aypee.com, for detailed information on orthopedics books, visit our website www.ejaypee.com, for detailed information on orthopedics books

The Sunshine Deficit

VITAMIN D DEFICIENCY IN PREGNANCY AND OSTEOMALACIA



Editors
Smruti Sachin Kale
Nindiya Kapoor Mehra

Co-Editors
Deepali Mehra Jain
Amol Lunkad
Jyotsna Rani
Sachin Yashwant Kale
Shivam Mehra
Vishal Kumar
Pramod Bhor
Bharat Veer Manchanda
Arvind J Vatkar
Sachiti Sachin Kale

Foreword
Ajay Murdia

JAYPEE

CONTENTS

Section 1: Understanding Vitamin D and its Role in Pregnancy

1. The Sunshine Vitamin: A Deep Dive into Vitamin D **3**
Nindiya Kapoor Mehra, Shivam Mehra, Sachiti Sachin Kale, Sumedha Shinde

- Overview of Vitamin D Types (D2 vs. D3) *4*
- Sources: Sunlight, Food, and Supplements *5*
- How the Body Processes Vitamin D? *11*
- Clinical and Public Health Relevance of Vitamin D Metabolism *13*

2. Why Vitamin D Matters in Pregnancy? **16**
Nindiya Kapoor Mehra, Shivam Mehra, Sachiti Sachin Kale, Sumedha Shinde, Amol Lunkad

- Role of Vitamin D in Maternal Health: Bone Strength, Immunity, and Hormone Regulation *17*
- Impact of Vitamin D on Fetal Development: Bone Growth, Immune Function, and Brain Health *19*
- Consequences of Maternal Deficiency for the Baby *21*
- Role of Vitamin D in Pregnancy *24*

3. The Global Burden of Vitamin D Deficiency **30**
Vishal Kumar, Nindiya Kapoor Mehra, Sachin Yashwant Kale, Shivam Mehra, Sushant Sudhir Srivastava, Pramod Bhor

- Prevalence and Distribution *30*
- Prevalence Across Different Populations *31*
- Key Global Trends *32*
- Risk Factors for Vitamin D Deficiency: Lifestyle, Diet, Limited Sun Exposure, and Cultural Influences *33*
- Case Studies from High-risk Regions *36*

Section 2: Causes and Consequences of Deficiency

4. Silent Threat: Signs and Symptoms of Vitamin D Deficiency **41**
Swati, Jyotsna Rani, Nindiya Kapoor Mehra, Smruti Sachin Kale

- Fatigue, Muscle Weakness, and Bone Pain *41*
- Causes of Vitamin D Deficiency in Pregnancy *42*
- Effects on Pregnancy: Gestational Diabetes, Preeclampsia, and Preterm Birth *46*
- Role of Vitamin D in Pregnancy Health *47*
- Identifying Early Warning Signs *47*

5. Osteomalacia: The Adult Version of Rickets **49**
Sachin Yashwant Kale, Shivam Mehra, Kamal Mehra, Arvind J Vatkar, Sushant Sudhir Srivastava
- How is Osteomalacia Different from Osteoporosis? *49*
- Causes and Progression of Osteomalacia *50*
- How Pregnancy can Worsen Osteomalacia? *53*

6. When Bones Weaken: The Science behind Osteomalacia **55**
Sachin Yashwant Kale, Shivam Mehra, Vishal Kumar, Arvind J Vatkar, Sushant Sudhir Srivastava
- How Vitamin D Deficiency Leads to Soft Bones? *56*
- The Role of Calcium, Phosphorus, and Hormones *56*
- How Osteomalacia Affects Movement, Posture, and Daily Life? *57*

7. Osteomalacia in Pregnant Women: A Hidden Crisis **63**
Smruti Sachin Kale, Amol Lunkad, Nindiya Kapoor Mehra, Sachin Yashwant Kale, Shivam Mehra, Vishal Kumar, Arvind J Vatkar, Sushant Sudhir Srivastava
- Epidemiology *63*
- Pathophysiology *64*
- Diagnostic Protocol *64*
- Radiological Investigations *65*
- Why Pregnant Women are more Vulnerable? *65*
- Impact on Labor, Delivery, and Postnatal Recovery *67*
- Management *69*
- Case Studies of Women Who Suffered from Severe Deficiency *70*

8. Risk Factors for Vitamin D Deficiency and Osteomalacia **74**
Arvind J Vatkar, Shivam Mehra, Jyotsna Rani, Sachin Yashwant Kale, Sushant Sudhir Srivastava
- Limited Sun Exposure *74*
- Dietary Deficiencies *75*
- Medical Conditions Affecting Absorption or Metabolism *75*

Section 3: Prevention, Treatment, and Physical Rehabilitation

9. Screening and Diagnosis: Detecting Deficiency Early **83**
Nindiya Kapoor Mehra, Smruti Sachin Kale, Sachiti Sachin Kale, Deepali Mehra Jain, Aditi Pramod Bhor
- Role of Blood Tests and Biomarkers *83*
- When and How Often should Pregnant Women be Screened? *84*
- Diagnostic Challenges in Detecting Osteomalacia *85*
- Case Example: Missed Diagnosis *86*

10. Role of Diet and Nutrition **89**
Shivam Mehra, Nindiya Kapoor Mehra, Jyotsna Rani, Smruti Sachin Kale
- Vitamin D-rich Foods: Fatty Fish, Dairy, Eggs, and Fortified Products *89*
- Calcium, Phosphorus, and Magnesium: Their Role in Bone Health *91*
- Nutritional Interactions *92*
- Special Dietary Considerations for Vegetarians and Vegans *92*

11. The Power of the Sun: Safe Sunlight Exposure **97**
Arvind J Vatkar, Shivam Mehra, Kamal Mehra, Sachin Yashwant Kale, Sachiti Sachin Kale
- How Much Sun Exposure is Enough? *98*
- Best Times and Practices for Sun Safety *98*
- Addressing Concerns about Skin Cancer and Sunscreen Use *100*

12. Supplementation: How much is Enough? **104**
Bharat Veer Manchanda, Smruti Sachin Kale, Nindiya Kapoor Mehra, Sachiti Sachin Kale, Shivam Mehra, Sachin Yashwant Kale
- Recommended Daily Intake during Pregnancy *104*
- Choosing the Right Vitamin D Supplement: Tablets, Drops, or Injections? *106*
- Clinical Monitoring and Follow-up *106*
- Global Vitamin D Market Overview *107*

13. Treating Osteomalacia: Reversing the Damage **110**
Shivam Mehra, Vishal Kumar, Sushant Sudhir Srivastava, Sachin Yashwant Kale, Bharat Veer Manchanda
- Pathophysiology Review *110*
- Treatment Objectives *110*
- Correcting Vitamin D and Calcium Deficiencies *111*
- Physical Therapy and Lifestyle Adjustments *113*
- Can Osteomalacia be Completely Reversed? *114*

14. Role of Vitamin D in Infertility **116**
Deepali Mehra Jain, Amol Lunkad, Nindiya Kapoor Mehra, Smruti Sachin Kale
- Vitamin D3: Structure, Function, and Metabolism *116*
- Role in Female Fertility *118*
- Vitamin D and In Vitro Fertilization Outcome *120*
- Evidence from Clinical Studies *122*
- Vitamin D3 Supplementation in Infertility *122*
- Guidelines and Recommendations *123*

15. Physiotherapy Perspectives in Vitamin D Deficiency and Pregnancy-related Osteomalacia **125**
Anu Arora, Sagar Deshpande, Shradha Deshpande, Sachin Yashwant Kale, Saanvi Sachin Kale, Shivam Mehra, Siddhant Pramod Bhor
- Physiology of Vitamin D in Pregnancy *126*
- Clinical Manifestations of Vitamin D Deficiency *126*
- Therapeutic and Functional Rehabilitation *128*
- Goals for Management *128*

16. Yoga in Vitamin D Deficiency during Pregnancy: Impacts of Alternative Therapy on Bone Health **137**
Ajit Dabholkar, Sagar Deshpande, Shradha Deshpande, Sachin Yashwant Kale, Saanvi Sachin Kale, Shivam Mehra, Siddhant Pramod Bhor
- Benefits of *Yoga* in Pregnant Women *138*

Section 4: Future Directions and Public Health Approaches

17. Living with Osteomalacia: Coping Strategies and Support **159**
Shivam Mehra, Pramod Bhor, Sachin Yashwant Kale, Vishal Kumar

- Understanding Osteomalacia *159*
- Long-term Management Strategies *160*
- Coping with Chronic Pain and Mobility Challenges *162*
- Personal Testimonials from Osteomalacia Patients *163*

18. Addressing Deficiency on a Larger Scale **166**
Nindiya Kapoor Mehra, Sachiti Sachin Kale, Smruti Sachin Kale

- Public Health Policies and Fortification Programs *166*
- Education and Awareness Initiatives *168*
- Challenges and Considerations *169*

19. Future of Vitamin D Research **173**
Vishal Kumar, Arvind J Vatkar, Sachin Yashwant Kale, Shivam Mehra, Nindiya Kapoor Mehra, Sushant Sudhir Srivastava

- Emerging Research Areas *173*
- Emerging Studies on Vitamin D and Pregnancy Outcomes *174*
- Vitamin D and Immunological Tolerance in Pregnancy *174*
- Innovations in Supplementation and Fortification *175*
- The Role of Artificial Intelligence and Big Data in Research *175*
- Challenges and Gaps in Current Research *176*
- Future Directions *176*

20. Conclusion: Empowering Mothers for Stronger Bones and Healthier Babies **179**
Smruti Sachin Kale, Nindiya Kapoor Mehra, Sachiti Sachin Kale, Sachin Yashwant Kale

- Key Takeaways: Clinical and Public Health Imperative *179*
- Actionable Steps: Multilevel Approach to Maternal Bone Health *180*
- Case Vignettes *181*
- Supplementation Strategies *182*
- Policy and Public Health Recommendations *184*

Index **187**

CHAPTER 7

Osteomalacia in Pregnant Women: A Hidden Crisis

Smruti Sachin Kale, Amol Lunkad, Nindiya Kapoor Mehra, Sachin Yashwant Kale, Shivam Mehra, Vishal Kumar, Arvind J Vatkar, Sushant Sudhir Srivastava

JAYPEE BROTHERS

INTRODUCTION

Osteomalacia, the softening of bones due to impaired mineralization, is largely caused by vitamin D deficiency, especially in adults. While the global prevalence of vitamin D deficiency in the general population is concerning, it poses a specific and underrecognized threat to *pregnant women*, particularly in low- and middle-income countries (LMICs). Despite being preventable and treatable, osteomalacia in pregnancy is rarely screened for, resulting in serious complications for both mother and baby. Often mistaken for general fatigue or back pain, this oversight becomes dangerous in contexts where *prenatal nutrition is poor*, sunlight exposure is limited, and screening for micronutrient deficiencies is minimal.[1,2]

A 2020 meta-analysis found that *over 54% of pregnant women globally* have suboptimal vitamin D levels, and the figure is significantly higher in South Asian populations, where estimates range from *70 to 90% deficiency*.[3]

This chapter explores the etiopathogenesis, clinical features, diagnostic pathways, and management protocols for osteomalacia in pregnant women, aiming to raise awareness of this hidden crisis.

EPIDEMIOLOGY

Osteomalacia is prevalent in developing countries, especially in regions with:

- Limited sun exposure (cultural clothing practices, urban living)
- Dietary calcium and vitamin D deficiency
- High parity and frequent pregnancies depleting maternal reserves

Prevalence estimates:

- Up to 60% of pregnant women in South Asia have subclinical vitamin D deficiency.[4,5]
- Clinical osteomalacia is rare but increasing with modern lifestyle-induced hypovitaminosis D.[1]

PATHOPHYSIOLOGY

Calcium and Phosphate Metabolism in Pregnancy

- Pregnancy increases the maternal demand for calcium and phosphate, essential for fetal skeletal development.
- Vitamin D deficiency leads to:
  - Impaired calcium absorption from the gut
  - Secondary hyperparathyroidism → increased bone resorption
  - Osteoid accumulation without mineralization[6,7]

Hormonal Changes

- Elevated parathyroid hormone (PTH) levels attempt to compensate for hypocalcemia.
- Estrogen and human placental lactogen modulate calcium transfer but cannot offset severe deficiencies.[6,7]

The clinical features of osteomalacia typically encompass a combination of *symptoms and physical signs* that reflect impaired bone mineralization and muscle weakness. Patients often report *diffuse bone pain* affecting the pelvis, ribs, or spine, along with *fatigue and generalized weakness*. Functionally, *proximal muscle weakness* leads to difficulty walking, a waddling gait, and problems rising from a chair. On examination, *tenderness over long bones*, spinal deformities such as *kyphosis or lordosis*, and *decreased muscle tone* are frequently observed. Together, these manifestations provide important clinical clues for early recognition of osteomalacia **(Table 1)**.

Complications

- Pelvic deformities → obstructed labor[8]
- Fractures (e.g., femoral neck and pubic rami)[9]
- Poor fetal growth due to impaired calcium transfer[10]

DIAGNOSTIC PROTOCOL

Biochemical investigations play a central role in confirming the diagnosis of osteomalacia and differentiating it from other metabolic bone disorders. Characteristically, patients demonstrate *low or normal serum calcium, reduced phosphate, and elevated alkaline phosphatase (ALP)*, reflecting defective bone

TABLE 1: Clinical features.

Symptoms	Signs
Diffuse bone pain (pelvis, ribs, and back)	Waddling gait
Proximal muscle weakness	Tenderness over long bones
Fatigue and general weakness	Kyphosis or lordosis
Difficulty walking or rising from chair	Decreased muscle tone

JAYPEE BROTHERS

TABLE 2: Biochemical investigations.	
Test	**Findings in osteomalacia**
Serum calcium	Normal or low
Serum phosphate	Low
Serum ALP	Elevated
Serum 25(OH)D	Low (<20 ng/mL)
Serum PTH	Elevated
Serum creatinine	Normal (rule out CKD)
Urinary calcium and phosphate	Low

(ALP: alkaline phosphatase; CKD: chronic kidney disease; PTH: parathyroid hormone)

mineralization. A hallmark finding is *low serum 25(OH)D (<20 ng/mL)*, often accompanied by *secondary hyperparathyroidism*, indicated by elevated PTH levels. *Normal serum creatinine* helps exclude chronic kidney disease as an alternative cause, while *low urinary calcium and phosphate* further support the diagnosis. Together, these laboratory markers provide a biochemical signature that, when correlated with clinical and radiological findings, confirms osteomalacia **(Table 2)**.[1,2,11]

RADIOLOGICAL INVESTIGATIONS

- *X-rays*:[9]
  - Looser's zones (pseudofractures)
  - Osteopenia
  - Bone deformities
- *Dual-energy X-ray absorptiometry (DEXA) scan*:
  - Often avoided in pregnancy due to radiation
  - Useful postpartum to assess bone mass
- *MRI (if needed)*: May show bone marrow edema or stress fractures without radiation exposure.

Diagnosing osteomalacia in pregnancy begins with *clinical suspicion* in women presenting with bone pain, weakness, or fatigue, especially with known vitamin D risk factors. *Biochemical testing* [calcium, phosphate, ALP, PTH, and 25(OH)D)] is the cornerstone, with *25(OH)D < 20 ng/mL* strongly suggestive. Empirical treatment should be started promptly, while radiological imaging is avoided in early pregnancy. Further evaluation rules out other causes, and orthopedic input is sought if deformities or fractures are present. *Fetal monitoring* and postpartum DEXA ensure comprehensive care **(Table 3)**.

WHY PREGNANT WOMEN ARE MORE VULNERABLE?

Pregnancy is a biologically demanding process. The maternal body adapts by increasing its absorption and mobilization of calcium and phosphorus to

JAYPEE BROTHERS

TABLE 3: Diagnostic table for osteomalacia in pregnant women.	
Step	**Description**
A	Pregnant woman with bone pain, fatigue, and weakness
B	Clinical evaluation and detailed history
C	Vitamin D risk factors? (limited sun, diet, and high parity)
D	Order blood tests: Calcium, phosphate, ALP, PTH, and 25(OH)D
E	25(OH)D < 20 ng/mL?
F	Suspect osteomalacia + treat empirically + avoid X-rays if early pregnancy
G	Evaluate for other metabolic or endocrine causes
H	Orthopedic consult if deformity or fractures present
I	Monitor fetal growth, consider early DEXA postpartum

(ALP: alkaline phosphatase; DEXA: dual-energy X-ray absorptiometry; PTH: parathyroid hormone)

support the fetal skeleton, especially in the *third trimester*, when up to 30 g of calcium is transferred to the fetus.

When vitamin D, which regulates calcium and phosphate metabolism, is deficient, the maternal body cannot compensate adequately. As a result, calcium is leached from bones, leading to softening, microfractures, and deformities.

Key reasons why pregnant women are more vulnerable to osteomalacia include:

- *Heightened physiological demands*: The calcium and phosphate needs of the developing fetus are prioritized by the body, even at the mother's expense. If dietary intake and vitamin D levels are insufficient, maternal bone mineral density begins to decline.[7,11]
- *Low sunlight exposure*: In many parts of the world, cultural practices such as purdah, hijab, or covering most of the body for religious or social reasons significantly limit exposure to sunlight, which is essential for vitamin D synthesis. Urban lifestyles, indoor occupations, and environmental pollution further reduce ultraviolet B (UVB) penetration.[1,4,5]
- *Poor dietary intake*: Diets low in dairy, eggs, fatty fish, and fortified foods are common among women of reproductive age, especially in lower socioeconomic groups. Vegetarian diets, though healthy in many respects, often lack adequate vitamin D and bioavailable calcium unless supplemented.[4,5]
- *Short interpregnancy intervals*: Many women in LMICs become pregnant again before their bodies have replenished the micronutrients lost during the previous pregnancy and lactation. This sets up a vicious cycle of worsening deficiencies.[1]
- *Darker skin tones*: Melanin acts as a natural sunscreen, which means individuals with darker skin require longer sun exposure to produce adequate vitamin D. This increases the risk of deficiency in women of South Asian, African, and Middle Eastern descent.[3,4]
- *Limited awareness and screening*: Unlike anemia or diabetes, osteomalacia is not routinely screened for pregnancy, even in high-risk populations.

JAYPEE BROTHERS

TABLE 4: Factors contributing to osteomalacia in pregnancy.

Risk factor	Mechanism	Impact
Increased fetal calcium demand	25–30 g calcium transferred in third trimester	Mobilization of maternal bone stores
Low sunlight exposure	Reduces skin synthesis of vitamin D3	Hypovitaminosis D
Poor dietary intake	Inadequate calcium and vitamin D	Fails to meet gestational needs
Dark skin tone	Higher melanin reduces UVB penetration	Less vitamin D production
Short birth intervals	No time to restore nutrient levels	Progressive depletion
Cultural clothing practices	Minimal skin exposure	Decreased cutaneous vitamin D synthesis

Musculoskeletal pain is often dismissed as a normal part of pregnancy, leading to underdiagnosis.[2,3]

Table 4 further lists the risk factors contributing to osteomalacia, its mechanism, and impact.

Supporting Data

- A study in North India found that *88% of pregnant women* were vitamin D deficient (<20 ng/mL), with *37% severely deficient* (<10 ng/mL).[4]
- A cross-sectional study in Riyadh found *83.6% deficiency* among pregnant women.[5]

IMPACT ON LABOR, DELIVERY, AND POSTNATAL RECOVERY

Osteomalacia's clinical impact during pregnancy is wide-ranging. The skeletal, muscular, and endocrine changes can significantly compromise both *maternal health* and *fetal outcomes*.

Obstructed Labor and Pelvic Deformities

Softening of pelvic bones due to demineralization can lead to *flattened pelvic inlet* and *cephalopelvic disproportion (CPD)*. This increases the risk of *prolonged or obstructed labor* and often necessitates *cesarean section*.

A retrospective study in Pakistan found that *12.4% of cesareans* were due to osteomalacia-related CPD.[8]

Muscle Weakness and Chronic Pain

Symptoms such as proximal myopathy, fatigue, and bone pain are often underreported or misdiagnosed. These impair daily function and reduce quality of life during and after pregnancy.[6,10]

JAYPEE BROTHERS

Fractures and Structural Deformities

A case series from Turkey reported *pubic rami fractures and rib fractures* during labor in women with undiagnosed osteomalacia.[9]

Delayed Postpartum Recovery

Women with osteomalacia may remain weak, bedbound, or dependent long after delivery. This affects *maternal–infant bonding*, increases the burden on families, and contributes to *postnatal depression*.[10]

Adverse Neonatal Outcomes

Neonates of deficient mothers are at risk for:

- Neonatal hypocalcemia
- Low birth weight
- Delayed skeletal development
- Infantile rickets

A study from Delhi found that infants born to vitamin D-deficient mothers had a *27% incidence of neonatal hypocalcemia* within 48 hours of birth.[10]

Maternal osteomalacia can have significant repercussions for both mother and child, with a spectrum of musculoskeletal and obstetric complications. *Pelvic deformities and CPD* occur in up to one-quarter of severe cases, often necessitating emergency cesarean delivery or resulting in prolonged labor. *Muscle weakness and bone pain*, seen in the majority of affected women, are frequently overlooked as normal pregnancy-related discomforts, delaying diagnosis. In advanced cases, *fractures* may complicate recovery and require surgical management. Furthermore, maternal deficiency can extend to the neonate, with *hypocalcemia leading to seizures and impaired bone health*. These clinical consequences underscore the importance of early screening and management to prevent adverse outcomes **(Table 5)**.

During pregnancy, vitamin D is crucial not only for maternal bone health but also for optimal *fetal skeletal growth and mineralization*. Adequate levels help maintain calcium and phosphate balance, reducing the risk of *osteomalacia, fractures, and pelvic deformities* in the mother. At the same time, deficiency

TABLE 5: Clinical consequences of maternal osteomalacia.

Manifestation	Frequency (Estimated)	Implication
Pelvic deformity/CPD	20–25% in severe cases	Emergency C-section, prolonged labor
Muscle weakness	Up to 80%	Reduced mobility, falls
Bone pain	75%	Misdiagnosed as pregnancy discomfort
Fractures	10–15%	Prolonged recovery, surgical intervention
Neonatal hypocalcemia	5–10%	Seizures, poor bone health

(CPD: cephalopelvic disproportion)

JAYPEE BROTHERS

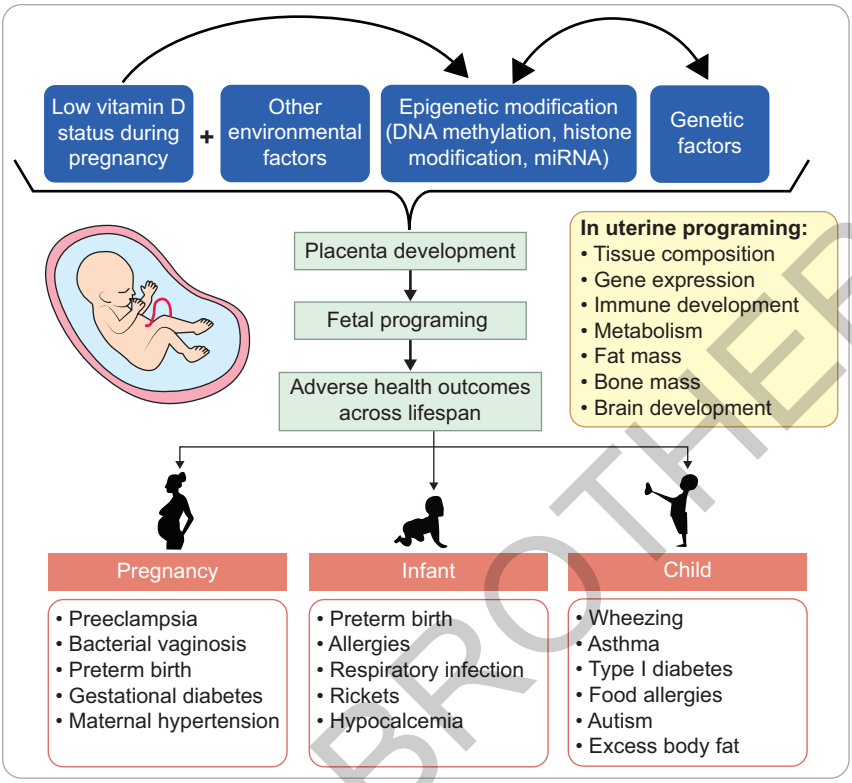

FIG. 1: Vitamin D's role in health and disease.

(miRNA: microribonucleic acid)

Source: Lockau L, Atkinson SA. Vitamin D's role in health and disease: How does the present inform our understanding of the past? Int J Paleopathol. 2018;23:6-14.

has been associated with *gestational diabetes, preeclampsia, and increased risk of cesarean delivery*. For the fetus, insufficient maternal vitamin D can contribute to *low birth weight, neonatal hypocalcemia, impaired bone development, and higher susceptibility to rickets* later in life. Thus, vitamin D functions as a vital determinant of both *maternal well-being and neonatal outcomes* in pregnancy **(Fig. 1)**.

MANAGEMENT

Medical Management[2,11]

- *Vitamin D supplementation*:
  - *Cholecalciferol (D3)*: 60,000 IU/week for 6–8 weeks, followed by maintenance (800–2,000 IU/day)
  - Safe in all trimesters
- *Calcium supplementation*:
  - *Calcium carbonate/citrate*: 1,000–1,500 mg/day (elemental)
  - Ideally split doses for absorption

JAYPEE BROTHERS

TABLE 6: Prevention strategy.	
Measure	**Details**
Antenatal screening	Vitamin D levels in high-risk women
Diet counseling	Promote calcium-rich diet
Fortified foods	Encourage fortified milk, cereals
Public health	Vitamin D fortification in prenatal supplements
Education	Awareness campaigns among pregnant women and healthcare workers

- *Phosphate supplementation*: Rarely needed unless specific phosphate wasting disorder.
- *Sunlight exposure*: Encourage 30 min/day exposure to sunlight (arms and legs uncovered).
- *Obstetric considerations*:
  - Monitor fetal bone growth via ultrasound.
  - Check fetal calcium levels if maternal osteomalacia is severe.
  - Preventive screening in high-risk pregnancies is crucial.[2]
- *Postpartum care*:
  - Continue supplementation for at least 6 months postpartum
  - Counsel on:
    - Diet (milk, dairy, and leafy greens)
    - Spacing of pregnancies
    - Long-term bone health

Preventing maternal osteomalacia requires a multifaceted approach that combines *clinical, dietary, and public health measures*. Antenatal screening for vitamin D deficiency in high-risk women enables early intervention, while *dietary counseling* encourages calcium-rich food choices. The use of *fortified foods and prenatal supplements* provides a practical means of improving vitamin D intake at a population level. In addition, *awareness campaigns* targeting pregnant women and healthcare workers are essential to improve compliance and promote preventive practices **(Table 6)**.

CASE STUDIES OF WOMEN WHO SUFFERED FROM SEVERE DEFICIENCY

Case Example 1: A 28-year-old Pregnant Woman at 30 Weeks' Gestation

- *Complaint*: Severe back pain and difficulty walking
- *History*: Third pregnancy, minimal sun exposure, and vegetarian diet
- *Findings*:
  - Serum 25(OH)D: 6 ng/mL
  - ALP: Elevated
  - Phosphate: Low
  - MRI: Looser's zones in pelvis

JAYPEE BROTHERS

- *Management*:
  - Started on high-dose cholecalciferol and calcium
  - Weekly follow-up
  - Cesarean delivery due to deformed pelvis
  - Baby born healthy
  - DEXA postpartum confirmed low bone mineral density (BMD); continued treatment and follow-up

Case Example 2: Subclinical Osteomalacia in Early Pregnancy

Patient: Mrs R, a 25-year-old primigravida

- *Gestation*: 12 weeks
- *Presenting symptoms*: Fatigue, mild low backache
- *Diet*: Strict vegetarian, no dairy
- *Sun exposure*: Minimal, due to indoor work
- *Investigations*:
  - Serum 25(OH)D: 11 ng/mL
  - Calcium: 8.3 mg/dL
  - Phosphate: 2.1 mg/dL
  - ALP: Slightly elevated (145 IU/L)
  - PTH: Elevated (88 pg/mL)
- *Management*:
  - Started on cholecalciferol 60,000 IU weekly × 8 weeks:
    - Oral calcium carbonate 500 mg BID
    - Lifestyle counseling on sun exposure
    - Follow-up at 4 and 8 weeks showed symptom resolution and normalized laboratories
- *Outcome*: Healthy vaginal delivery at 39 weeks; no complications

Case Example 3: Classic Osteomalacia with Pelvic Deformity

- *Patient*: Mrs K, 32 years old, G4P3L3
- *Gestation*: 28 weeks
- *Presenting symptoms*: Severe bilateral hip pain, waddling gait, and unable to stand unassisted
- *History*: Frequent pregnancies, no supplementation
- *Investigations*:
  - Serum 25(OH)D: 7 ng/mL
  - Calcium: 7.9 mg/dL
  - ALP: 320 IU/L
  - Phosphate: 1.9 mg/dL
  - MRI: Bilateral Looser's zones in ischiopubic rami
- *Management*:
  - Vitamin D loading dose regimen (60,000 IU weekly)
  - Calcium 1 g/day in divided doses
  - Advised bed rest and physiotherapy
  - Orthopedic consultation: Conservative management with pelvic support belt

JAYPEE BROTHERS

- *Outcome*:
  - Cesarean section at 38 weeks due to pelvic deformity. Continued supplementation postpartum
  - Postpartum DEXA: T-score –2.7 → Confirmed osteomalacia. Continued treatment for 6 months

Case Example 4: Osteomalacia with Fragility Fracture

- *Patient*: Mrs A, 29 years old, second pregnancy
- *Gestation*: 22 weeks
- *Presenting symptoms*: Sudden onset of left thigh pain after walking a few steps
- *History*: Uncontrolled hypothyroidism, dark skin, and no prenatal supplements
- *Investigations*:
  - X-ray: Transverse femoral neck fracture
  - Serum 25(OH)D: 4 ng/mL
  - ALP: 480 IU/L
  - PTH: 150 pg/mL
  - Calcium: 7.5 mg/dL
- *Management*:
  - Emergency orthopedic fixation of femoral neck using pregnancy–safe anesthesia
  - Vitamin D3, 60,000 IU weekly × 12 weeks + daily calcium
  - High-protein diet and monitored physiotherapy
  - Endocrine follow-up for thyroid management
- *Outcome*:
  - Preterm cesarean at 36 weeks due to fetal distress, the baby did well.
  - Mother continued recovery and ambulation with the walker. Bone markers normalized postpartum.

REFERENCES

1. Holick MF. Vitamin D deficiency. N Engl J Med. 2007;357(3):266-81.
2. Lips P, Cashman KD, Lamberg-Allardt C, et al. Management of vitamin D deficiency in pregnant women. Osteoporos Int. 2019;30(9):1631-8.
3. Mithal A, Wahl DA, Bonjour JP, Burckhardt P, Dawson-Hughes B, Eisman JA, et al. Global vitamin D status and determinants of hypovitaminosis D. Osteoporos Int. 2009;20(11):1807-20.
4. Sachan A, Gupta R, Das V, Agarwal A, Awasthi PK, Bhatia V. High prevalence of vitamin D deficiency among pregnant women and their newborns in northern India. BJOG. 2005;112(6):738-41.
5. Al-Faris NA, AlKehayez NM, AlMushawah FI, AlNaeem AN, AlAmri ND, AlMudawah ES, et al. Vitamin D deficiency and associated risk factors in women from Riyadh, Saudi Arabia. Sci Rep. 2019;9(1):20371.
6. Specker B. Vitamin D requirements during pregnancy. Am J Clin Nutr. 2004;80(6):1740S-1747S.
7. Javaid MK, Crozier SR, Harvey NC, Gale CR, Dennison EM, Boucher BJ, et al. Maternal vitamin D status during pregnancy and childhood bone mass at age 9 years: a longitudinal study. Lancet. 2006;367(9504):36-43.
8. Khan MR, Ahmed S, Anwar M. Osteomalacia in pregnancy—A cause of obstructed labor. J Ayub Med Coll Abbottabad. 2002;14(4):32-4.

JAYPEE BROTHERS

9. Akhtar T, Siraj M, Iqbal S, Hussain S. Pathological fractures due to osteomalacia in pregnancy. Eur J Obstet Gynecol Reprod Biol. 2010;149(2):225-9.
10. Harinarayan CV, Akhila H, Shanthisree A. Maternal vitamin D status and neonatal hypocalcemia. Indian J Med Res. 2012;135(2):1630-9.
11. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, et al. Evaluation, treatment, and prevention of vitamin D deficiency: An Endocrine Society clinical practice guideline. J Clin Endocrinol Metabol. 2011;96(7):1911-30.

JAYPEE BROTHERS

for detailed information on orthopedics books, visit our website www.ejaypee.com, for detailed information on orthopedics books, visit our we

The Sunshine Deficit: VITAMIN D DEFICIENCY IN PREGNANCY AND OSTEOMALACIA

Salient Features

- *Comprehensive coverage:* Explores the full spectrum of vitamin D deficiency in pregnancy and osteomalacia, from basic physiology to clinical practice, rehabilitation, and public health
- *Multidisciplinary perspective:* Contributions from experts in orthopedics, obstetrics, endocrinology, nutrition, physiotherapy, and public health, ensuring a holistic approach
- *Evidence-based content:* Integrates current research findings, international guidelines, and clinical best practices with illustrative case studies and patient experiences
- *Focused clinical relevance:* Emphasizes practical aspects such as diagnosis, screening protocols, supplementation strategies, physiotherapy, and safe sunlight exposure during pregnancy
- *Special emphasis on osteomalacia:* Detailed discussion of pathophysiology, clinical manifestations, pregnancy-specific implications, and rehabilitation strategies for this often-overlooked condition
- *Innovative topics:* Inclusion of chapters on yoga, physiotherapy, and the role of vitamin D in infertility, broadening the scope beyond conventional management
- *Public health orientation:* Highlights the importance of awareness campaigns, food fortification, and policy interventions to address vitamin D deficiency on a population level
- *Future-oriented outlook:* Dedicated section on emerging research, novel supplementation approaches, and potential innovations in prevention and treatment
- *Structured and reader-friendly format:* Clear division into four sections:
  1. Understanding Vitamin D and Its Role in Pregnancy
  2. Causes and Consequences of Deficiency
  3. Prevention, Treatment, and Physical Rehabilitation
  4. Future Directions and Public Health Approaches
- *Target audience:* Designed as a reference for postgraduate students, residents, clinicians, and allied health professionals, while also serving as an educational resource for policymakers and public health specialists

Smruti Sachin Kale is a distinguished Obstetrician and Gynecologist based in Navi Mumbai, Maharashtra. She is the Founder and Director of Sachi Hospital, Airoli, Navi Mumbai, Maharashtra, India where she offers expert care in women's health. With a passion for advancing medical knowledge, Dr Kale has contributed academically as the Co-editor of two medical books published by Jaypee Brothers Medical Publishers—"*Comprehensive Guide for Femoral Neck System*" and "*Gout: The Indian Scenario*". Her dedication to clinical excellence and academic contribution marks her as a respected name in the field of obstetrics and gynecology in India.

Nindiya Kapoor Mehra combines a strong scientific background with a passion for healthcare and writing. An alumna of IIT Kanpur and Thapar University, she has also completed Hospital Management from IIM Ahmedabad. She has worked with leading research organizations including Serum Institute of India, Biocon Bristol Myers Squibb Research Centre, and Intas Pharmaceuticals. Her publications and books on orthopedics, osteoarthritis, and gout reflect her dedication to advancing knowledge and improving patient care. As a passionate writer and researcher, she has been a Co-Editor in books, *"A Practical Guidebook in Femoral Neck Fixation System"* and *"Gout: The Indian Scenario"* published by Jaypee Brothers Medical Publishers. She currently oversees management at Mehra Hospital and Research Institute, Lucknow, Uttar Pradesh, India, combining her scientific expertise with healthcare leadership. In this volume, she contributes as both author and editor.

Shelving Recommendation
ORTHOPEDICS

ISBN 978-93-7202-913-0

Buy from ejaypee

JAYPEE BROTHERS