Int J Med Rev 2025 December;12(4): 1002-1011

10.30491/ijmr.2025.541297.1347

INTERNATIONAL JOURNAL OF MEDICAL REVIEWS

Narrative Review

Pathogenesis of Vitamin D Deficiency in Female Fertility: The Impact on Mast Cell Function

Zahra Mosayebi [1], Nasim Beigi-Boroujeni [2], Negar Azadi [2], Mandana Beigi-Boroujeni [2*]

[1] Student Research Committee, School of Medicine, Lorestan University of Medical Sciences, Khorramabad, Iran
[2] Razi Herbal Medicines Research Center, School of Medicine, Lorestan University of Medical Sciences, Khorramabad, Iran

* **Corresponding Author:** Mandana Beigi-Boroujeni, Razi Herbal Medicines Research Center, School of Medicine, Lorestan University of Medical Sciences, Khorramabad, Iran. E-mail: Beigiboroujeni@gmail.com

Received August 14, 2025; **Accepted** September 14, 2025; **Online Published** December 30, 2025

Abstract

Introduction: Mast cells, through the repair of inflammatory mediators, cause structural and functional changes in the female reproductive system; however, unregulated mast cell activity can lead to fertility problems in women. On the other hand, vitamin D, due to its modulatory role on mast cell function, may influence pregnancy success rates.

Methods: The present study is a narrative review conducted using that incorporates observational studies (both descriptive and analytical) from the past 25 years (2000–2025). A total of 53 articles indexed in databases such as SID, Science Direct, Iran medex, Google Scholar, Scopus, and PubMed were reviewed.

Results: Studies have shown that vitamin D, by reducing mast cell activity and inhibiting the production of inflammatory cytokines, can help improve fertility by decreasing inflammation. Based on the available evidence, vitamin D may be considered an inflammatory a regulator of inflammation in reproductive health. However, further research is required to completely understand the precise mechanisms by which vitamin D affects mast cell activity.

Conclusion: Given the role of vitamin D in enhancing folliculogenesis, hormonal regulation, and its anti-inflammatory and antioxidant properties within the ovaries, existing studies suggest that vitamin D treatment may help regulate the number and activity of mast cells in the endometrium of ovulation-induced mice. This regulation can prevent excessive inflammation, improve the uterine environment for embryo implantation, and ultimately increase the success of ovulation and fertility.

Keywords: Vitamin D, Mast Cells, Fertility

Introduction

To ensure prenatal protection, enhance newborn survival, and achieve a successful pregnancy, the immune system plays a crucial role in various reproductive processes, including ovulation, corpus luteum formation and degeneration during folliculogenesis, the menstrual cycle, and embryo implantation. Given the immune system's functions, the importance of immune responses in the ovary and endometrial tissue is well recognized.[1]

One of the key aspects of uterine function is its ability to regulate immune and inflammatory responses. The uterus must provide a safe, non-inflammatory environ ment for embryo implantation while also being capable of identifying and eliminating harmful external agents. Mast cells, as vital components of the innate immune system, play a significant role in this regulation. Both hyperactivity and insufficient activity of these cells can lead to complications such as infertility, chronic inflammation, or implantation failure.[2]

Vitamin D plays non-classical roles in reproductive biology, including folliculogenesis, spermatogenesis, and the acrosome reaction. Its serum levels are associated with sperm quality and ovarian reserve, and have been linked to conditions such as polycystic ovary syndrome (PCOS) and endometriosis.

Beyond reproduction, vitamin D is involved in various disorders such as cardiovascular diseases, autoimmune conditions, and cancers. Research has emphasized its crucial role in both male and female fertility, as well as in maintaining reproductive health during pregnancy.

Vitamin D deficiency is considered a risk factor for infertility, gonadal cancers, pregnancy complications, PCOS, and endometriosis. Due to its wide-ranging effects on the immune system, it has attracted growing

interest from researchers in recent years.[3]

The vitamin D receptor (VDR), as well as the enzyme responsible for producing its active form (CYP27B1), has been identified in reproductive tissues, including the endometrium. The active form of vitamin D enhances embryo implantation in the uterine endometrium through various mechanisms, such as promoting the differentiation of stromal cells into decidual cells and modulating immune factors. Several studies have also demonstrated that vitamin D supplementation can improve pregnancy outcomes in infertile patients undergoing assisted reproductive techniques by enhancing endometrial function and embryo endometrium embryo-endometrium interaction.[4,5]

Mast cells play a crucial role in regulating immune and inflammatory responses within the endometrium, especially during the preparation phase for embryo implantation.

During ovulation, hormonal changes activate mast cells, which are essential for establishing a receptive uterine environment. By releasing inflammatory mediators and tissue remodeling factors, these cells contribute to both structural and functional changes in the endometrium.

Such changes are vital during ovulation and the early stages of implantation. However, excessive or dysregulated mast cell activity can lead to abnormal inflammation, potentially impairing the implantation process. In this context, vitamin D may serve as a modulator of mast cell function. It helps prevent abnormal activity and supports successful implantation.[6]

This narrative review aimed to investigate the effects of vitamin D on female fertility through its influence on mast cell activity. By reviewing relevant literature, the findings were shared with other researchers to help prevent duplication of similar studies and to contribute to the development of new research ideas in this field.

Materials and Methods

Vitamin D and Fertility Success

The consequences of vitamin D deficiency suggest a strong link between insufficient vitamin D levels and public health, particularly among women. Among the various physiological processes influenced by vitamin D, its role in reproductive physiology is especially significant. Based on available evidence, vitamin D is considered a key component in achieving successful fertility. Therefore, pathophysiological mechanisms related to vitamin D deficiency may present risks to fertility. The impact of vitamin D deficiency on female fertility remains a subject of ongoing debate and scientific inquiry.[7]

Vitamin D plays a significant role in modulating the immune system by regulating hormone secretion, immune function, and cellular differentiation and proliferation. Vitamin D receptors are distributed throughout the reproductive system, including the ovaries, endometrium, and placenta. Studies have confirmed the role of vitamin D in folliculogenesis and oogenesis, as well as its positive impact on embryo implantation. Furthermore, research has shown that successful reproductive outcomes are associated with sufficient levels of vitamin D.[8,9]

In the field of endocrinology, vitamin D has been shown to influence sex hormones, lipid factors, and other biomarkers. Previous studies have demonstrated that vitamin D supplementation in patients may lead to reductions in HDL and LDL levels, which can significantly improve infertility outcomes.[10] Importantly, the embryo implantation rate in women with sufficient vitamin D levels is 6% higher than in those with vitamin D deficiency.[11]

Low levels of vitamin D have been significantly associated with spontaneous abortion.[12] According to studies, vitamin D functions as a steroid hormone with progesterone-like activity and works in tight coordination with progesterone during the early stages of pregnancy to regulate various physiological processes.[8,9] However, conflicting reports exist regarding the impact of vitamin D on IVF success rates. While some studies have found a significant correlation between vitamin D levels and IVF outcomes.[13,14]

In women, the vitamin D receptor (VDR) is found in the cell membrane of the reproductive system, including ovarian follicles, granulosa cells, follicular cells, ovarian stroma, germinal epithelium, corpus luteum cells, fallopian tube epithelium, as well as in the endometrium, myometrium of the uterus, ovaries, and placenta.[15]

Vitamin D deficiency plays a role in reproductive dysfunctions such as polycystic ovary syndrome (PCOS), uterine fibroids, poor sperm parameters, and IVF treatment failure. Therefore, vitamin D supplementation is recommended in the treatment of infertility in both women and men. Women with serum vitamin D levels above 50 nmol/L have a higher chance of becoming

pregnant. Supplementation is especially advised in cases of deficiency, such as in overweight individuals, insulin-resistant women, those with low anti-Müllerian hormone (AMH) levels, and in men with oligospermia or asthenospermia.[16]

Studies have shown that female mice lacking the vitamin D receptor suffer from ovarian failure, characterized by impaired follicular development.[17]

Vitamin D also plays a role in regulating ovarian follicular growth and the menstrual cycle through its effects on steroidogenesis, including the production of estrogen and progesterone. In fact, serum vitamin D levels are associated with AMH levels, which can be used as an indicator of ovarian reserve.[18]

Anti-Müllerian hormone (AMH) is a dimeric glycoprotein that inhibits follicle-stimulating hormone (FSH) sensitivity during the growth of antral follicles. It is considered one of the most reliable markers for assessing ovarian reserve and is commonly used in assisted reproductive technologies (ART) as an indicator of ovarian response, particularly in cases of ovarian hyperstimulation. The highest levels of AMH are observed in women after puberty, and these levels decline with age, likely reflecting the age-related reduction in ovarian reserve.[19,20]

Research has shown that vitamin D may influence the activity of P450 aromatase in granulosa cells, which is essential for converting androstenedione to estradiol. It also regulates calcium transport in the fallopian tube epithelium, a process necessary for successful fertilization within the lumen of the fallopian tube.[18]

Moreover, vitamin D is crucial for the decidualization process of the endometrium, during which uterine cells undergo transformation to support embryo implantation and placental development.[21] Vitamin D contributes to successful implantation by increasing the expression of HOXA10 in the endometrium, playing a key role in embryo attachment. The presence of CYP27B1 and VDR in placental tissues indicates vitamin D's involvement in the expression and secretion of human chorionic gonadotropin (hCG) and placental lactogen. Additionally, vitamin D plays a significant role in female estrogen biosynthesis and promotes the production of progesterone, estradiol, and estrone under in vitro conditions.[22]

The effect of vitamin D is likely mediated through the endometrium, as no association has been observed between vitamin D deficiency and ovarian stimulation parameters or embryo quality markers. In another study, no correlation was found between serum and follicular vitamin D levels and pregnancy rates in IVF cycles.[23]

Vitamin D promotes the maturation of ovarian follicles and improves oocyte quality. It influences the levels of estrogen, progesterone, and anti-Müllerian hormone (AMH), all of which are vital for ovulatory function. Additionally, vitamin D reduces oxidative stress and creates an optimal environment for ovulation.[24]

Studies examining serum and follicular fluid concentrations of vitamin D in women undergoing assisted reproductive treatments have shown that serum vitamin D may be an effective factor in improving the success rate of these methods. Moreover, the level of vitamin D in follicular fluid may serve as an indicator of oocyte fertility potential, possibly reflecting the amount of vitamin D uptake by individual follicles, though the exact mechanism remains unclear.[24]

In 2018, Ciepiela and colleagues conducted a study on 198 infertile women. The aim was to assess the potential relationship between follicular fluid vitamin D levels and the ability of oocytes to develop into embryos that result in clinical pregnancy.

The results demonstrated a strong association between follicular fluid vitamin D and oocyte quality. The researchers concluded that follicular fluid vitamin D concentration may be considered a marker of oocyte quality. It is therefore hypothesized that localized, yet undefined, actions of vitamin D may enhance the ability of oocytes to be fertilized and develop into embryos, ultimately influencing pregnancy outcomes in infertile women.[25]

One of the most significant causes of infertility in women is ovulatory dysfunction, accounting for approximately 40% of female infertility cases.[26] Observations have linked low vitamin D levels in women to conditions such as preeclampsia, preterm birth, bacterial vaginosis, gestational diabetes, and infertility. According to a meta-analysis, moderate daily intake of vitamin D supplements may increase the chances of pregnancy in infertile women and positively influence pregnancy outcomes. Vitamin D deficiency has also been associated with reduced pregnancy rates in women undergoing IVF.[15]

Furthermore, vitamin D deficiency has been linked to a lower likelihood of live birth following IVF or

intracytoplasmic sperm injection (ICSI). Treatment with vitamin D has been shown to reduce cytokine production in endometrial stromal cells in patients experiencing recurrent implantation failure.[27]

In female rats, vitamin D deficiency has been shown to impair reproduction by reducing the probability of pregnancy. Reproductive dysfunction in women with vitamin D deficiency is attributed to impaired estrogen signaling. Female rats lacking membrane vitamin D receptors (VDR) exhibit hypergonadotropic hypogonadism and reduced aromatase activity, which is essential for estrogen synthesis. Additionally, female rats lacking aromatase develop large hemorrhagic ovarian cysts, indicating ovulatory defects.[28]

Recent research suggests that vitamin D deficiency may contribute to increased inflammation in the uterine endometrium and disrupt the implantation process. This increased inflammation can lead to imbalances in mast cell activity, preventing proper embryo acceptance in the uterus. As a result, vitamin D deficiency may increase the risk of infertility and miscarriage. Therefore, adequate vitamin D intake and monitoring its levels in women planning to conceive are considered preventive strategies to improve implantation conditions and support pregnancy maintenance.[29]

Vitamin D, Mast Cells, and the Female Reproductive System

One of the most basic effects of vitamin D during the early stages of embryonic development is its anti-inflammatory action.[8] Mast cells, as immune cells with complex roles in inflammatory and immune processes across various tissues, play a key role in creating a suitable environment for embryo implantation. An increase or decrease in mast cell numbers in the endometrium may lead to changes in the uterine immune environment, which can affect implantation and pregnancy success. Ovulation stimulation and the pre-implantation phase are critical stages in reproduction, where hormonal and immune changes play a significant role in fertility outcomes.[30]

Mast cells are among the key elements of the innate immune system. They are involved not only in inflammatory and allergic responses but also in physiological processes such as ovulation. These cells are found in various tissues, including the uterine endometrium, and influence reproductive processes such as ovulation and implantation through the secretion of mediators like histamine and cytokines. By releasing inflammatory substances and modulating the inflammatory environment in the ovaries, mast cells may affect ovulation and the preparation of the uterus for implantation.

During ovulation, localized inflammation is considered a necessary step for follicle rupture and oocyte release from the ovary. Mast cells contribute to this process by releasing histamine and other inflammatory mediators, thereby enhancing the inflammation that facilitates ovulation. Additionally, they help prepare the uterine milieu for embryo implantation. However, excessive mast cell activity may lead to harmful inflammation and disrupt the normal processes of ovulation and fertility.[14]

Vitamin D, as an immune modulator, may play a crucial role in regulating mast cell activity during ovulation. By inhibiting mast cell activation and reducing the secretion of inflammatory mediators such as histamine and cytokines, vitamin D can prevent excessive inflammation and help create a favorable environment for ovulation and implantation.

In fact, maintaining optimal vitamin D levels in the body may improve reproductive processes and increase the success rate of ovulation and fertility. Thus, mast cells through, their role in regulating inflammation and immune responses, significantly influence ovulation and implantation. Vitamin D, by modulating mast cell activity, helps maintain immune and inflammatory balance during these processes, contributing to improved fertility and reproductive health.[31]

It is also possible that vitamin D plays a role in fertilization, implantation, placental development, and healthy pregnancy due to its properties in cell proliferation, anti-inflammation, anti-angiogenesis, and immune modulation. Vitamin D contributes to reducing pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF-α), interleukin-1 (IL-1), and IL-6, thereby supporting anti-inflammatory regulation. Moreover, certain immune cells express vitamin D receptors (VDR) as well as vitamin D metabolizing enzymes such as 1-α hydroxylase and 24-hydroxylase.[32]

As an immune regulator, vitamin D may also exert protective effects against tissue damage by inhibiting the activity of mast cell-derived proteolytic enzymes. By reducing the secretion and activity of proteases such as tryptase and chymase, vitamin D can help

control unnecessary tissue degradation and support optimal and natural tissue repair. Therefore, vitamin D not only plays a role in reducing inflammation and regulating immune responses but also protects against inflammatory tissue damage caused by excessive mast cell activity.[33]

Mast cells in the endometrial tissue of the uterus play a vital role in regulating immune status and preparing the tissue for embryo acceptance.[34] Vitamin D, as a key regulator of the immune system, can positively influence mast cell activity in the uterine endometrium. By reducing the secretion of inflammatory mediators from mast cells and suppressing chronic inflammation, vitamin D helps create a more favorable environment for embryo implantation. Lower inflammation in the endometrium not only facilitates better embryo acceptance but also helps prevent complications such as abortion. Therefore, maintaining adequate vitamin D levels during the pre-pregnancy and implantation phases may significantly contribute to the success of these processes.[35]

Previous studies suggest that vitamin D treatment may help regulate the number and activity of mast cells in the endometrium of ovulation-induced mice, thereby preventing excessive inflammation.

This targeted regulation improves the uterine environment for embryo implantation and generally enhances ovulation and fertility outcomes. In contrast, vitamin D deficiency may lead to increased mast cell numbers and hyperactivity, resulting in chronic inflammation of uterine tissue and reduced fertility potential.

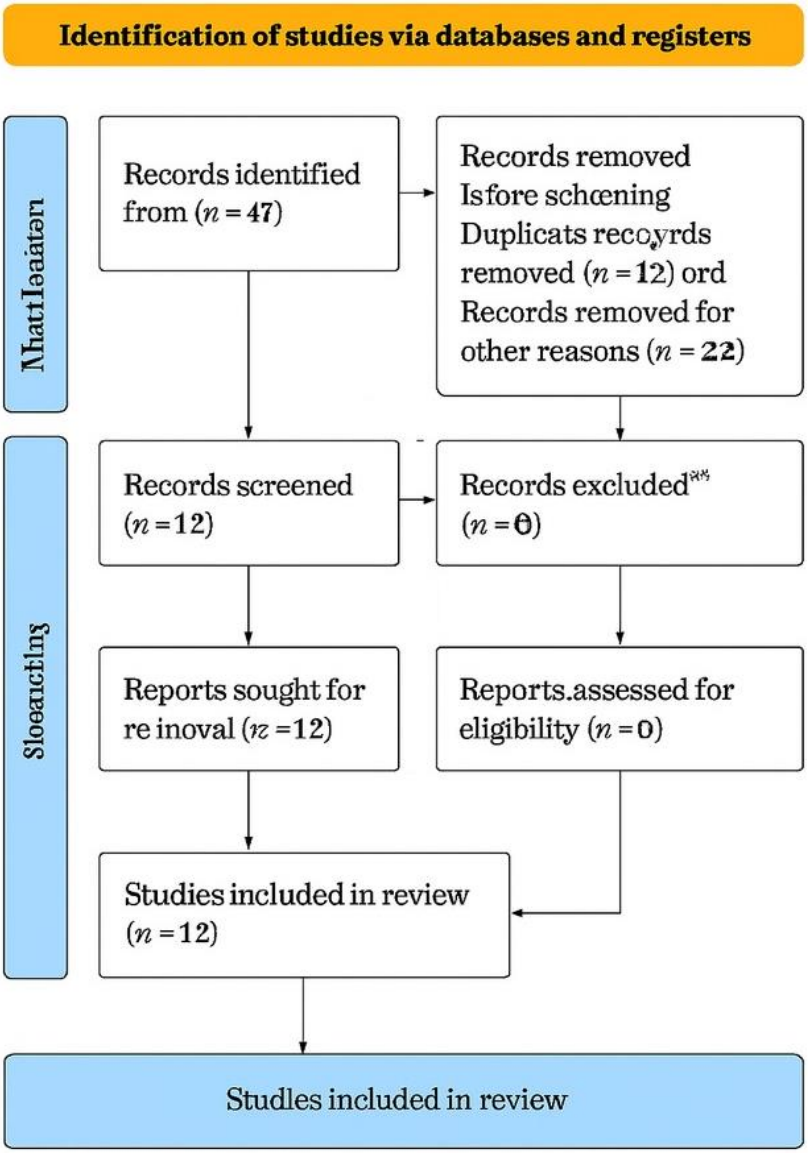

Figure 1. Prisma Flow Diagram.

Table 1. Summary of Studies on the Effects of Vitamin D on Female Infertility

Row	Author	Year	Clinical conditions	Intervention	Findings
1	Pal et al.	2018	PCOS	50,000 IU of vitamin D per week	Improves ovulation and insulin sensitivity.[37]
2	Gordon et al.	2019	Infertility without a known cause	2,000 IU of vitamin D per day	Increase AMH levels and improve follicle growth.[38]
3	Meng et al.	2023	The relationship between serum vitamin D levels and natural fertilization rates in the in vitro fertilization process.	Daily intake between 1,000 and 10,000 units	Significant increase in clinical pregnancy rates and positive effect of moderate doses of vitamin D in improving fertility outcomes in the IVF process.[39]
4	Sara Abedi et al.	2019	Infertile women are candidates for ICSI (intracytoplasmic sperm injection).	50,000 IU of vitamin D per week	Increasing chemical and clinical pregnancy rates and improving ICSI outcomes.[40]
5	Patrick et al.	2020	Infertility and ICSI	50,000 IU of vitamin D per week	Increasing the chances of pregnancy and better selection of embryos for transfer.[41]
6	Zhano et al.	2021	Polycystic ovary with insulin resistance	4,000 IU of vitamin D per day + clomiphene citrate	Increased ovulation success compared to the control group.[42]
7	Na Meh et al.	2023	Irregular ovulation cycles	3,000 IU of vitamin D per day	Improve menstrual cycle regularity and reduce oxidative stress.[43]

Given the critical role of mast cells in managing inflammation and immune responses—and the influence of vitamin D on their activity—it can be concluded that vitamin D acts as an immune-modulating agent. It may effectively control mast cell function and regulate immune and inflammatory responses across various tissues, including the uterine endometrium.

These effects could support improved implantation processes and ultimately boost fertility success. Further research into these mechanisms may pave the way for using vitamin D in treating fertility disorders and inflammation-related reproductive conditions.[35]

The uterine endometrium is one of the most critical components in reproduction and embryo implantation. The role of immune cells and environmental factors in regulating immune status and preparing the endometrium for embryo acceptance remains a central focus in reproductive research.

Additionally, a decrease in mast cell numbers during implantation has been associated with increased estrogen levels. It is hypothesized that the decidualization response during implantation is regulated by histamine released from uterine mast cells.[36]

Discussion

Today, the role of vitamin D in pregnancy has attracted significant attention, prompting numerous researchers to investigate its effects. In the present review, an effort was made to compare the outcomes of various studies and then explore the mechanisms underlying these relationships.

Due to vitamin D's role in ovulatory dysfunction and its anti-inflammatory benefits, it has been shown that vitamin D supplementation can positively influence follicular development, thereby improving ovulation and ultimately fertility. Numerous studies have explored this topic.[44]

It has also been observed that vitamin D deficiency is associated with a reduced likelihood of successful delivery following IVF or intracytoplasmic sperm injection (ICSI). Treatment with vitamin D has been shown to reduce cytokine production in endometrial stromal cells in patients undergoing recurrent implantation failure. Moreover, vitamin D is essential for the decidualization process of the endometrium, during which uterine cells transform to support embryo implantation and placental development.[21,27]

Increasing vitamin D levels may reduce inflammation and improve implantation. In this context, Di Renzo et al. (2022) found that vitamin D receptors are present in endometrial cells and that vitamin D regulates the expression of genes involved in the growth, differentiation, and function of these cells. As an immune modulator, vitamin D may play a crucial role in controlling mast cell activity during ovulation. By inhibiting mast cell activation and reducing the secretion of inflammatory mediators such as histamine and cytokines, vitamin D can prevent excessive inflammation and create an optimal environment for ovulation and implantation. In fact, maintaining optimal vitamin D levels in the body may enhance

reproductive processes and increase the success of ovulation and fertility.[31]

Cermisoni et al. (2018) demonstrated that vitamin D deficiency may be associated with increased inflammation in the uterine endometrium and disruption of the implantation process. This inflammation can lead to imbalances in mast cell activity, preventing proper embryo acceptance and increasing the risk of infertility and spontaneous abortion. Therefore, adequate vitamin D intake and monitoring its levels in women planning pregnancy are considered preventive strategies to improve implantation conditions and support pregnancy.[29]

Diedrich et al. (2007) reported that mast cells, as immune cells with varied roles in inflammatory and immune processes among tissues, play a key role in creating a suitable environment for embryo implantation. Changes in mast cell numbers in the endometrium may alter the immune microenvironment of the uterus, affecting implantation and pregnancy success.[30]

Vitamin D appears to influence gene and protein expression of decidualization factors in the endometrium. Hosseinirad et al. (2021) observed that the active form of vitamin D enhances embryo implantation through mechanisms such as stromal cell differentiation into decidual cells and modulation of immune factors. Similarly, Du et al. (2005) showed that vitamin D is important for decidualization and contributes to successful implantation by increasing HOXA10 expression in the endometrium.[27]

Vitamin D may also affect follicular and embryonic development. Mice lacking vitamin D receptor genes exhibited disrupted folliculogenesis and uterine development. Other studies have reported beneficial effects of vitamin D on ovarian steroidogenesis.[45]

Reichel et al. (1989) found a correlation between vitamin D levels and sperm quality, as well as ovarian reserve. They also associated vitamin D with conditions such as polycystic ovary syndrome (PCOS) and endometriosis, and noted its relevance in cardiovascular diseases, autoimmune disorders, and cancers.[3]

Soto et al. (2020) emphasized the vital role of vitamin D in male and female fertility and reproductive function during pregnancy. They identified vitamin D deficiency as a risk factor for infertility, gonadal cancers, pregnancy complications, PCOS, and endometriosis.[46]

Colonese et al. (2015) reported associations between low vitamin D levels and conditions such as preeclampsia, preterm birth, bacterial vaginosis, gestational diabetes, and infertility. They highlighted vitamin D's role in fertilization, implantation, placental development, and healthy pregnancy due to its effects on cell proliferation, anti-inflammation, anti-angiogenesis, and immune modulation. Vitamin D helps reduce pro-inflammatory cytokines such as TNF-α, IL-1, and IL-6, supporting anti-inflammatory regulation.[47]

Johnson et al. (1996) showed that vitamin D may influence P450 aromatase activity in granulosa cells, which is essential for converting androstenedione to estradiol. It also regulates calcium transport in the fallopian tube epithelium, which is necessary for successful fertilization.[18]

Graziottin et al. (2014) reported that mast cells in the uterine endometrium play a key role in regulating immune status and inflammation, especially during the preparation of the uterus for implantation. Hormonal changes during ovulation stimulate mast cell activity, which is essential for creating a favorable uterine environment.[30]

Woidacki et al. (2013) reported that mast cells contain receptors for estradiol and progesterone, and activation of these receptors leads to mast cell degranulation.[47]

Özen et al. (2007) reported a significant difference in the number of mast cells between the follicular and luteal phases in bovine ovaries, with more mast cells detectable during the follicular phase. Mast cell numbers are higher during the estrus and metestrus phases. The highest concentration of mast cells is found in the ovarian medulla, tunica albuginea, and the interstitial connective tissue of the ovarian cortex, while fewer mast cells are located near the corpus luteum compared to the Graafian follicle. Mast cells are involved in follicular development and ovulation.[48]

van Kempen et al. (2009), asserted that the immune system in the reproductive tract plays a role in preventing infections and regulating cervical changes during the estrous cycle and pregnancy.[49]

Ethnicity has been shown to influence the relationship between vitamin D status and pregnancy rates following IVF.

Notably, most studies conducted on Asian populations have not observed the beneficial effects of sufficient vitamin D levels. In fact, a study by Roddick et al. (2012) reported an inverse association between high vitamin D levels and IVF success.

The impact of vitamin D status on pregnancy

outcomes may be confounded by other factors contributing to lower pregnancy rates in Asian patients.

Although vitamin D appears to influence female fertility—both naturally and through assisted reproductive technologies such as IVF—the contradictory findings across studies suggest that its role in reproductive health remains under debate.

Further research is urgently needed to confirm a causal relationship and to explore the potential therapeutic benefits of vitamin D supplementation.[51]

Most recommendations regarding the relationship between vitamin D and implantation stem from studies showing that women with higher vitamin D levels at the time of embryo transfer and IVF had more successful pregnancies. According to a study by Irani (2017), which investigated the role of vitamin D in IVF failure, it was found that vitamin D deficiency plays a role in IVF treatment failure and may reduce pregnancy rates by affecting endometriosis.[52]

Ximena et al. (2025) demonstrated that vitamin D deficiency, due to its reproductive consequences, poses a major public health challenge for women of reproductive age.

Vitamin D supplementation may improve fertility outcomes, particularly in conditions such as endometriosis and polycystic ovary syndrome (PCOS). Its primary benefit appears to lie in metabolic regulation, which in turn influences reproductive function.

Several studies have reported positive effects of vitamin D on metabolic markers and ovulation in both endometriosis and PCOS. However, the lack of standardized criteria for diagnosing vitamin D deficiency—and the absence of consensus on optimal supplementation regimens regarding dosage, treatment duration, and individual patient needs—remain significant limitations.

Despite these challenges, vitamin D supplementation is emerging as a promising therapeutic strategy for enhancing reproductive health.[53]

Conclusion

Given the role of vitamin D in enhancing folliculogenesis, hormonal regulation, and its anti-inflammatory and antioxidant properties within the ovaries, existing studies suggest that vitamin D treatment may help regulate the number and activity of mast cells in the endometrium of ovulation-induced mice. This regulation can prevent excessive inflammation, improve the uterine environment for embryo implantation, and ultimately increase the success of ovulation and fertility.

Moreover, vitamin D deficiency may lead to an increase in mast cell numbers and hyperactivity, contributing to chronic inflammation in uterine tissue and reducing fertility potential. Considering the pivotal role of mast cells in modulating immune and inflammatory responses, and the immunomodulatory effects of vitamin D on these cells, it can be concluded that vitamin D may serve as an effective regulator of mast cell activity and immune responses in various tissues, including the endometrium. These effects may support improved implantation processes and enhance overall reproductive success.

Further investigation into these mechanisms could open new way for the use of vitamin D in treating fertility disorders and conditions associated with inflammation and immune dysregulation.[29]

Conflict of Interest

The authors declare no conflicts of interest.

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