IJBMC International Journal of Body, Mind and Culture

Volume 12, Issue 5, pp 153-160
DOI: 10.61838/ijbmc.v12i5.1117

Article type:
Original Research

Association between Lifestyle Factors and Hormonal Profile Among Primary Infertile Females

Ban. Abdul-Fatah[1*], B. T. Yahya[1]

1 College of Medicine, University of Anbar, Al-Anbar 31001, Iraq.

Corresponding author email address:
ban.nadum@uoanbar.edu.iq

Article history:

Received 21 May 2025
Revised 14 June 2025
Accepted 24 June 2025
Published online 01 Aug 2025

How to cite this article:
Abdul-Fatah, B., & Yahya, B. T. (2025). Association between Lifestyle Factors and Hormonal Profile Among Primary Infertile Females in Ramadi Province. International Journal of Body, Mind and Culture, 12(5), 153-160.

ABSTRACT

Objective: The study aimed to investigate the association between lifestyle factors—such as stress, smoking, physical activity, and dietary habits—and hormonal profiles in women with primary infertility.

Methods and Materials: A cross-sectional study was conducted among 300 women with primary infertility (married for 12–18 months) who attended the Gynecology and Obstetrics Hospital in Ramadi Province, Iraq, from August to September 2023. Participants were selected using non-probability sampling. Data were collected through structured interviews that covered demographics and lifestyle behaviors, while hormonal tests were performed on days 4 and 21 of the cycle. Statistical analysis included descriptive measures (mean, SD), correlation coefficients, and significance testing at a 99% confidence level ($p = 0.01$).

Findings: The results showed that hormonal profiles indicated significant disturbances: 70% had reduced DHEA and vitamin D3, while more than half displayed elevated testosterone and prolactin. Approximately 50% of the participants exhibited increased FSH and LH levels, accompanied by low levels of estradiol and progesterone. Additionally, 40% of the participants had elevated AMH levels, while TSH levels remained within the normal range. Significant correlations were identified between obesity, age, smoking, diet, supplement use, and hormonal imbalances. Education level and living conditions were also related to vitamin D3, LH, testosterone, and dietary patterns.

Conclusion: Over half of the infertile women presented with hormonal disturbances strongly associated with age, obesity, smoking, and poor nutrition. The prevalence of diets high in carbohydrates, fats, and sweetened beverages underscores the urgent need for lifestyle and nutritional interventions to improve fertility outcomes.

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. A Mediterranean diet rich in dairy products, whole grain foods, green vegetables, omega-3 fatty acids, soybeans, and olive oil is crucial for preventing 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). Consuming more than 200 milliliters of caffeine per day may impact 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 essential 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). Figure 1 shows a fertility diet chart.

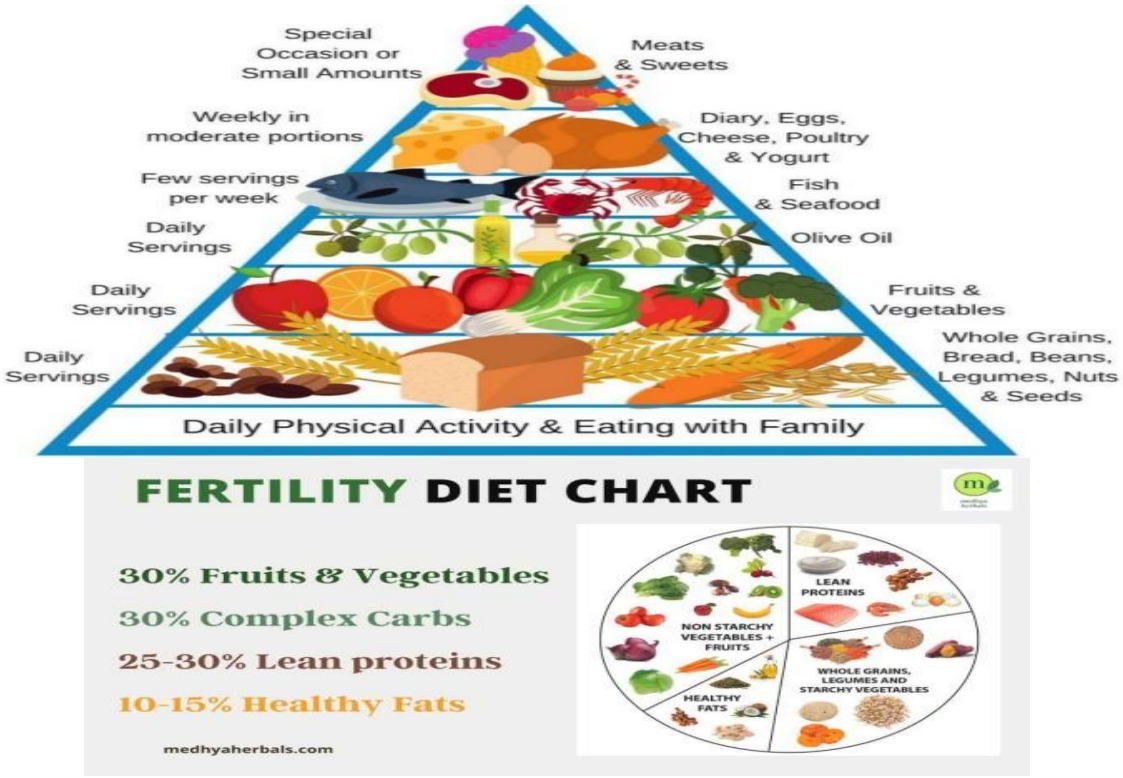

Figure 1.
Fertility diet chart

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 = $(2.58)^2$ × P(1-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 the orange group.

- Fats such as olive oil.

-Nuts. Additionally, consuming unhealthy foods, such as sugary beverages, starchy foods (like rice and white bread), and junk food, is also problematic. When intake of food is 4-5 times/week, it is considered a good dietary pattern or daily intake; when intake of food is 2-3times/week, it is regarded as an average dietary pattern or weekly intake. In contrast, when food intake is less than twice a week, it is considered a poor nutritional pattern or a monthly intake (Mahan & 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 (Figure 2). 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

Figure 2.
The hormonal profile

- 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, and 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% were over 35, 30% had completed their second year of education, and 20% had completed college. 67% were urban homemakers (Table 1).

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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% of the participants were obese, 40% were overweight, 60% experienced anxiety, in addition to 20% had 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 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 of 66.7333 ng/dl, and 70% increase in prolactin level, with a mean 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/L (Table 3).

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

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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. There was a correlation between obesity and levels of D3, LH, FSH, Prolactin, Estradiol, progesterone, and DHEA, respectively, except for testosterone. For supplements, a correlation was observed with all the hormones.

For education, a correlation was found with D3, LH, AMH, and testosterone. There was a correlation between Living and D3, LH, FSH, and AMH. 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 (Table 4).

Table 4

Correlation between lifestyle and hormonal profile

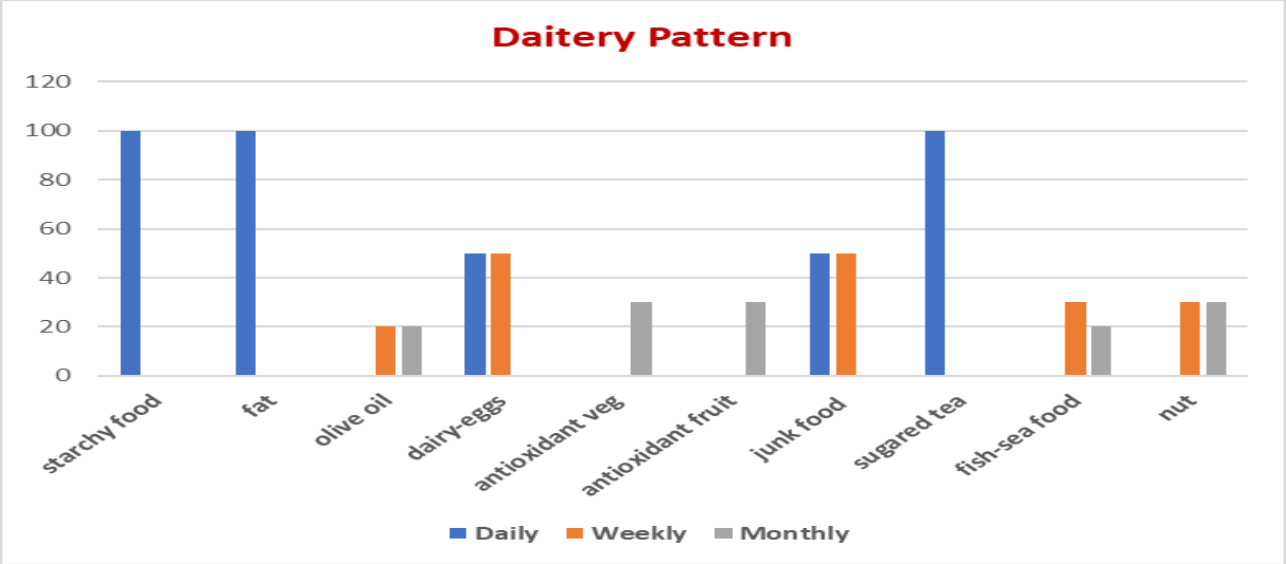
		D3	FSH	LH	Prolactin	Estradiol	Progeste	Testos	DHEA	AMH
Age	Pearson Correlation	.782**	.841**	.732**	.732**	.699**	.623**	.433	.453	.732**
	Sig.(1-tailed)	.000	.000	.000	.000	.000	.000	.000	0.00	0.00
	N	300	300	300	300	300	300	300	300	300
Obesity	Pearson Correlation	.809**	.771**	.822**	.709**	.758*	.858**	.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 3).

Figure 3

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 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, unlike 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 increases estrogen production and reduces serum FSH, thereby decreasing the likelihood of becoming pregnant (Colleran et al., 2014; Dag & Dilbaz, 2015). Additionally, in IVF, a high BMI reduces serum FSH levels during stimulation, necessitating personalized gonadotropin dosing for optimal response (Trindade, 2020). In our study, there was an 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. Calciferol has been shown to lower the incidence of endometriosis, primary hypogonadism, and myoma, as well as reduce 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 ovum 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 age of the ovarian pool and predicting reproductive lifespan (Van Der Ham et al., 2024). ALso we fountd 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,

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evidence suggests that female offspring may experience decreased fertility 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 is a need for more research at the national and regional levels, given the scarcity of in-depth studies in this field.

Acknowledgments

The authors express their gratitude and appreciation to all participants.

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 Declaration of Helsinki, which provides guidelines for ethical research involving human participants. Ethical considerations in this study included the fact that participation was entirely optional.

Transparency of Data

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

Funding

This research was conducted independently, with personal funding, and without the financial support of any governmental or private institution or organization.

Authors' Contributions

All authors equally contribute to this study.

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