

Optimizing Vitamin D During Pregnancy Benefits Children's Bone Health

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STORY AT-A-GLANCE

- › A recent study revealed that pregnant women taking 1,000 IU/day of vitamin D had children with significantly higher bone density at ages 4 and 6 to 7, suggesting long-lasting benefits for skeletal health
- › Optimal vitamin D levels during pregnancy reduce the risk of complications like preeclampsia and gestational diabetes, with supplementation lowering preeclampsia risk by approximately 50%
- › Women with adequate vitamin D levels show higher fertility rates and IVF success, while vitamin D also supports fetal immune system development and reduces respiratory infection risk
- › Research indicates proper vitamin D levels during pregnancy help prevent autism spectrum disorders, ADHD and schizophrenia by supporting neurological development processes
- › While sunlight is the best source of vitamin D, those consuming seed oils should limit sun exposure during peak hours for six months after elimination, as UV interaction with linoleic acid in your skin may trigger DNA damage

During pregnancy, ensuring optimal nutrition is key for the baby's health and development. Among the essential nutrients, vitamin D has garnered significant attention for its role in bone health. Conventionally recognized for its importance in

calcium regulation and skeletal development, vitamin D's influence extends beyond infancy into childhood and even adulthood.

A study published in *The American Journal of Clinical Nutrition* sheds light on how vitamin D supplementation during pregnancy has lasting benefits on children's bone mineral density (BMD) years after birth.¹

Vitamin D During Pregnancy Leads to Stronger Bones in Children

The Maternal Vitamin D Osteoporosis Study (MAVIDOS) was a trial of vitamin D supplementation during pregnancy. The study focused on pregnant women who were between 14 to 17 weeks gestation and had vitamin D levels ranging from 10 to 40 ng/mL (25 to 100 nmol/L). Participants were randomly assigned to receive either 1,000 IU/day of cholecalciferol (a form of vitamin D) or a placebo from early pregnancy until delivery.

The primary aim was to evaluate whether this supplementation could enhance the bone health of their offspring. Initially, the MAVIDOS trial revealed that children who were born to mothers who took vitamin D supplements had higher bone mineral density (BMD) at age 4 compared to those whose mothers received a placebo.²

A follow-up study extends these findings, examining the persistence of these benefits at ages 6 to 7. Even at that age, children whose mothers received vitamin D supplementation showed significantly higher BMD compared to those in the placebo group.

The study showed that children whose mothers took vitamin D supplements had slightly more minerals in their bones and denser bones compared to those who didn't receive the supplements. Additionally, these children also had stronger bones and more muscle mass, indicating better overall bone and muscle growth.

Moreover, the effects were similar across different bone regions, including the lumbar spine, although the impact was more pronounced in the whole-body measurements. Interestingly, these positive effects were consistent with the findings at age 4, indicating

that the benefits of vitamin D supplementation during pregnancy are not fleeting but persist into mid-childhood and perhaps beyond.

How Vitamin D During Pregnancy Boosts Children's Bone Health

The sustained improvement in bone health observed in the MAVIDOS study suggests that vitamin D plays a key role in skeletal development that extends beyond calcium absorption. One hypothesis is that adequate vitamin D levels during pregnancy facilitate better fetal bone development, setting a foundation for stronger bones as the child grows.

It could also have an indirect role on children's bone health by increasing vitamin D in breast milk. Additionally, higher maternal vitamin D levels might influence the epigenetic programming of the child's genes related to bone metabolism, leading to enhanced bone density.³

Comparing these findings with other studies, such as the Copenhagen Prospective Studies on Asthma in Childhood (COPSAC2010) trial, reinforces the evidence that gestational vitamin D supplementation has lasting positive effects on bone health.⁴ From a public health perspective, these findings advocate for optimizing vitamin D levels in standard prenatal care.

Given the low cost and safety profile of vitamin D supplements, enhancing current guidelines to recommend optimization could be a strategic move to improve bone health outcomes in children on a population level. This proactive approach could reduce the incidence of fractures and osteoporosis later in life, contributing to overall public health and reducing health care costs associated with bone-related ailments.

Vitamin D's Role in Reducing Pregnancy Complications

Maintaining optimal vitamin D levels during pregnancy is not just about supporting children's development; it also safeguards [women's health](#). Research reveals that

vitamin D deficiency increases the risk of several serious pregnancy complications, including preeclampsia, gestational diabetes, preterm birth and even cesarean delivery.⁵

Preeclampsia, a dangerous condition involving high blood pressure and damage to other organs, affects up to 15% of pregnancies. Studies show that pregnant women with vitamin D levels below 20 ng/mL are at a much higher risk. Supplementation, especially starting early in pregnancy, has been linked to a lower incidence of preeclampsia.

One review found that women who supplemented with vitamin D were about 50% less likely to develop the condition.⁶ Similarly, low vitamin D levels have been associated with gestational diabetes, a form of diabetes that develops during pregnancy and leads to complications such as larger babies and delivery issues.

Increasing vitamin D levels has been shown to improve glucose metabolism and reduce insulin resistance, lowering the likelihood of developing gestational diabetes. Even the mode of delivery may be affected by vitamin D. Women with lower levels are at a higher risk of cesarean sections, possibly due to weaker pelvic floor muscles and longer labor.⁷

Vitamin D and Fertility – Optimizing Conception

If you're planning to conceive, ensuring adequate vitamin D levels enhances your fertility and improves your chances of a healthy pregnancy. Vitamin D receptors are found in reproductive tissues, including your ovaries, uterus and endometrium, indicating its role in reproductive health.

For women, vitamin D promotes the production of sex hormones like estrogen and progesterone, which are essential for ovulation and maintaining a pregnancy. It also supports the health of your endometrial lining, creating an environment that's more receptive to implantation. Studies have shown that women with sufficient vitamin D levels are more likely to conceive naturally and have higher success rates with assisted reproductive techniques such as in vitro fertilization (IVF).

One study found that women undergoing fertility treatments who had vitamin D levels above 30 ng/mL had significantly higher pregnancy rates compared to those with

deficient levels.⁸

Additionally, vitamin D reduces inflammation in the reproductive system. This is helpful for conditions like endometriosis, which is a contributing factor to fertility. For men, vitamin D is equally important, as it supports healthy sperm production, motility and quality. Couples struggling to conceive benefit from assessing and optimizing both partners' vitamin D levels.

Strengthening Your Baby's Immune System with Vitamin D

Vitamin D is also a cornerstone of infants' immune system development. From the moment of conception, vitamin D helps regulate immune function, reducing the risk of infections and autoimmune conditions as the child grows.

Babies born to mothers with optimal vitamin D levels are less likely to experience respiratory infections like bronchiolitis and pneumonia, which are leading causes of hospitalization in infancy.⁹

This is because vitamin D boosts your baby's innate immunity, increasing the production of antimicrobial peptides that help fight off pathogens. Studies have found that newborns with vitamin D levels above 30 ng/mL have a lower risk of severe respiratory illnesses compared to those with lower levels.¹⁰

Vitamin D also plays a protective role against asthma. Research indicates that supplementing with vitamin D during pregnancy may lower your child's risk of developing asthma or recurrent wheezing by supporting healthy lung development. Additionally, adequate vitamin D levels during pregnancy have been linked to a lower risk of Type 1 diabetes and multiple sclerosis in later life.

Vitamin D's Role in Neurological Development and Autism Prevention

Evidence also suggests that vitamin D is involved in infants' brain development, reducing the risk of neurological conditions like autism spectrum disorders (ASD). Vitamin D supports neuronal growth, differentiation and synaptic function — processes involved in brain development during pregnancy.¹¹

Studies have shown that children born to mothers with low vitamin D levels are more likely to be diagnosed with ASD. Researchers believe that vitamin D's role in regulating brain chemicals and protecting against oxidative stress may explain its protective effect.

In one intervention study, women with a previous child diagnosed with autism supplemented with 5,000 IU of vitamin D3 daily during pregnancy. After birth, their babies received 1,000 IU daily for three years. Remarkably, only one child out of 19 developed autism, compared to the typical recurrence rate of 20%.¹²

Other research has demonstrated that maternal vitamin D deficiency during early pregnancy is particularly associated with a higher likelihood of ASD diagnoses in offspring.¹³

For example, children whose mothers had vitamin D levels below 10 ng/mL (25 nmol/L) in mid-pregnancy were significantly more likely to develop ASD. Moreover, studies that measured vitamin D levels at birth also found that neonates with lower vitamin D concentrations had a greater risk of ASD, underscoring the importance of maintaining optimal levels throughout pregnancy.¹⁴

Addressing ADHD Risk with Maternal Vitamin D Supplementation

Attention-deficit hyperactivity disorder (ADHD) has also been linked to maternal vitamin D levels during pregnancy. A systematic review found low vitamin D levels in mothers were associated with a higher incidence of ADHD diagnoses and symptoms in children. Another study specifically identified a connection between third-trimester vitamin D deficiency and increased odds of ADHD in children, highlighting an important window for intervention.¹⁵

Vitamin D's role in ADHD prevention may stem from its ability to regulate brain function during fetal development. It promotes neuronal growth and differentiation, processes that are essential for the development of attention and executive function skills. Children born to vitamin D-deficient mothers often exhibit more behavioral challenges, including hyperactivity and difficulty concentrating, which are hallmarks of ADHD.

The link between maternal vitamin D deficiency and schizophrenia in offspring is another area of growing interest. Schizophrenia is a complex psychiatric disorder often diagnosed in young adulthood, and its roots may begin as early as pregnancy.

Studies have shown that neonates with lower vitamin D levels at birth had a significantly higher risk of developing schizophrenia later in life.¹⁶ Maternal vitamin D levels appear to serve as a proxy for fetal brain health, as fetal vitamin D depends entirely on maternal stores.¹⁷

Beyond ASD, ADHD and schizophrenia, research suggests prenatal vitamin D deficiency influences other **psychiatric outcomes**, such as **depression**, anxiety,¹⁸ psychotic symptoms and behavioral issues. While the evidence for these conditions is less conclusive, the findings emphasize vitamin D's importance in brain health and development.

Sunlight Is Best for Optimizing Your Vitamin D Levels

While vitamin D supplements are widely available, nothing quite matches the effectiveness of natural sunlight for vitamin D production in your body. The benefits we typically associate with vitamin D actually stem from healthy sun exposure itself, with elevated vitamin D levels serving as a marker of this exposure.

However, one frequently overlooked aspect of sun exposure involves dietary seed oils, which are rich in the polyunsaturated fat **linoleic acid** (LA). When ultraviolet (UV) radiation interacts with LA in your skin, it triggers inflammatory responses and damage to DNA.

This interaction necessitates a more cautious approach to sun exposure for those who regularly consume seed oils, found widely in processed foods and fast-food meals. The recommended strategy is to limit sun exposure to earlier in the morning or later in the afternoon if you've been consuming these oils regularly. A safe approach is to wait four to six months after eliminating these oils from your diet before increasing sun exposure.

Keep in mind that your body's relationship with sunlight depends on several personal characteristics. Your skin pigmentation plays a crucial role, as melanin acts as a natural sunscreen. This means individuals with darker skin require longer sun exposure to generate the same vitamin D levels as those with lighter complexions.

Body composition also matters significantly. Since fat tissue stores fat-soluble compounds, including oxidized seed oils, people with higher body fat percentages should exercise additional caution. These stored oils extend the risk period even after dietary modifications.

Safe Sun Exposure Guidelines

A reliable method for determining appropriate sun exposure is a simple "sunburn test." Monitor your skin for any redness — staying below the threshold where your skin shows even slight pinkness indicates you're within safe exposure limits. You'll want to avoid sunburn, as it's a clear signal of damage.

As your body reduces its LA stores, your susceptibility to both sunburn and skin cancer decreases. However, for the first six months after eliminating seed oils, avoid direct sunlight during peak hours — two to three hours before and after solar noon.

While complete clearance of seed oils from tissue takes approximately two years, reaching the six-month milestone typically allows for safer sun exposure during peak hours.

Remember that during summer months (Daylight Saving Time), solar noon occurs at 1 p.m. rather than 12 p.m., making peak sunlight hours approximately 10 a.m. to 4 p.m. If

you plan to spend time in the sun before your body has adequately cleared stored seed oils, consider these protective strategies:

- Take 12 milligrams of **astaxanthin** daily to enhance your skin's UV resistance.
- Apply topical niacinamide (vitamin B3) cream before sun exposure to protect against UV-induced DNA damage.
- Take a baby **aspirin** 30 to 60 minutes before sun exposure to help prevent LA conversion to harmful oxidized linoleic acid metabolites (OXLAMs).
- Utilize **molecular hydrogen** supplements to combat oxidative stress.

Tips for Vitamin D Supplementation

When regular sun exposure isn't feasible, vitamin D supplementation is often necessary, especially during pregnancy. However, the conventional definition of vitamin D deficiency (below 20 ng/mL) is inadequate for optimal health. While sufficiency begins at approximately 40 ng/mL (100 nmol/L), optimal health benefits appear at levels between 60 to 80 ng/mL (150 to 200 nmol/L). To optimize your vitamin D levels:

1. Test your levels twice a year
2. Modify sun exposure or supplementation based on the results
3. Perform follow-up testing after three to four months
4. Continue regular monitoring to maintain optimal levels

Optimizing vitamin D levels during pregnancy represents a powerful, evidence-based strategy for safeguarding both maternal and child health. From strengthening children's bones and immune systems to supporting neurological development and reducing the risk of conditions like autism, ADHD and schizophrenia, adequate vitamin D levels play an impressive role in fetal development and long-term health outcomes.

While sunlight remains the optimal source of vitamin D – with important considerations around seed oil consumption and safe exposure times as mentioned – supplementation

offers a reliable alternative when needed, particularly during pregnancy.

By maintaining vitamin D levels in the optimal range of 60 to 80 ng/mL through regular testing and appropriate sun exposure or supplementation, mothers will provide their developing children with a strong foundation for lifelong health while protecting themselves from common pregnancy complications.

This simple yet profound nutritional strategy represents one of the most impactful steps expectant mothers can take to support their child's development from conception through childhood and beyond.

Sources and References

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