Blood Tests in Fertility Treatment: A Comprehensive Review of Diagnostic Biomarkers, Clinical Significance, and Lifestyle Modifications for Both Men and Women

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1. Introduction

Infertility affects approximately 15% of couples of reproductive age worldwide, with male factors contributing to roughly 50% of cases either independently or in combination with female causes. Assisted reproductive technologies (ART) — including intrauterine insemination (IUI), in vitro fertilisation (IVF), and intracytoplasmic sperm injection (ICSI) — have become cornerstone treatments for infertile couples. A critical component of fertility management is the systematic use of blood tests to assess hormonal status, screen for infections, evaluate genetic factors, and monitor treatment response.[1][2]

The diagnostic blood work-up serves multiple purposes: it identifies the aetiology of infertility, guides clinicians in selecting appropriate treatment protocols, predicts ovarian and testicular response, and screens for conditions that could compromise pregnancy safety. This paper provides an in-depth analysis of all blood tests routinely and selectively employed in fertility treatment for both men and women, explains what each test reveals about reproductive and general health, and synthesises current evidence on lifestyle modifications that can enhance fertility biomarkers and treatment outcomes.[2]

2. Female Blood Tests in Fertility Treatment

2.1 Ovarian Reserve Markers

2.1.1 Anti-Müllerian Hormone (AMH)

AMH is a glycoprotein produced by granulosa cells of pre-antral and small antral follicles. It is considered the most reliable serological marker of ovarian reserve and can be measured on any day of the menstrual cycle, as its levels remain relatively stable throughout.[3]

Clinical significance: AMH reflects the remaining pool of primordial follicles and predicts ovarian response to controlled ovarian stimulation (COS). In a study of 300 women undergoing IVF versus IUI, AMH was significantly correlated with pregnancy outcomes ($r = 0.38$, $p < 0.001$) and emerged as a significant predictor of clinical pregnancy (OR = 1.52). A separate study found that clinical pregnancy rates were significantly higher in women with AMH > 2.1 ng/mL (20.0%) compared to those with AMH < 2.1 ng/mL (10.0%; $p = 0.041$). In IVF-ET, AMH has been demonstrated to predict the number of oocytes retrieved and clinical pregnancy, with age and AMH being independent factors (AMH OR = 1.43, 95% CI: 1.13–1.82).[4][5][6]

Reference range: General reproductive-age reference range is approximately 0.77–14.5 ng/mL. Values below 0.7–1.0 ng/mL typically indicate diminished ovarian reserve (DOR), while values above 3.5–5.0 ng/mL may suggest polycystic ovary syndrome (PCOS).[1]

2.1.2 Follicle-Stimulating Hormone (FSH)

Basal FSH is measured on day 2–6 of the menstrual cycle and reflects the pituitary drive required to initiate follicular development.[7]

Clinical significance: Elevated basal FSH indicates reduced ovarian reserve, as the pituitary must produce more FSH to stimulate the remaining follicles. In a large IVF/IUI cohort, FSH was negatively correlated with pregnancy outcomes ($r = −0.25$, $p = 0.011$) and predictive of treatment success (OR = 0.81). Following DHEA supplementation in women with DOR, FSH levels decreased significantly ($p = 0.03$), which was associated with improved follicular development. However, studies in women over 30 without infertility

diagnoses have cautioned that elevated FSH (> 10 mIU/mL) did not significantly reduce natural fertility, suggesting that FSH is more predictive of stimulation response than of spontaneous conception.[8][9][4]

Reference range: Normal basal FSH is typically 3.0–10.0 mIU/mL. Values > 10 mIU/mL suggest diminished reserve; values > 20 mIU/mL indicate significant ovarian depletion.

2.1.3 Estradiol (E2)

Basal estradiol is measured alongside FSH on cycle day 2–6.[7]

Clinical significance: Elevated early follicular estradiol (> 60–80 pg/mL) can suppress FSH through negative feedback, masking a true elevation. A falsely normal FSH alongside elevated E2 may still indicate diminished reserve. During COS, rising estradiol levels reflect follicular growth and guide trigger timing. Higher follicular fluid estradiol has been associated with improved fertilisation outcomes following ICSI (AOR = 1.14).[10]

Reference range: Basal E2 on day 2–3 should be < 60–80 pg/mL. During stimulation, levels rise to approximately 200–400 pg/mL per mature follicle.

2.2 Endocrine and Metabolic Hormones

2.2.1 Luteinising Hormone (LH)

LH is measured alongside FSH in the early follicular phase and is particularly relevant in the diagnosis of PCOS.[7]

Clinical significance: An elevated LH:FSH ratio (> 2:1) is suggestive of PCOS. LH is also critical during stimulation monitoring, as premature LH surges can lead to premature ovulation and cycle cancellation. In antagonist IVF protocols, an endogenous LH rise > 10 IU/L after the last GnRH antagonist administration was observed in 17% of women and was associated with fewer pre-ovulatory follicles and retrieved oocytes.[11]

Reference range: Follicular phase LH: 2.0–15.0 mIU/mL; mid-cycle surge: 22–105 mIU/mL.

2.2.2 Progesterone

Mid-luteal progesterone (day 21, or 7 days before expected menses) confirms ovulation.[7]

Clinical significance: A serum progesterone level > 3 ng/mL (> 10 nmol/L) mid-luteal phase indicates that ovulation has occurred. Progesterone levels on the day of hCG trigger during IVF are also clinically significant — elevated levels may indicate premature luteinisation, which is associated with impaired endometrial receptivity and lower implantation rates.[12]

Reference range: Mid-luteal: > 3 ng/mL confirms ovulation; > 10 ng/mL indicates good corpus luteum function. On hCG trigger day in IVF, progesterone should ideally be < 1.5 ng/mL.

2.2.3 Thyroid-Stimulating Hormone (TSH) and Thyroid Hormones

Thyroid function screening is recommended particularly in women with irregular cycles.[7]

Clinical significance: Both hypothyroidism and hyperthyroidism can impair ovulation, increase miscarriage risk, and reduce implantation rates. TSH is the primary screening tool; values outside the normal range prompt measurement of free T4 and thyroid antibodies. Subclinical hypothyroidism (TSH 2.5–4.5 mIU/L) is increasingly recognised as a factor in unexplained infertility, and many fertility clinics target a TSH < 2.5 mIU/L before and during early pregnancy.

Reference range: General: 0.4–4.0 mIU/L. Fertility-specific target: < 2.5 mIU/L.

2.2.4 Prolactin

Prolactin testing is indicated when irregular cycles, galactorrhoea, or anovulation are present.[7]

Clinical significance: Hyperprolactinaemia suppresses GnRH pulsatility, leading to anovulation and menstrual irregularity. Serum levels should be measured in the non-stressed, fasting state (as prolactin is sensitive to stress, food intake, and time of day). In a comparative study of fertile women and those with primary

infertility, prolactin levels were significantly different, suggesting its diagnostic value in infertility evaluation.[13][14]

Reference range: Normal: 2–29 ng/mL (non-pregnant females). Values > 100 ng/mL warrant pituitary imaging.

2.2.5 Testosterone and Androgens

Testosterone and dehydroepiandrosterone sulphate (DHEA-S) are measured when PCOS or adrenal pathology is suspected.[7]

Clinical significance: Elevated androgens are central to the pathophysiology of PCOS, contributing to anovulation, hirsutism, and metabolic dysfunction. Free androgen index is useful for identifying hyperandrogenism, particularly when SHBG is altered by obesity or insulin resistance. In a systematic review and network meta-analysis, combined diet and exercise interventions were ranked first for free androgen index reduction (SMD −1.59, 95% CI: −3.18 to 0.01) in women with overweight or obesity.[15]

2.3 Vitamin D

25-hydroxyvitamin D (25(OH)D) is increasingly tested as part of fertility work-ups.

Clinical significance: Vitamin D receptors are expressed in the ovary, uterus, and placenta, and vitamin D plays roles in folliculogenesis, oocyte development, steroidogenesis, and endometrial receptivity. In a study of 848 IVF patients, vitamin D status was correlated with fertilisation rates. A systematic review found that the majority of studies reported a decrement in ART outcomes in patients with vitamin D deficiency. A prospective cohort of 500 women undergoing ART found live birth rates of 23.2% in deficient (< 50 nmol/L), 27.0% in insufficient, and 37.7% in replete (> 75 nmol/L) women. Another retrospective study of 1,113 women found cumulative live birth rate was significantly lower in the vitamin D-deficient group (43.9% vs 50.9%). In PCOS patients specifically, evidence generally supports that adequate vitamin D levels are associated with improved IVF success.[16][17][18][19][20]

Reference range: Deficient: < 20 ng/mL (< 50 nmol/L); Insufficient: 20–29 ng/mL; Sufficient: ≥ 30 ng/mL (≥ 75 nmol/L). In IVF contexts,

vitamin D at 20–60 ng/mL is generally associated with better outcomes.[21]

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3. Male Blood Tests in Fertility Treatment

3.1 Hormonal Panel

3.1.1 Total Testosterone (tT)

Morning serum testosterone is a fundamental component of the male fertility endocrine evaluation.[1]

Clinical significance: Low testosterone is associated with impaired spermatogenesis and can indicate primary or secondary hypogonadism. In a cross-sectional study of infertile men, testosterone was positively correlated with semen quality index ($r = 0.28$, $p = 0.042$). Patients with poorer general health exhibited lower tT levels. Free testosterone and percentage free testosterone have been shown to be superior markers to total testosterone in evaluating male infertility, as they better differentiate between oligozoospermic and azoospermic men and fertile controls.[22][23][1]

Reference range: 2.48–8.36 ng/mL (8.6–29.0 nmol/L). Values below 2.5 ng/mL suggest hypogonadism.[1]

3.1.2 FSH (Male)

Clinical significance: FSH in men reflects Sertoli cell function and is the principal hormonal marker of spermatogenesis. Elevated FSH indicates primary testicular failure (spermatogenic damage), while low FSH suggests hypogonadotropic hypogonadism. In infertile men, FSH was significantly negatively associated with semen quality ($\beta = -0.286$, $p = 0.003$). Elevated FSH with low testosterone and elevated LH characterises primary hypogonadism, as seen in conditions such as Klinefelter syndrome. A position paper from IRCCS Ospedale San Raffaele reported male FSH reference range of 1.4–18.1 mIU/mL.[22][2][1]

Reference range: 1.4–18.1 mIU/mL. Values > 10 mIU/mL generally suggest primary testicular damage.[1]

3.1.3 LH (Male)

Clinical significance: LH stimulates Leydig cells to produce testosterone. Combined with FSH and testosterone, it allows classification of hypogonadism type. Low LH + low FSH + low testosterone indicates central (hypothalamic-pituitary) hypogonadism; elevated LH + elevated FSH + low testosterone indicates primary testicular failure.[2]

Reference range: 1.7–8.6 mIU/mL.[1]

3.1.4 Prolactin (Male)

Clinical significance: Elevated prolactin in men leads to reduced GnRH secretion, resulting in decreased LH, FSH, and testosterone. Significant higher prolactin levels were found in infertile men (mean 199.79 μIU/mL) compared to fertile controls (127.23 μIU/mL). Hyperprolactinaemia can cause erectile dysfunction, low libido, and impaired spermatogenesis. Causes include pituitary adenomas, medications (e.g., antipsychotics), and hypothyroidism.[24]

Reference range: Normal: 2–18 ng/mL (males). Values > 25 ng/mL warrant further investigation; values > 100 ng/mL require pituitary imaging.

3.1.5 Sex Hormone-Binding Globulin (SHBG) and Free Testosterone

Clinical significance: SHBG binds testosterone, reducing its bioavailability. Conditions such as obesity and insulin resistance decrease SHBG, potentially masking true hypogonadism. Median SHBG levels tend to rise across age quartiles while decreasing with increasing BMI. When total testosterone is borderline, measuring SHBG and albumin to calculate free testosterone provides a more accurate assessment of androgen status.[23][1]

3.1.6 Inhibin B

Clinical significance: Produced by Sertoli cells, inhibin B is a direct marker of spermatogenesis. Low inhibin B levels correlate with reduced testicular volume, elevated FSH, and impaired sperm production. It provides additional information beyond FSH for predicting sperm retrieval success in azoospermic men.[1]

4. Infection Screening (Both Partners)

Infection screening is a mandatory requirement before any ART procedure in most regulatory jurisdictions worldwide.[25]

4.1 Standard Mandatory Screening

Test	Rationale	Key Data
HIV I and II	Prevents vertical transmission; ensures lab safety	Seroprevalence 0.2% in IVF cohorts[25]
Hepatitis B (HBsAg)	Risk of perinatal transmission; HBV can be present in follicular fluid and semen	HBsAg positive in 0.4% of IVF patients[25]; higher miscarriage rate in infected couples (22.5% vs 17.7%)[26]
Hepatitis C (anti-HCV)	Similar transmission concerns; associated with reduced fertility	Anti-HCV positive in 0.2% [25]; no significant impact on live birth rates after complete IVF cycle[26]
Syphilis (RPR/VDRL/TPHA)	Congenital syphilis prevention	Positive in 0.3% of IVF patients[25]

4.2 Additional Infection Screening

- **Rubella immunity (IgG):** Women who are non-immune should receive MMR vaccination at least one month before attempting pregnancy.[27][7]
- **Varicella-zoster (IgG):** Particularly relevant if no history of chickenpox or vaccination.
- **Cytomegalovirus (CMV):** Tested depending on clinic policy; relevant for donor gamete matching.
- **TORCH panel:** Encompasses Toxoplasma, Rubella, CMV, and HSV, with extended panels including HBV, HCV, HIV, and syphilis.[27]

- **HPV (in males):** High-risk HPV genotypes in semen are associated with compromised sperm progressive motility and higher sperm DNA fragmentation.[1]
- **Chlamydia trachomatis and Mycoplasma/Ureaplasma:** Urogenital tract infections are present in 15–20% of infertile men and can impair spermatogenesis and sperm function.[2]

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5. Genetic Blood Tests

5.1 Karyotype Analysis

Indications: Recommended for both partners in cases of azoospermia, severe oligozoospermia (< 10 million sperm/ejaculate), recurrent miscarriage, and primary testicular failure.[28][2]

Clinical significance: Chromosomal abnormalities (e.g., Klinefelter syndrome 47,XXY in men; Turner syndrome 45,X mosaics in women) are found at significantly higher rates in infertile populations. Men with Klinefelter syndrome present with small testes, elevated gonadotropins, and azoospermia. A normal karyotype is 46,XX (female) or 46,XY (male).

5.2 Y-Chromosome Microdeletion Analysis

Indications: Men with non-obstructive azoospermia or severe oligozoospermia and primary testicular failure.[2][1]

Clinical significance: Deletions in AZF (azoospermia factor) regions (AZFa, AZFb, AZFc) on the Y chromosome are found in 5–15% of men with severely impaired spermatogenesis. AZFa/AZFb deletions are generally associated with complete absence of spermatogenesis (no sperm retrieval possible), while AZFc deletions may allow sperm retrieval for ICSI. One study found AZFa deletions in 66.7% of infertile men using specific sequence-tagged site markers.[29]

5.3 CFTR Gene Mutation Analysis

Indications: Men with congenital bilateral absence of the vas deferens (CBAVD) and their female partners.[2]

Clinical significance: CFTR mutations are present in 60–90% of men with CBAVD. Since cystic fibrosis carrier frequency is high in the general population (approximately 1 in 25 Caucasians), partner screening is essential to assess the risk of having offspring with cystic fibrosis when ART is planned.[2]

5.4 Other Genetic Tests

- **Androgen receptor (AR) gene mutations:** In men with non-obstructive azoospermia and signs of androgen insensitivity (high testosterone, high LH).[2]
- **CFTR carrier screening (female partner):** Particularly when the male has CBAVD.
- **Thrombophilia screening:** Factor V Leiden, prothrombin gene mutation, and antiphospholipid antibodies may be offered in cases of recurrent implantation failure or pregnancy loss.
- **Preimplantation genetic testing (PGT):** While not a blood test per se, carrier screening blood tests (e.g., for thalassaemia, sickle cell disease, spinal muscular atrophy) inform PGT decisions.

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6. Blood Tests by Treatment Type

The following table summarises which blood tests are typically required for different fertility treatments:

Blood Test	IUI	IVF	ICSI	Special Indications
AMH	✓	✓	✓	Ovarian reserve assessment
FSH (basal, day 2–6)	✓	✓	✓	Response prediction
Estradiol (basal)	✓	✓	✓	Interpret with FSH
LH	✓	✓	✓	PCOS diagnosis
Progesterone (mid-luteal)	✓	✓	✓	Ovulation confirmation
TSH	✓	✓	✓	Thyroid dysfunction
Prolactin	If indicated	✓	✓	Irregular cycles, anovulation
Testosterone (female)	If PCOS suspected	✓	✓	Hyperandrogenism
Vitamin D	Recommended	✓	✓	Optimise outcomes
HIV, HBV, HCV, Syphilis	✓	✓	✓	Mandatory regulatory screening
Rubella IgG	✓	✓	✓	Pre-pregnancy immunity
FSH/LH/Testosterone (male)	If SA abnormal	✓	✓	Male endocrine evaluation
Prolactin (male)	If indicate	If indic	If indic	Central hypogonadism

Blood Test	IUI	IVF	ICSI	Special Indications
	d	ated	ated	
Karyotype	—	If indicated	If indicated	Severe oligozoospermia, RPL
Y-microdeletions	—	If indicated	✓	Severe oligozoospermia/azoospermia
CFTR	—	If CBAVD	✓	CBAVD, partner screening
Blood group + Rh	✓	✓	✓	Rh incompatibility prevention
Full blood count	✓	✓	✓	General health assessment

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7. Supplementation and Adjuvant Therapies Based on Blood Test Results

7.1 Dehydroepiandrosterone (DHEA)

DHEA supplementation (typically 75 mg/day for 8–12 weeks) has been studied extensively in women with diminished ovarian reserve (DOR) or poor ovarian response (POR).

Evidence: A meta-analysis of randomised controlled trials found that DHEA supplementation improved clinical pregnancy rates (RR improved significantly) and reduced miscarriage rates in women with DOR/POR undergoing IVF/ICSI. A network meta-analysis of 16 RCTs (2,323 women) found that DHEA significantly improved embryo implantation rate (OR 2.80, 95% CI: 1.41–5.57), high-quality embryo rate (OR 2.01, 95% CI: 1.07–3.78), and the number of oocytes retrieved (WMD 1.63, 95% CI: 0.34–2.92). In IUI patients with low ovarian

reserve, 12 weeks of DHEA at 75 mg/day significantly increased AMH ($p < 0.01$) and decreased FSH ($p = 0.03$), with mature follicle rates rising from 54.3% to 71.6%.[30][31][8]

7.2 Coenzyme Q10 (CoQ10)

CoQ10 is an intracellular antioxidant essential for mitochondrial energy production in oocytes.

Evidence: In the same network meta-analysis, CoQ10 demonstrated the strongest effect on clinical pregnancy rate (OR 2.22, 95% CI: 1.05–4.71) and was the only adjuvant therapy to significantly improve live birth rate (OR 2.36, 95% CI: 1.07–5.38; SUCRA 89.9%). CoQ10 also increased the number of oocytes retrieved (WMD 1.34, 95% CI: 0.64–1.99). The evidence, though limited to a small number of RCTs, positions CoQ10 as a promising adjuvant for POR patients.[31]

7.3 Vitamin D Supplementation

Evidence: A trial sequential meta-analysis of 5 RCTs investigated vitamin D supplementation in vitamin D-deficient women undergoing IVF. A systematic review found that cost-benefit analyses suggested screening and supplementing vitamin D prior to ART might be cost-effective. Women with sufficient vitamin D (> 30 ng/mL) had live birth rates of 37.7% compared to 23.2% in deficient women. In PCOS patients, a systematic review found that higher baseline vitamin D levels were associated with improved IVF success.[32][18][20][16]

7.4 Myo-Inositol

Myo-inositol has shown benefits in PCOS patients undergoing IVF. A meta-analysis of 11 RCTs (981 participants) found significantly improved metaphase II oocyte rates in the myo-inositol group (OR 1.55, 95% CI: 1.04–2.31, $p = 0.03$), with PCOS women showing even greater improvement (OR 1.97, 95% CI: 1.20–3.25). For men, myo-inositol treatment was associated with significant increases in total sperm motility (SMD 0.90, $p = 0.001$), progressive motility (SMD 1.48, $p = 0.008$), and testosterone (SMD 0.54, $p < 0.0001$), as well as decreased sperm DNA fragmentation.[33][34]

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8. Lifestyle Modifications to Enhance Fertility Biomarkers and Treatment Outcomes

8.1 Body Weight and BMI Optimisation

Evidence for women: A systematic review and network meta-analysis evaluating exercise, diet, and pharmacological interventions in reproductive-aged women with overweight or obesity found that combined exercise, diet, and ovulation inducers was most likely (89%) to produce the highest ovulation rate improvement. In PCOS women undergoing IVF, those with normal BMI had significantly higher clinical pregnancy rates (OR 1.16, 95% CI: 1.04–1.29) and live births (OR 1.88, 95% CI: 1.56–2.27) compared to those with elevated BMI. Miscarriage risk was significantly increased in the high-BMI group. Gestational diabetes (OR 3.96) and gestational hypertension (OR 2.16) were also significantly more common in PCOS women with high BMI.[35][15]

Evidence for men: A systematic review examining obesity interventions on male fertility found that preconception weight loss through lifestyle modification (healthy diet and exercise) or bariatric surgery has reproductive implications. Bariatric surgery resulted in a significant increase in total testosterone (2.23 vs 2.74 nmol/L, p = 0.009) and improvement in sexual function scores. A 5–10% weight loss in men with obesity is associated with improved testosterone levels and semen parameters.[36][37]

8.2 Diet and Nutrition

Mediterranean diet: Emerging evidence supports the Mediterranean diet — rich in fruits, vegetables, whole grains, fish, olive oil, and nuts — as beneficial for both male and female fertility. In women with PCOS, low-glycemic and Mediterranean-style diets were consistently associated with reductions in total and free testosterone, improved insulin sensitivity, and enhanced menstrual regularity.[38]

Antioxidant-rich diets: Oxidative stress is a primary contributor to sperm DNA damage and is linked to modifiable lifestyle factors. Diets

rich in antioxidants (vitamins C, E, selenium, zinc, folate) can help reduce oxidative stress in both oocytes and sperm.[1]

Specific nutrients:

- **Folate/folic acid:** Essential for DNA synthesis; reduces risk of neural tube defects; recommended at 400–800 μg/day before conception.
- **Omega-3 fatty acids:** May improve oocyte quality and endometrial receptivity.
- **Zinc:** Critical for testosterone synthesis and sperm production in men.
- **Iron:** Deficiency can impair ovulation in women.

8.3 Physical Activity

Regular moderate exercise improves insulin sensitivity, reduces inflammatory markers, and supports hormonal balance. The network meta-analysis in overweight/obese reproductive-aged women showed that exercise combined with dietary modifications achieved the greatest BMI reduction and ovulation improvement. However, excessive exercise (e.g., intense endurance training) can suppress the hypothalamic-pituitary axis, leading to hypothalamic amenorrhoea in women or reduced testosterone in men.[39][15]

Recommended approach: 150–300 minutes per week of moderate-intensity aerobic activity, combined with 2–3 sessions of resistance training.

8.4 Smoking Cessation

Smoking has well-established detrimental effects on both male and female fertility:

- **Women:** Accelerates ovarian ageing, reduces AMH levels, increases time to conception, and impairs IVF outcomes.
- **Men:** Cigarette smoking is classified as a minor risk factor for male infertility, associated with reduced sperm concentration, motility, and morphology, as well as increased sperm DNA fragmentation.[2]

Smoking cessation should be strongly advised before initiating any fertility treatment.

8.5 Alcohol and Caffeine

- **Alcohol:** Even moderate alcohol consumption has been associated with reduced fecundity. Current guidance recommends avoiding alcohol entirely during ART cycles and pregnancy.
- **Caffeine:** Moderate caffeine intake (< 200 mg/day, approximately 1–2 cups of coffee) is generally considered safe, though some guidelines recommend further reduction during treatment cycles.

8.6 Stress Management

While direct causal links between stress and IVF failure remain debated, psychological stress can influence hormonal regulation through the hypothalamic-pituitary-adrenal (HPA) axis. A randomised controlled trial evaluating a smartphone-supported positive adjustment coping intervention (PACI) for couples undergoing fertility treatment found benefits in psychological outcomes. Sleep optimisation, mindfulness, and cognitive-behavioural strategies are recommended adjuncts.[40]

8.7 Environmental and Occupational Factors

Exposure to endocrine-disrupting chemicals (EDCs), heavy metals, pesticides, air pollution, and electromagnetic fields are recognised risk factors for male infertility. Men should be counselled about:[2][1]

- Avoiding prolonged testicular heat exposure (hot baths, saunas, tight clothing, laptop use on lap).
- Minimising exposure to BPA, phthalates, and other known endocrine disruptors.
- Reducing occupational exposure to toxic chemicals where possible.

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9. Interpretation Framework: Linking Blood Test Results to Clinical Action

9.1 Female Interpretation Guide

Biomarker Pattern	Likely Interpretation	Clinical Implication
Low AMH + High FSH + Low AFC	Diminished ovarian reserve	Consider aggressive stimulation protocols; donor oocytes if severe; DHEA/CoQ10 supplementation
High LH:FSH ratio + Elevated androgens + Normal/High AMH	PCOS	Lifestyle modification; metformin; careful stimulation to avoid OHSS
Elevated TSH + Normal/Elevated prolactin	Hypothyroidism-related anovulation	Levothyroxine to achieve TSH < 2.5 mIU/L
Elevated prolactin + Low gonadotropins	Hyperprolactinaemia	Rule out pituitary adenoma; dopamine agonist therapy
Low progesterone (mid-luteal)	Anovulation or luteal phase defect	Ovulation induction; luteal phase support
Vitamin D < 20 ng/mL	Deficiency	Supplementation (1000–4000 IU/day) before ART

9.2 Male Interpretation Guide

Adapted from the hormonal interpretation framework proposed by Ferlin and Foresta (2020):[2]

FSH	LH	Testosterone	Interpretation	Example Aetiology
Normal	Normal	Normal	Post-testicular or mild testicular	Obstruction, varicocele
High	High	Low-normal	Primary testicular failure	Klinefelter syndrome, chemotherapy
High	Normal	Normal	Spermatogenesis damage only	Y-microdeletions, cryptorchidism
Low	Low	Low	Hypogonadotropic hypogonadism	Kallmann syndrome, pituitary tumour
Low	Low	High	Exogenous androgens	Anabolic steroid use
High	High	High	Androgen resistance	AR gene mutations

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10. Sperm DNA Fragmentation: An Emerging Biomarker

While not a blood test, sperm DNA fragmentation (SDF) testing deserves mention as it is increasingly incorporated into the male fertility work-up.

Clinical significance: Even men with normal semen parameters may have elevated SDF, which is correlated with higher levels of systemic inflammation and metabolic diseases. A SDF index < 30% (by SCSA) is considered the clinical threshold for normalcy. Elevated SDF is associated with recurrent pregnancy loss, ART failure, and reduced

embryo quality. Men with unexplained infertility, poly-abortions, Prader orchidometer volume < 15 mL, age ≥ 38 years, and total motile sperm count < 20×10^6 have increased risk of pathological SDF.[1]

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11. Discussion

The comprehensive blood testing framework described in this paper underscores the importance of evaluating both partners simultaneously, as advocated by current EAU, ESHRE, and ASRM guidelines. A common malpractice in fertility evaluation is to focus attention on only one partner or to limit the male evaluation to semen analysis alone. Our review demonstrates that hormonal, infectious, and genetic blood tests — when interpreted in the clinical context of the couple — provide essential diagnostic, prognostic, and therapeutic information.[1][2]

The evidence for lifestyle modifications is compelling but often limited by study quality. The most robust data support weight optimisation in overweight/obese women, with combined diet and exercise interventions demonstrating the greatest improvements in ovulation and hormonal profiles. For men, the relationship between obesity and hypogonadism is well-established, and weight loss interventions improve testosterone levels. Nutritional supplementation — particularly DHEA, CoQ10, vitamin D, and myo-inositol — shows promise as adjuvant therapy, with CoQ10 demonstrating the strongest effect on live birth rates in POR patients (OR 2.36).[37][36][15][31]

A critical gap remains in the standardisation of testing protocols across fertility centres and the development of personalised treatment algorithms that integrate multiple biomarkers simultaneously.

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This paper synthesises evidence from peer-reviewed clinical trials, systematic reviews, meta-analyses, and international clinical guidelines. The rapidly evolving field of reproductive medicine means clinicians should always refer to the most current editions of ESHRE, ASRM, and EAU guidelines for practice recommendations.