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Vitamin D Status and Reproductive Health in Obesity Women: A Review

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ABSTRACT

This review article aims to explain how vitamin D status and obesity relate to women's reproductive health. Every year, the prevalence of obesity rises, with women accounting for most cases. Women who are obese typically have poor vitamin D status. The sequestration of vitamin D by fat tissue, volumetric dilution, elevated metabolic basal, decreased synthesis of vitamin D in adipose tissue, and the lifestyle of obese people who typically avoid outdoor activities so that they receive little exposure to direct sunlight are all factors that contribute to the low status of vitamin D. Reproductive health will be affected to some extent by low vitamin D status, particularly during preconception and pregnancy. The processes underlying vitamin D deficiency's link to obesity and its effects on women's reproductive health require more study.

Keywords: Obesity; Vitamin D; Women's Reproductive Health

INTRODUCTION

The buildup of fat characterizes the condition of obesity and results from an imbalance between caloric intake and energy usage **(1)**. Over 1.9 billion persons aged 18 and older were overweight in 2016, with 13% (650 million) being obese **(2)**. Women have a higher global prevalence of obesity than males do. By 2030, it is predicted that up to 1 in 5 women will be obese **(3)**.

Vitamin D status is closely associated with obesity. A form of fat-soluble vitamin called vitamin D is obtained from food and can also be created by the body on its own with the help of sun exposure **(4)**. Obesity rates are correlated with low vitamin D status. Obese women with low vitamin D status will affect their reproductive health **(5)**. This article will discuss the connection between low vitamin D status and obesity and how low vitamin D affects obese women's reproductive health.

DISCUSSION

Obesity

Obesity is a disorder that develops when there is an imbalance between the amount of food consumed and the amount of energy expended **(1)**. The Body Mass Index (BMI) is the most popular and straightforward way to diagnose adult obesity. If a person's BMI is greater than 25 kg/m2, they are considered obese **(6)**. The WHO states that women's pre-pregnancy or early adulthood (18–25 years), pregnancy, and menopause are the critical periods for obesity in women **(7)**. Women with obesity will experience body metabolic and reproductive system disorders. Excessive energy intake, less physical activity, metabolic variables, hereditary factors, and psychological influences can all contribute to obesity **(6,8)**.

Vitamin D

Cholecalciferol and ergocalciferol are the two forms of vitamin D, a fat-soluble vitamin **(4)**. The Endocrine Society states that the normal range of vitamin D status is

between 30 and 100 ng/mL. Serum 25(OH)D values of less than 30 ng/mL indicate vitamin D deficiency **(9)**.

Both food intake and skin production of vitamin D are sources of this nutrient. With the help of sunshine exposure, 7-dehydrocholesterol transforms into pre-vitamin D in the skin. Additionally, the thermal isomerization of this pre-vitamin D will create vitamin D3 (cholecalciferol). Vitamin D passes through the bloodstream and is bound to Vitamin D Binding Protein after it is made in the skin and obtained from the diet. Additionally, vitamin D is converted in the liver to 25(OH)D, the primary form of vitamin D in circulation. 25(OH)D levels are used as a reference to estimate someone's vitamin D status. From a biological standpoint, 25(OH)D in the liver is an inert substance that is later transformed into the free form [1,25(OH)2D] in the kidneys and transported to various locations throughout the body to perform its tasks. Vitamin D's target tissues spread across multiple body tissues, including the reproductive organs **(4)**.

Vitamin D Status In Obesity

Those who are obese have a lower 25(OH)D status than those who are not. According to Khodabakhshi's research from 2022, there is a significantly different average serum 25(OH)D status between the obese group (26.7 14.5 ng/mL) and the group with normal nutritional status (29.5 16.3 ng/mL), with a p-value of 0.016 **(10)**. When comparing groups with obese and normal dietary status, Lorensia et al. found significant differences in serum 25(OH)D status, with a p-value of 0.0001 **(11)**. In contrast, a study by Maviş et al. in 2020 revealed that there was no significant difference with a p-value of 0.028 between the mean serum 25(OH)D status in the obese group (11.85 ng/mL) and the mean in the normal nutritional status group (10.86 ng/mL) **(12)**.

The increased frequency of serum 25(OH)D deficiency nowadays is increased due to obesity. Low serum 25(OH)D status is caused by several factors, including higher absorption of 25(OH)D into fat tissue, volumetric dilution, increased metabolic baseline, lower vitamin D production in the liver and adipose tissue, and the lifestyle of obese people, who often avoid being outside and get little sun exposure. Low serum 25(OH)D status is seen in the blood, and that is linked to decreased vitamin D bioavailability, which is another factor contributing to low serum 25(OH)D levels in obese people **(13)**.

Low serum 25(OH)D status occurs from obese people's inability to convert pre-vitamin D into vitamin D in their skin tissue, where extra fat tissue might sequester the fat-soluble vitamin (Figure 1). Furthermore, the abundance of fat tissue in obesity stimulates the infiltration of activated immune cells, which causes inflammation of the adipose tissue and vitamin D degradation, which lowers serum 25(OH)D status **(14)**.

In addition to inadequate vitamin D consumption and sun exposure, obese individuals also experience vitamin D status improvement that is less effective and efficient than it is in lean patients. Women of normal weight reach normal 25(OH)D3 status more quickly and with lower dosages than obese women, who need higher doses. The response to vitamin D supplementation relies on body weight, with obese people needing more significant amounts of vitamin D to reach appropriate vitamin D status than the general population **(5)**.

Effect Of Vitamin D Deficiency On Reproductive Health In Obese Women

The women’s reproductive health is impacted by vitamin D status (Figure 1). Early menarche is influenced by vitamin D status, with earlier menarche occurring in women who are vitamin D deficient **(15)**. Research by Villamor E et al. in 2011 states that girls with low vitamin D status menstruated earlier than girls with normal vitamin D status **(16)**. A different result from another study by Al-Taiar A et al. in

2022 showed no relation between vitamin D status and the age of menarche **(17).**

Vitamin D levels affect fertility in young adults or preconception women. Research in 2018 by Mumford et al. in the US found that women with preconception vitamin D levels of 75 ng/ml were more likely to have safe pregnancies than women with lower levels **(18)**. Normal vitamin D levels in the preconception period were related to a lower chance of miscarriage, according to Hewison's study from the same year **(19)**.

Vitamin D is implicated in female reproduction because it controls the expression of several genes in reproductive organs. It is presented that the endocrine, immune, and reproductive systems all include vitamin D receptors. Human ovarian granulosa cells contain vitamin D receptors both in their nucleus and cytoplasm, indicating that vitamin D is influential for the health of ovarian follicles. Subfertility, endometriosis, polycystic ovarian syndrome (PCOS), preeclampsia, early birth, gestational diabetes, and bacterial vaginosis infection are all linked to vitamin D deficiency **(14,15).**

In addition, pregnant and nursing women need more vitamin D than usual **(15)**. According to research conducted in 2018 by Aji AS, more than 85% of pregnant women had low vitamin D intake, and 61.25% had low vitamin D status **(20)**. Another study conducted in 2021 by Ghafarzadeh M indicated that 60.9% of moms and their newborns had vitamin D deficiency, whereas 89% of pregnant women and infants had low vitamin D status **(21).**

Vitamin D status regulates immune cells, and the female reproductive system contains vitamin D target areas. Fertility, embryo implantation, and pregnancy continuity are all significantly influenced by vitamin D. The results of pregnancy will be impacted by low vitamin status **(22)**. An appropriate maternal vitamin D intake also affects the unborn child's health for the rest of their life, affecting fertility and pregnancy issues. Since active vitamin D multiplies unimpeded by calcium, phosphate, or parathormones levels, pregnancy-related variations in vitamin D levels significantly counteract the shortage of vitamin D in developing embryos **(23)**.

Significant adjustments are made to vitamin D metabolism during pregnancy, increasing 1,25-dihydroxy vitamin D status in maternal serum. This happens because the enzyme 25-hydroxyvitamin D-1-hydroxylase (CYP27B1), which converts 25-hydroxy vitamin D to 1,25-dihydroxy vitamin D, is more active in the kidneys. In addition to increased CYP27B1 expression in the placenta and trophoblast, decidual tissue and placental villi also express vitamin D receptors for 1,25-dihydroxy vitamin D, which may suggest that vitamin D is involved in the remodeling of uteroplacental circulation and the process of decidualization **(24)**. Pregnancy-harming high blood pressure is also linked to vitamin D insufficiency throughout preconception and pregnancy **(25)**.

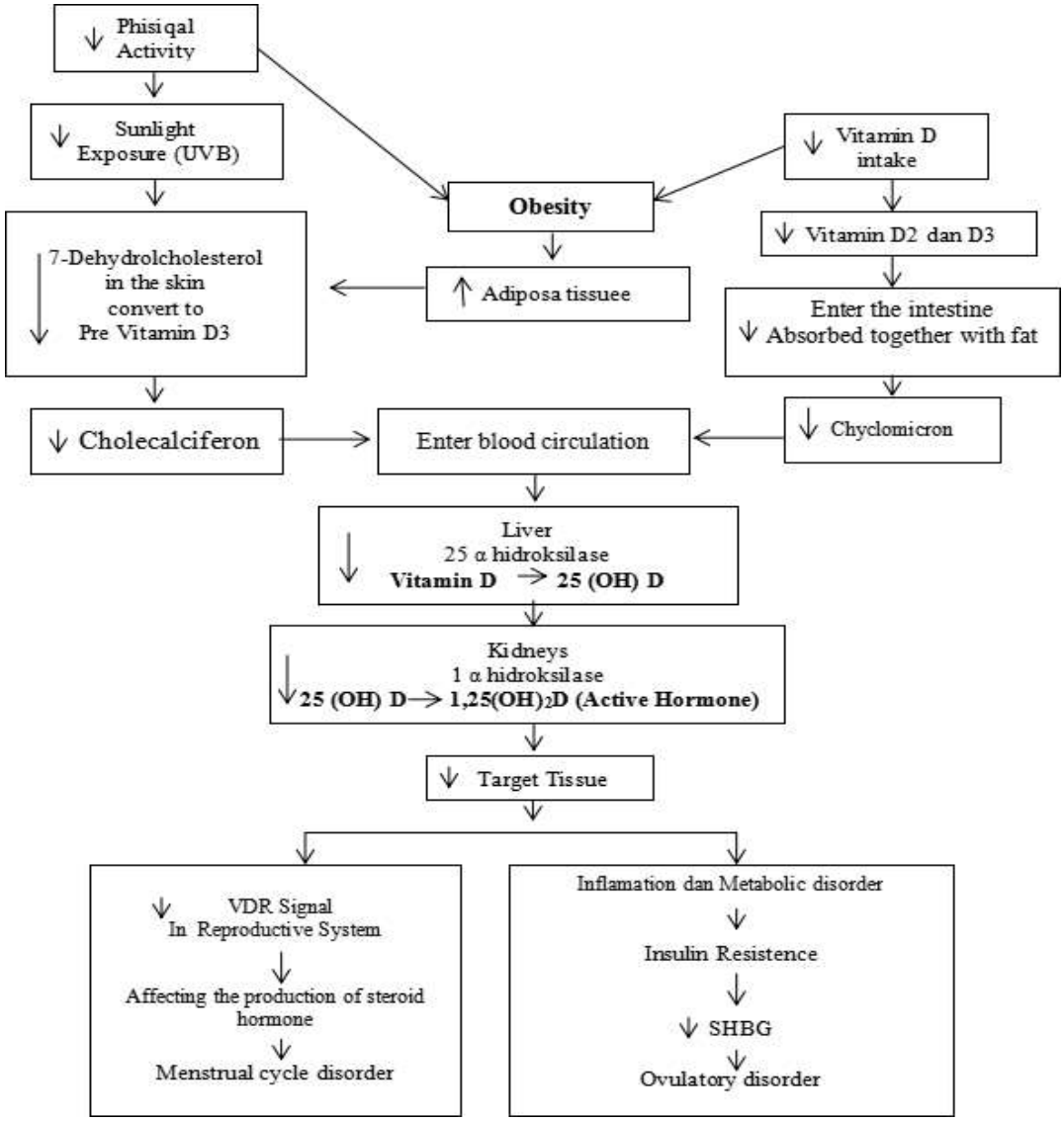

Figure 1 The Mechanism link between Vitamin D Status, Obesity, and Women's Reproductive Health

CONCLUSION

In this review, obesity, vitamin D status, and their connections to women's reproductive health are discussed. Obese people have vitamin D deficiency. Low vitamin D status in obesity is caused by several factors, including the absorption of vitamin D by fat tissue, an increase in metabolic basal, volumetric dilution, a decrease in vitamin D synthesis in adipose tissue and the liver, and an obese person's tendency to avoid outdoor activities and inadequate sun exposure. Obese women with low vitamin D status will experience problems conceiving and having children since their reproductive system will be effecting. The processes underlying the relationship between vitamin D status and obesity in Women's Reproductive Health require more study.

Declaration by Authors

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