, when the BMI was less than 25.3 kg/m2, the TSH level dropped with increasing BMI ($p = 0.0573$). After adjusting for relevant confounders, they discovered a non-linear connection between BMI and TSH levels in infertile individuals [18].

Obesity has been found to affect reproductive functions by causing hyperinsulinemia and insulin resistance. Abnormalities in the levels of luteinizing hormone, follicle-stimulating hormone, thyroid-stimulating hormone, and prolactin have also been found [19]. A study performed in Karachi demonstrated that a high
The proportion of infertile women in their study had normal levels of prolactin in their blood [20]. In our research, similar results showed that both the obese, fertile and infertile patients had normal levels of prolactin in their blood. According to one study performed in New Delhi for hormonal evaluations, infertile women had a greater tendency for

hypothyroidism as compared to the fertile group. The infertile group also showed a higher prevalence of increased prolactin levels [21]. The results of our study are similar to a study conducted in Sweden, which took into consideration eight hormones, including the follicle-stimulating hormone, luteinizing hormone, thyroid-stimulating hormone, prolactin, and insulin. The results showed that there was no significant difference in the hormone levels of infertile women. They also found no difference in the levels of thyroid-stimulating hormone between the women studied in these groups [22]. Previously, it was demonstrated by Cramer et al. (2003) [23] that there were high levels of thyroid-stimulating hormone and low levels of prolactin in women with infertility. On the other hand, Arjoki et al. (2000) [24] found that there were low levels of thyroid-stimulating hormone in women with male infertility and high levels of this hormone in women with unexplained infertility.

Infertile women in the reproductive age group, i.e., 13-45 years, were studied in Dhaka. Among the hormones tested were follicle-stimulating, luteinizing, thyroid-stimulating, prolactin, T3 and free T4, progesterone, and testosterone. According to the findings, the hormone levels of the infertile group differed significantly from the reference values. Except for T3, there were also highly significant variations in the mean levels of other hormones [25] (Shapla et al., 2015). Another study conducted in Iraq compared the levels of serum luteinizing hormone, follicle-stimulating hormone, prolactin, and testosterone between fertile and infertile women. This study showed a significant difference in the mean serum levels of luteinizing and follicle-stimulating hormones between the case and control groups. It also shows a statistically significant difference in the serum prolactin levels in the infertile group compared to the fertile group [26] (Rashid et al., 2013). A study conducted in Nigeria compared the hormones between fertile and infertile non-obese women. These hormones included luteinizing hormone, follicle-stimulating hormone, estradiol, prolactin, and progesterone. The study showed a statistically significant difference between the two groups. The levels of follicle-stimulating hormone, luteinizing hormone, estradiol, and progesterone were lower in the infertile group compared to the control group, while prolactin levels were higher. The observed decrease in follicle-stimulating hormone and luteinizing hormone in this study is due to elevated prolactin levels in infertile women. This hyperprolactinemia may be responsible for infertility in these women [27].

Our study did not identify any significant variation between fertile and infertile women for different hormonal levels. The influence of obesity on the level of AMH in obese and non-obese premenopausal women was investigated by Sahmay et al. (2021) [27]. No statistically significant difference was observed between the two groups regarding FSH, LH, estradiol, and prolactin levels. Neither group had a statistically significant association between Anti Müllerian Hormone (AMH) levels and BMI levels. According to the researchers, body mass index does not influence serum AMH levels in women of reproductive age. Obesity does not affect the blood's follicle-stimulating hormone, luteinizing hormone, estradiol, prolactin, or thyroid-stimulating hormone levels. Obesity has no effect on ovarian reserve in premenopausal women.

On the other hand, other researchers have found a substantial negative relationship between AMH levels and BMI in the literature [29]. Others, on the other hand, discovered no link between AMH and BMI [30]. We must know if obesity impacts AMH levels to make therapeutic decisions [28]. Obesity's association with reproductive functioning is currently being researched. Menstrual disorders and anovulation are more common in overweight women. Women who are overweight or obese are at a higher risk of having a miscarriage. These women have a higher risk of subfecundity and infertility, as well as higher risks of conception, miscarriage, and pregnancy problems. The enhanced peripheral aromatization

of androgens to estrogens affects gonadotropin production in obese women. Hyperandrogenemia is caused by insulin resistance and hyperinsulinemia in obese women. Leptin levels rise while sex hormone-
The levels of binding globulin (SHBG), growth hormone (GH), and insulin-like growth factor binding proteins (IGFBP) fall. These changes might account for decreased ovulatory function and, as a result, reproductive health [16].

CONCLUSION:

Our study also showed that the insulin levels in the cases and controls were more significant than the typical values in over 30% of the subjects. The study showed that the hormone insulin must have some relation to obesity but not necessarily to infertility. We found no significant difference between fertile and infertile groups in hormonal profiles.

RECOMMENDATIONS:

Further studies should be carried out on a more significant number of patients. Further investigations should be performed on the subjects, including T3 and T4, for thyroid profile and testosterone. In additional studies, the hormonal profile might be compared between obese and non-obese subjects, too. Before undergoing any medical or surgical treatment for infertility, individuals should be informed about maintaining healthy body weight through lifestyle changes. To boost the odds of conception in overweight women, a comprehensive approach to weight control and reproductive health must be used. This will also have a favourable influence on their general health. In these people, losing weight positively impacts their reproductive results. Overweight and obese individuals should be told about the necessity of pre-pregnancy weight loss and encouraged to do so before treatment to lower the risk of poor obstetrical outcomes caused by obesity. In future studies, the causal links between obesity and hormones in infertile and infertile women will need to be elucidated.

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