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Association between Lifestyle Factors and Hormonal Profile Among Primary Infertile Females

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ABSTRACT

Objective: Stress, exercise, smoking, and diet all have an impact on a woman's ability to become pregnant. Women who follow a healthy diet are more likely to have a successful conception.

Methods and Materials: A cross-sectional study using non-probability sampling was conducted in which 300 primary infertile women (12–18 months of marriage) were interviewed at the Gynecology and Obstetric Hospital in Ramadi Province, Iraq, from August to September 2023, to evaluate the association between lifestyle factors and hormonal profile among primary infertile females. Hormonal assessment was done during the (4) and (21) days of the cycle. A questionnaire was used to assess the demographic characteristics and lifestyle; the mean, standard deviation (SD), and correlation coefficient were determined. The confidence level was 99% and the p-value was 0.01.

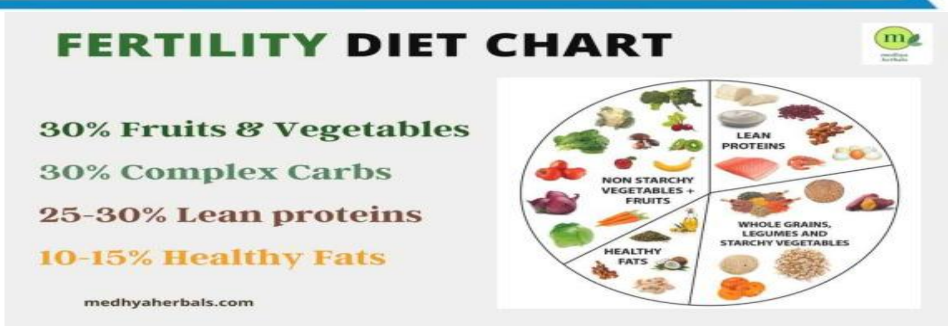
Findings: Seventy percent of females aged 18-35, with 30% over 35, are homemakers from metropolitan regions, and only 20% college degrees. Sixty percent had a BMI ≥28 (average 32±3) and experienced anxiety. Some used supplements, 35% smoked, and none exercised. Ultrasound showed 20% with polycystic ovaries. Hormone levels were impaired: 70% had decreased DHEA and D3 (43±5 and 269±94.22 ml/dl), over half had increased testosterone and prolactin (65±0.5 and 28±2.50 ml/dl), and 50% had higher FSH and LH with lower estradiol and progesterone (17.8±6.55 and 7.6±2.17). Forty percent had increased AMH (~5±3 ml/dl), and TSH was normal. Obesity, diet, and supplements were strongly correlated with hormones, as were age and smoking, but not with testosterone and DHEA. Education correlated with D3, LH, and testosterone; living also correlated with D3, LH, and dietary habits including starches, fats, junk food, sugared tea, olive oil, dairy, antioxidants, veggies, and seafood.

Conclusion: More than half of females exhibited hormonal imbalances that were positively correlated with aging, BMI, living, Activity, Diet, smoking, and supplements. In terms of dietary pattern, the survey revealed that the majority had a poor, unhealthy reproductive diet, characterized by a high intake of carbohydrates, sweets, fat, and sugary tea. There is a need for more research at the national and regional levels due to the scarcity of in-depth studies in this field.

Keywords: Lifestyle, infertility, females, hormonal balance.

Introduction

Primary infertility means failure to achieve conception after 12 months or more of unprotected, regular sexual intercourse, which may reach 25% in the United States (Thoma et al., 2013). Diet and modified lifestyle influence human fertility (Fontana & Torre, 2016). Consuming a diet rich in green veggies, whole beans, fish, and seafood, along with plant-based proteins and olive oil, can help increase fertility. Mediterranean diet dairy, whole grain products, green vegetables, omega-3 fatty acids, soy beans, and olive oil are crucial to prevent non-ovulation (Capurso, 2021). High intakes of supplemental folic acid, vitamin D3, and vitamin B12 help improve fertility, whereas diets high in CHO, sweets, red meat, and saturated fat have the opposite impact (Łakoma et al., 2023). More than 200 milliliters of caffeine per day may affect fertility (Koga et al., 2020). Taking large amounts of supplements containing 1.0 milligrams of folic acid for several months before conception increases the likelihood of becoming pregnant (Ricci et al., 2017). Vitamin D3 supplements affect the lipid profile and endometrial thickness in women with polycystic ovary syndrome and reduce the incidence of endometriosis (Dolin et al., 2018; Van Tienhoven et al., 2025). Reproductive disorders such as polycystic ovary syndrome and celiac disease can also impact fertility through nutritional deficiencies and hormonal abnormalities (El-Nahhal, 2020). Studies have found that zinc, selenium, and folic acid deficiency in some cases of celiac disease may contribute to reduced fertility in women during their reproductive years (Pieczyńska, 2017). Similarly, polycystic ovary syndrome has been associated with dyslipidemia, insulin resistance, and increased androgen levels, all of which can impact fertility. Preconception counseling, weight loss, and management of associated risk factors like obesity are also important strategies for improving fertility in women with polycystic ovary syndrome (Kumar et al., 2010). Dietary interventions such as increasing whole grains, antioxidant fruits and vegetables such as strawberries, artichokes, curly kale, spinach, dried apricots and mango, avocado, grape, prunes, berries, okra, beets, Broccoli, peppers, orange, and omega-3 fatty acids have shown some promise in improving fertility outcomes, particularly in the context of polycystic ovarysyndrome (Agarwal et al., 2021).



This study aims to evaluate the association between lifestyle factors and hormonal profile among primary infertile females.

Methods and Materials

Study Design and Participants

A cross-sectional study design, employing convenience sampling, was conducted at the Gynecology and Obstetrics Hospital in Ramadi Province, Iraq, from August to September 2023, following approval from the ethics review committee of the Medical College, Anbar University, Ramadi Province, Iraq. The calculated sample size for reporting the prevalence of primary female infertility was determined using the equation: $N = (2.58)^2 \times P(1\text{-}P)$ (Cameron & Gunn, 2004; Maya et al., 2012). P-value was<0.01.

m^2

300 primary infertile women within 12–18 months of marriage were questioned for this study, with the inclusion requirements. Male infertility and chronic illness were exclusion factors. Using SPSS Version 26, the mean, standard deviation (SD), and correlation coefficient were determined. A p-value of 0.01 and a confidence level of 99% were reported. Researchers created an interview form that includes:

- Demographic details included age, marital status, education level, and employment status.

- Lifestyle habits and details included diet, supplements, smoking, exercise, and anxiety.

Ultrasound was done on all females by a professional doctor in the hospital to detect polycystic ovaries.

Instruments

- Dietary patterns: Had been measured by using a dietary frequency table according to food groups concerning the antioxidant foods, starting with:

- Meet the group in the fish and seafood section.

-Dairy group and eggs.

-Carbohydrate (CHO) group, such as soybeans, legumes, beans, and whole grains.

-Antioxidant vegetable and fruit groups that were chosen in Iraq, such as leafy green vegetables, avocado, berries, strawberries, turnip, spinach, apricots, mango, grape, okra, Sweet potato, beets, Broccoli, peppers, and orange group.

- Fats such as fat and olive oil.

-Nuts. Additionally, consuming unhealthy foods like sugary tea, starchy foods (such as rice and white bread), and junk food is also problematic. When intake the food 4-5 times/week, it is considered as a good dietary pattern or daily intake, when intake food 2-3times/week considered as an average dietary pattern or weekly intake, while when intake food less than 2 times/week considered poor dietary pattern or monthly intake (Mahan & Sylvia Escott, 2006).

- Hormonal Profile: The hormonal profile was conducted during the fourth and twenty-first days of the cycle, by using the TOSOH AIA 360 Immunoassay, and the hormone levels in the blood were measured. Regarding the hormone references:

-The range of DHEA sulfate levels below 29 years is between 65 - 380 µg/dl, from 30 to 39 years, the level is between 45- 270 µg/dL.

- Vitamin D3 should be over 30 ng/ml.

- During the early follicular phase, follicle-stimulating hormone (FSH) ranges from 3–9 mIU/mL, and luteinizing hormone (LH) is 2–10 mIU/mL.

- Estradiol level at day 4 of the cycle is 30–40 pg/ml.

- Progesterone: A range of less than 10 ng/ml indicates an unlikely ovulation (20–23 days of cycle).

- TSH (thyroid-stimulating hormone) is 0.5–5 mU/L.

- Testosterone levels range from 15 to 70 ng/dl.

- Anti Millenarian Hormone(AMH) ranges from0.7-3.5 ng/ml (Andrea & Elena Santiago, 2025).

Hormones	Normal levels
FSH	3-9 mIU/ml
LH	2-10 mIU/ml
TSH	0,2-4,7 mIU/ml
Estradiol	27-161 pg/ml
Progesterone	5-20 ng/ml (on day 21)
Prolactin	0-20 ng/ml
AMH	0,7-3,5 ng/ml

- Body Mass Index (BMI) Measurement: Weight was measured by a weight scale, and height by using a digital tape, and BMI was calculated by using the equation = weight(kg)/height(m^2). A BMI between 18-25 is considered normal, between 25-30 is considered overweight, while above 30 is considered obese.

Findings and Results

The study revealed that 70% of the population was between the ages of 18 and 35, 30% was over 35, 30% had finished their second year of education, and 20% completed college. 67% were urban homemakers.

Table 1

Demographic characteristics

Demography	Age	No.	%
1. Age	18-25 years	120	40
	26-35	90	30
	>35	90	30
2. Graduation	1st school	150	50
	2ndschool	90	30
	Gollege	60	20
3. Living	Urban	200	67
	Rural	100	33
4. Work	Working	100	33
	Housewife	200	67

A mean body mass index of 32.±3 indicated that 20% were obese and 40% were overweight—60% experienced anxiety, in addition to 20% having irregular supplement intake. Thirty-five percent smoked, and none of them exercised (Table 2).

Table 2

Lifestyle characteristics

Lifestyle	Groups	No	%
1. B.M.I			
Normal	18-25	120	40
Overweight	18-28	120	40
Obesity	>28	60	20
			Mean 32±3
2. Anxiety	Present	180	60
	Absents	120	40
3. Smoking	Yes	105	35
	No	195	65
4. Exercise	Yes No	----- 300	----- 100
5. Supplements	Yes No	60 140	20 80

Regarding hormones, there was a 75% decrease in the levels of D3 and DHEA, with a mean average of (26.7900±13.45720 ng/ml) and (300.456±40.00μg/dl). There was an impairment of the level of testosterone (65%), with a mean average of 66.7333 ng/dl, and 70% increase in prolactin level, with a mean average of (36.7067±20.86989). 50% increase in levels of FSH and LH, with an average mean of (12±2.8), (17±2.7) mlU/ml, respectively, which affected estradiol and progesterone (40 ±5ml/dl pg/ml, 10±pg/ml, ng/ml, at day 4 of the cycle and day 21 of the cycle. The mean AMH level was 5±3 ng/mL, indicating a 40% increase. TSH levels were normal, averaging 2.7±0.5 mU/dL.

Table 3

Hormonal Assay

	N	Minimum	Maximum	Mean	Std. Deviation

	Statistic	Statistic	Statistic	Statistic	Statistic
TSH	300	2.12	2.67	2.17	±0.500
TESTOSTERONE	300	200	90.00	66.7333	15.71450
LH	300	14.3	19.70	17.00	2.700
PROLACTIN	300	11.00	90.00	36.7067	20.86989
D3	300	2.00	70.00	26.7900	13.45720
DHEA	300	150.00	450.00	269.000	94.21606
FSH	300	6.00	18.00	8.8677	2.61177
Estrodiol	300	10.00	30.00	17.8000	5.00
Progesteron	300	7.00	5.00	12.00	7.6000
AMH	300	5.00	5.600	5.300	3.00
Valid N (listwise)	300				

-There was a correlation between age and D3, LH, FSH, Prolactin, Estradiol, and progesterone, respectively, except DHEA and Testosterone. (782**, .841**, .732**, 732**, 6.99**, .623**).

-There was a correlation between obesity and D3, LH, FSH, Prolactin, Estradiol, progesterone, and DHEA, respectively, except for testosterone hormone. .809*, .771**, .822**, .709**, **.858**, .758**, .858**, and.858**.

- For supplements, there was a correlation with all the hormones.

- For education there was a correlation with D3, LH, AMH and testosterone, 874**, .724**, .753** ,and .809**.

-There was a correlation between Living and D3, LH, FSH, and AMH, the mean was .809**, .771**, .831**, and .751** respectively.

-There was a correlation between diet and all hormones.

-Regarding smoking and hormones, there was a strong correlation with all hormones except testosterone and DHEA hormones, with average mean .858**, .809**, .858**, .679**, .858**, and .809**, and .753**.

Table 4

Correlation between lifestyle and hormonal profile

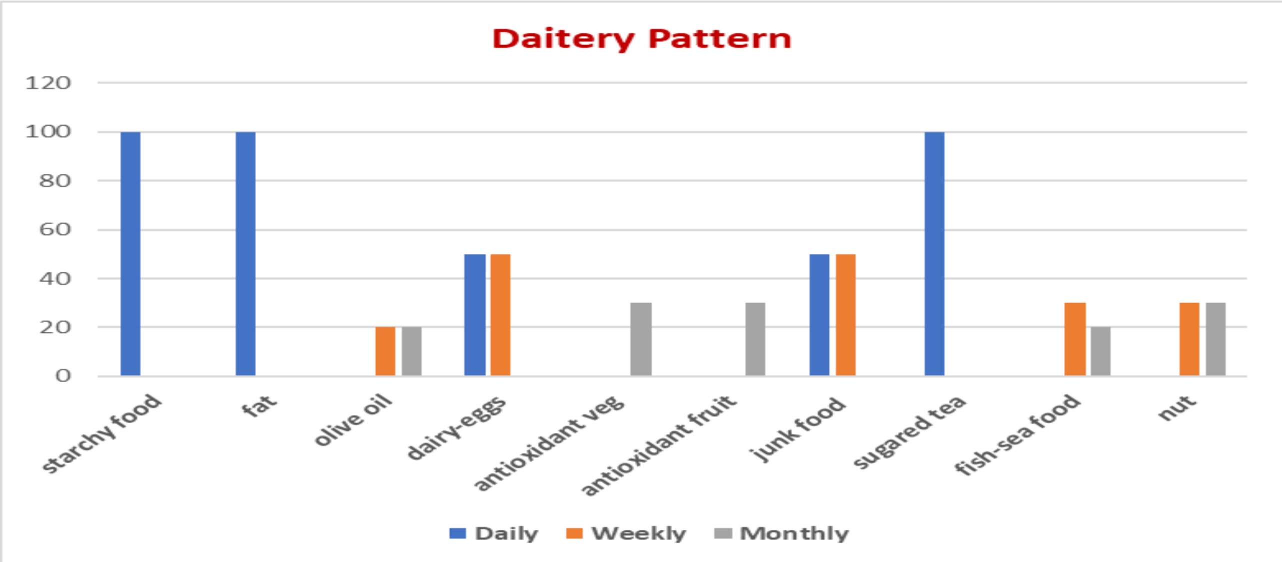
		D3	FSH	LH	Prolactin	Estradiol	Progeste	Testos	DHEA	AMH
Age	Pearson Correlation	.782**	.841**	.732**	.732**	.699**	.623**	.433	.453	.732**
	Sig.(1-tailed)	.000	.000	.000	.000	.000	.000	.000	0.00	0.00
	N	300	300	300	300	300	300	300	300	300
Obesity	Pearson Correlation	.809**	.771**	.822**	.709**	.758*	.858**	.858**	.433	.853**
	Sig. (1-tailed)	.000	.000	.00	.000	.000	.000	.000	.00	0.00
	N	300	300	300	300	300	300	300	300	300
Supplement	Pearson Correlation	.614*	.643*	.823**	.899**	.769**	.869**	.569**	.753**	.896**
	Sig. (1-tailed)	.000	.000	.000	.000	.000	.000	.000	0.00	0.00
	N	300	300	300	300	300	300	300	300	300
Educ	Pearson Correlation	.874**	.724**	.408	.496	.409	.489	.809**	3.66	.753**
	Sig. (1-tailed)	.000	.000	.00	.000	.000	.000	.000	.00	0.00
	N	300	300	300	300	300	300	300	300	300
Living	Pearson Correlation	.809**	.771**	.831**	.466	.422	.422	.422	3.77	.753**
	Sig. (1-tailed)	.000	.000	.00	.000	.000	.000	.000	0.00	0.00
	N	300	300	300	300	300	300	300	300	300
Activity	Pearson Correlation	1**	.760**	.841**	.588*	.859**	.859**	.859**	.378	.723**
	Sig. (1-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	0.00
	N	300	300	300	300	300	300	300	300	300
Diet	Pearson Correlation	.927**	.679**	.799**	.699*	.596*	.596*	.596*	.699*	.953**
Smok	Sig. (1-tailed)	.000	.000	.00	.000	.000	.000	.000	.00	0.00
	N	300	300	300	300	300	300	300	300	300
	Pearson Correlation	.858**	.809**	.858**	.679**	.858**	.809**	0.44	0.34	.753**
	Sig. (1-tailed)	.000	.000	.00	.000	.000	.000	.000	.00	0.00
	N	300	300	300	300	300	300	300	300	300

By Ultrasound examination in the middle of the cycle, 20% of females had polycystic ovaries.

Showed that 100% had starchy food, fat, and sugar daily. 50% consumed junk food weekly and monthly, 20% used olive oil weekly and monthly, and 50% had dairy and eggs daily and weekly. 30% intake of antioxidant-rich veggies and fruits, monthly. 30% had fish and seafood weekly, and 20% had it monthly. 30% had nuts on a weekly and monthly basis.

Figure 1

Dairy pattern



Discussion and Conclusion

The majority of females were between the ages of 18 and 35, and thirty percent were over thirty-five. Statistical results indicated that there was a positive correlation between hormone levels and aging, which could disrupt ovarian function and fertility (Liu et al., 2015; Liu et al., 2022). Half of the women in the study were workers, and less than half had a college degree. Studies found that Occupation has a significant role in female infertility, which can expose risk factors such as exposure to physical strain, environmental toxins, and irregular working hours (Tang et al., 2023), but opposite to our study, they found that longer education can give empowered women, delay marriage and childbearing. The body mass index was 32.3, meaning that most of the women were overweight or obese, with a strong correlation with hormonal imbalance. This was in line with other studies that found a link between obesity and infertility, with a high prevalence of obesity among infertile women. An elevated weight index will raise estrogen production and reduce serum FSH, which lowers the possibility of becoming pregnant (Colleran et al., 2014; Dag & Dilbaz, 2015). Also, in IVF, high BMI reduces serum FSH levels during stimulation, requiring personalized gonadotropin dosing for optimal response (Trindade, 2020). In our study, there was irregular intake of supplements. Trindade (2020) has found a link between diet and supplements and hormonal imbalance (Fatemi et al., 2025). Another study said that supplements improve sexual intercourse, sex desire, and orgasm (Maurya, 2022). Additionally, supplements were found to raise the mean progesterone level from 8.2 to 12.8 ng/mL during the mid-luteal phase (Shiroyama, 2007). A high percentage of vitamin D insufficiency was found in this study, which may have an impact on fertility because calciferol lowers the incidence of endometriosis, primary hypogonadism, myoma, and lowers blood lipids in females with polycystic ovary syndrome (Chu et al., 2021). Even with a high saturated fat consumption and high BMI, there was an imbalance in the level of DHEA. This suggests that fat affects the concentration of this hormone, which may be caused by the consumption of rich and polyunsaturated fatty acids (Mititelu et al., 2024). Supplementing with DHEA improves the endometrium, hormonal balance, and ova number retrieval (Chen et al., 2020). For a successful pregnancy, a daily dose of 25 mg micronized DHEA is currently given before 12 weeks of IVF treatment (Keane et al., 2018). The study revealed that fewer than half of the females had elevated levels of AMH, indicating that anti-Müllerian hormone is the most accurate indicator for determining the ovarian pool's age and predicting the lifespan of reproduction (Van Der Ham et al., 2024). ALso we foundd that less than half of females had elevated prolactin level and 20% had polycyxtic ovaries, so the ovulation process may be halted or slowed by high prolactin levels, which may also have an impact on progesterone levels, which cause endometrial thickening after ovulation may explained the lower level of progesterone, also low level of estradiol may cause ovulation disorder (Tomassetti & D'Hooghe, 2018). In this study, there was a correlation between smoking and most hormones. In another study, evidence indicates decreased fertility in the female offspring later in life. Also, they found that smoking has been linked to lower rates of implantation, fertilization, and ova retrieval as well as an increased chance of miscarriage. The majority had a poor, unhealthy reproductive diet, with high intake of carbohydrates, sweets, and fat, and frequent intake of sugary tea can negatively affect fertility (Skoracka et al., 2021). A study done by Zhang et al. 2024 found that over half of infertile females smoked, drank tea more than three times a day, and had inadequate intakes of reproductive foods (Zhang et al., 2024).

More than half of the females exhibited hormonal imbalances that were positively correlated with aging, BMI, lifestyle, Physical Activity, Diet, smoking, and supplements. In terms of dietary pattern, the survey revealed that the majority had a poor, unhealthy reproductive diet characterized by high intake of carbohydrates, sweets, fat, and sugary tea. There must be more research at the national and regional levels, due to the dearth of in-depth studies in this field.

Acknowledgments

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Ethical considerations in this study were that participation was entirely optional.

Transparency of Data

By the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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