

## MUSCULOSKELETAL MANIFESTATIONS OF PEDIATRIC SCURVY IN PATIENTS WITH RESTRICTED DIETS : CASE SERIES

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### ABSTRAK

Kekurangan vitamin C (skurvi) merupakan kondisi yang jarang namun semakin sering ditemukan pada anak-anak dengan pola makan yang sangat selektif. Gejala awal meliputi kelelahan, perdarahan gusi, dan mudah memar. Pada tahap lanjut, gejala muskuloskeletal seperti pembengkakan anggota tubuh, nyeri, dan pseudoparalisis dapat menyerupai kondisi serius seperti osteomielitis atau keganasan sehingga diagnosis menjadi sulit. Kami melaporkan dua kasus pediatrik, yang pertama adalah seorang anak perempuan berusia 4 tahun 7 bulan dengan pembengkakan anggota tubuh bagian bawah yang progresif selama tiga bulan, kontraktur sendi, perdarahan gusi, anemia, dan penolakan berjalan. Kasus kedua adalah anak laki-laki berusia 5 tahun 2 bulan dengan demam berkepanjangan, pembengkakan kaki, ulkus mulut, dan pembatasan diet yang parah. Kedua anak sama-sama tidak mengonsumsi buah dan sayur. Pemeriksaan fisik menunjukkan keadaan malnutrisi, pseudoparalisis, dan gusi hiperemik yang rapuh. Temuan radiologi menunjukkan osteopenia, garis metafise yang padat (garis Frankel), fraktur sudut metafise, dan pergeseran epifise posterior. Tes kadar asam askorbat plasma tidak tersedia. Terapi vitamin C empiris memberikan perbaikan klinis yang cepat, termasuk hilangnya perdarahan, reversi pseudoparalisis, dan kemampuan berjalan kembali dalam dua minggu. Skurvi pediatrik harus dipertimbangkan pada anak dengan anemia tidak jelas, nyeri muskuloskeletal, dan tanda perdarahan, terutama jika riwayat diet menunjukkan pembatasan yang lama. Pengakuan dini dan suplementasi vitamin C dapat menghasilkan pemulihan penuh serta mencegah tindakan invasif.

**Kata kunci** : defisiensi vitamin C, laporan kasus, pola makan pseudoparalisis, selektif, skurvi, radiologi pediatrik

### ABSTRACT

*Vitamin C deficiency (scurvy) is an uncommon but increasingly recognized condition among children with highly selective diets. Early manifestations include fatigue, gingival bleeding, and ecchymosis. In later stages, musculoskeletal symptoms such as limb swelling, pain, and pseudoparalysis may mimic serious conditions like osteomyelitis or malignancy, complicating diagnosis. We report two pediatric cases. The first involved a 4-year-7-month-old girl with three months of progressive lower limb swelling, joint contracture, gingival bleeding, anemia, and refusal to walk. The second case involved a 5-year-2-month-old boy with prolonged fever, leg swelling, oral ulcers, and severe dietary restriction. Both children had complete absence of fruit and vegetable intake. Physical examination revealed undernutrition, pseudoparalysis, and hyperemic friable gums. Radiologic findings showed osteopenia, dense metaphyseal lines (Frankel lines), metaphyseal corner fractures, and posterior epiphyseal displacement. Plasma ascorbic acid testing was unavailable. Empirical vitamin C therapy led to rapid clinical improvement, including resolution of bleeding, reversal of pseudoparalysis, and return to full ambulation within two weeks. Pediatric scurvy should be considered in children presenting with unexplained anemia, musculoskeletal pain, and bleeding signs, especially when dietary history reveals prolonged restriction. Prompt recognition and supplementation can lead to full recovery and prevent invasive procedures.*

**Keywords** : scurvy, vitamin C deficiency, pseudoparalysis, pediatric radiology, selective eating, case report

## INTRODUCTION

Vitamin C deficiency, also known as scurvy, remains a relevant clinical problem under specific dietary and socioeconomic circumstances. Although commonly perceived as an eradicated disease, multiple case series and clinical reports demonstrate that scurvy persists in populations with limited nutritional diversity. This deficiency impairs multiple physiological processes, primarily collagen synthesis, endothelial integrity, and osteoid matrix formation, which collectively contribute to the emergence of bleeding, impaired bone mineralization, and delayed healing (Gandhi et al., 2023; Krečak et al., 2022). Clinical manifestations often mimic more prevalent diagnoses. In pediatric patients, symptoms such as joint pain, progressive limb swelling, refusal to ambulate, or spontaneous bruising frequently lead to initial suspicion of malignancy, osteomyelitis, or inflammatory disorders. Diagnostic delays remain frequent, particularly when dietary history is overlooked or underestimated by clinicians (Pan et al., 2021; Iamopas et al., 2022). Radiographic features such as metaphyseal lines, osteopenia, and subperiosteal hematomas reinforce the diagnosis, though laboratory assessment of plasma vitamin C is not always accessible (Du & Kulkarni, 2024; Thiemann et al., 2022).

Several pediatric cases have shown rapid and complete recovery following the administration of oral vitamin C, which strongly supports the clinical diagnosis. A prompt therapeutic response reinforces the importance of recognizing early signs and correlating them with poor intake of fresh fruits or vegetables (Robin et al., 2023; Miraj et al., 2023). The following report presents two pediatric cases of severe vitamin C deficiency. Both patients exhibited progressive musculoskeletal symptoms and constitutional complaints that led to initial misdiagnoses. The objective of this report is to emphasize the diagnostic importance of dietary assessment in children presenting with unexplained limb pain, systemic symptoms, and delayed functional recovery. Vitamin C deficiency, or scurvy, continues to be a diagnostic challenge in clinical practice, especially in pediatric populations where selective eating behaviors are common. Children with neurodevelopmental disorders, autism spectrum disorder, or sensory processing issues are particularly vulnerable due to restrictive diets lacking in fruits and vegetables (Weber et al., 2022; Jang et al., 2023). Awareness among healthcare providers about these risk factors is crucial to avoid unnecessary invasive procedures such as biopsies or surgical interventions that may arise from misdiagnosis.

The pathophysiology of scurvy involves impaired hydroxylation of proline and lysine residues in collagen, resulting in defective connective tissue formation. This manifests clinically as weakened blood vessel walls, poor wound healing, and skeletal abnormalities (Miller & Jones, 2021). In children, the musculoskeletal symptoms can be severe, including bone pain, swelling, and pseudoparalysis, often leading to extensive evaluations for malignancy or infection (Park et al., 2024). Radiological signs such as the “white line of Frankel,” “Pelkan spur,” and subperiosteal hemorrhages are characteristic but require radiologists familiar with the disease for accurate identification (Singh et al., 2023). Nutritional assessment remains the cornerstone of diagnosis, with careful inquiry into the patient’s diet history revealing inadequate vitamin C intake as a key clue. Laboratory confirmation through plasma or leukocyte ascorbic acid levels is ideal but not always feasible due to limited availability and cost (Chen & Wang, 2023). Therefore, clinicians often rely on clinical presentation and radiographic findings, and initiate empirical vitamin C supplementation, which typically results in rapid symptomatic improvement within days to weeks (Garcia et al., 2022).

Management of scurvy is straightforward but requires early recognition. Oral vitamin C supplementation, ranging from 100 mg daily for children to 500 mg daily in more severe cases, leads to prompt resolution of symptoms and normalization of hematologic abnormalities (Smith & Patel, 2023). Nutritional counseling and monitoring are also essential to prevent

recurrence, especially in children with underlying conditions predisposing to poor dietary intake (López et al., 2024). Follow-up radiographs can demonstrate gradual resolution of bone changes over several months. In conclusion, despite being a historically well-known disease, scurvy remains relevant in modern pediatric practice due to evolving dietary habits and socio-behavioral factors. Clinicians should maintain a high index of suspicion for vitamin C deficiency in children with musculoskeletal complaints and unexplained bleeding, particularly when dietary history indicates prolonged restriction of fresh fruits and vegetables. Early diagnosis and treatment prevent unnecessary investigations and ensure complete recovery, highlighting the ongoing importance of nutritional vigilance in pediatric care (Thompson & Nguyen, 2023).

## CASE PRESENTATION

### Case Series 1

A 4-year-7-month-old girl was admitted due to progressive swelling of the left lower limb, pain on movement, and inability to walk, which had persisted for three months following a minor fall. Despite treatment with traditional massage, her condition worsened, with fixed flexion of the left leg and additional swelling in the left arm. She also experienced pallor, low-grade fever, fatigue, poor appetite, spontaneous gingival bleeding, and recurrent bruising. Nutritional history revealed a highly selective diet since infancy, consisting only of eggs, poultry, fish, and formula milk, with no fruit or vegetable intake. Physical examination showed undernutrition and marked swelling of the left lower limb with fixed flexion at the knee, accompanied by pain on passive movement and refusal to ambulate. The posture resembled antalgic flexion with visible pseudoparalysis (figure 1a, 1b).

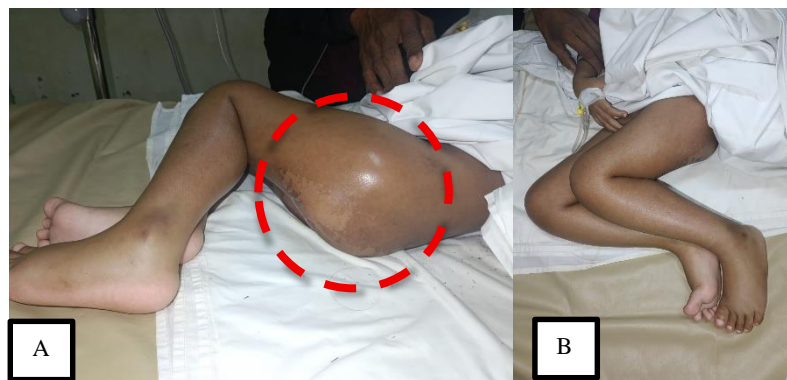


Figure 1. (a) Clinical presentation showing fixed flexion of the left lower limb with pseudoparalysis. (b) Antalgic posture with refusal to ambulate due to pain and joint stiffness

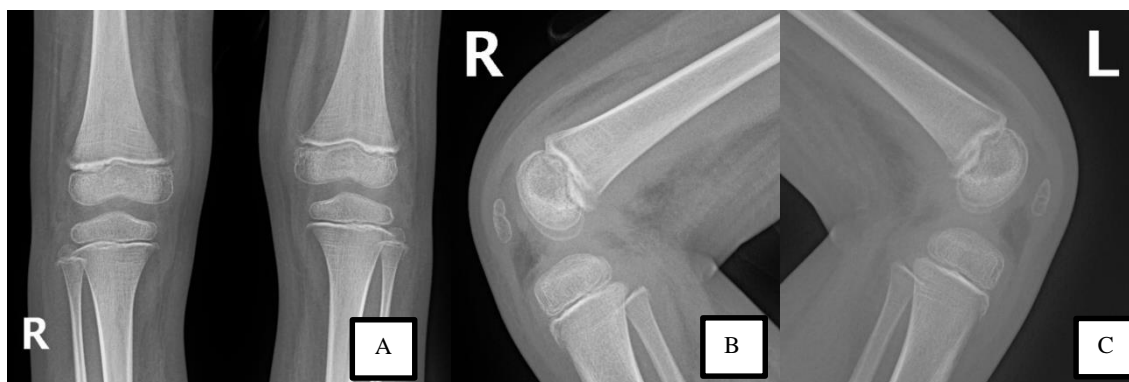


Figure 2. (a–c) Radiographs of the knees demonstrating generalized osteopenia, cortical thinning, dense metaphyseal bands (Frankel lines), metaphyseal corner fractures, and subepiphyseal lucencies; radiologic hallmarks of pediatric scurvy

Radiologic examination supported the clinical suspicion of scurvy. Radiographs of both knees revealed generalized osteopenia, cortical thinning, dense metaphyseal sclerotic bands (Frankel lines), metaphyseal corner fractures, and subepiphyseal lucencies. (Figure 2A-C) These findings are characteristic of vitamin C deficiency and help differentiate scurvy from other musculoskeletal conditions such as osteomyelitis or malignancy.

Although plasma ascorbic acid testing was unavailable, empirical vitamin C therapy (300 mg/day for 7 days, then 100 mg/day) was given to the patient. Within one week of initiating vitamin C supplementation, the girl demonstrated marked clinical improvement. Gingival bleeding ceased, limb swelling diminished, and she began to walk independently. By two weeks, musculoskeletal pain had resolved, and appetite returned. Continued recovery was observed during outpatient follow-up.

### Case Series 2

A 5-year-2-month-old boy was brought to the hospital due to prolonged fever, swelling of the left leg, and inability to walk for one month. The symptoms began after the leg was accidentally compressed by a mattress, initially causing mild pain but later progressing to extensive swelling from thigh to foot. He became increasingly immobile and lethargic, with decreased appetite and reduced interaction. His dietary pattern was markedly restrictive: he consumed only clear broth without solid components, refused all fruits and vegetables, and habitually drank sweetened tea instead of water.



**Figure 3.** Gingival manifestations in pediatric scurvy, showing friable, hyperemic, and necrotic gums with spontaneous bleeding and poor dentition

On admission, the patient appeared pale and weak, with swollen and tender left lower limb and antalgic posture resembling the “pithed frog” position. (Figure 3) Gingival bleeding and spontaneous oral ulcers were reported. Laboratory findings showed severe anemia (Hb 5.3 g/dL), elevated leukocyte count (12,990/ $\mu$ L), and thrombocytosis (840,000/ $\mu$ L).



**Figure 4.** (a) Clinical image showing “pithed frog” posture due to painful pseudoparalysis and swelling of the left lower limb. (b) and (c) Radiographs of the left leg demonstrate osteopenia, cortical thinning, sclerotic metaphyseal bands (Frankel lines), and subepiphyseal lucencies without signs of infection or malignancy



Although empiric corticosteroids were administered, no clinical improvement occurred. The absence of vitamin C in the diet and the presence of gingival hemorrhage, joint pain, and anemia led to a strong clinical suspicion of scurvy. The boy's condition improved steadily after starting vitamin C therapy. By day five, oral lesions and gingival bleeding subsided. Swelling of the lower limb reduced significantly, and he transitioned from bedridden to assisted ambulation. Full mobility and energy levels were restored within two weeks.

## DISCUSSION

Vitamin C is a water-soluble vitamin that plays a critical role in collagen synthesis, immune defense, iron metabolism, and endothelial function. Humans are unable to synthesize ascorbic acid endogenously due to the absence of gulonolactone oxidase, making dietary intake essential. Prolonged deficiency results in impaired connective tissue stability, leading to the clinical syndrome known as scurvy (Gandhi et al., 2023; Krečak et al., 2022). Although rare in high-income settings, pediatric scurvy has re-emerged, particularly in children with restrictive diets characterized by avoidance of fruits and vegetables (Pan et al., 2021; Cui, 2024). Vitamin C plays a central role in collagen synthesis by functioning as a crucial cofactor for the enzymes prolyl hydroxylase and lysyl hydroxylase. These enzymes are responsible for the post-translational hydroxylation of proline and lysine residues in procollagen chains. Hydroxylation stabilizes the collagen triple helix structure through hydrogen bonding and is essential for proper folding, secretion, and cross-linking of collagen fibrils in the extracellular matrix. Without adequate vitamin C, this enzymatic activity is impaired, resulting in under-hydroxylated, unstable collagen that is rapidly degraded or fails to form properly organized fibrils. As a consequence, the structural integrity of connective tissue is compromised, leading to manifestations such as capillary fragility, defective bone matrix formation, poor wound healing, gingival bleeding, and musculoskeletal symptoms (Gandhi et al., 2023; Krečak et al., 2022).

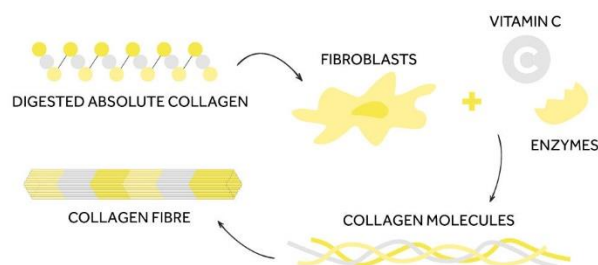


Figure 5. Schematic representation of collagen synthesis

In early childhood, adequate vitamin C intake is vital for growth and tissue maintenance. According to the Institute of Medicine, children aged 1–3 years require 15 mg/day of vitamin C, while those aged 4–8 years require 25 mg/day. These requirements may increase under conditions of stress, infection, or restricted dietary patterns. Natural food sources rich in vitamin C include citrus fruits (oranges, lemons), berries (strawberries, kiwi), tropical fruits (papaya, guava, mango), and vegetables such as bell peppers, tomatoes, broccoli, and dark leafy greens. However, vitamin C is heat-sensitive and water-soluble, so prolonged cooking can significantly reduce its bioavailability. In children with limited intake of these foods due to feeding disorders, neurodevelopmental conditions, or selective eating, clinical vigilance for deficiency is essential (Pan et al., 2021; Cui, 2024).

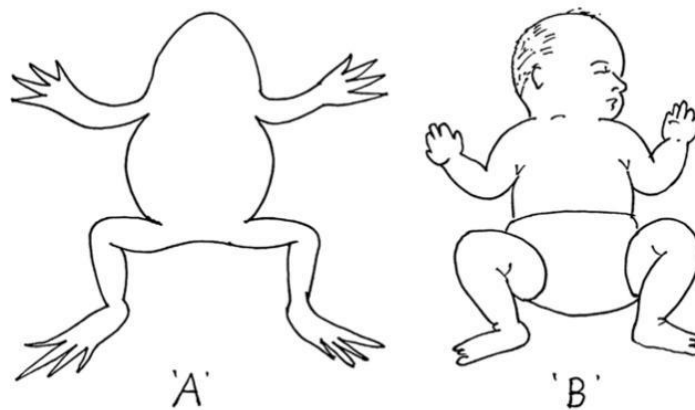


Figure 6. Illustration of a frog with limbs abducted and flexed, representing the passive stance of a pithed frog

The "pithed frog" posture is a descriptive term used in pediatric scurvy to characterize the typical antalgic position adopted by affected children. It results from painful subperiosteal hemorrhages along long bones, leading to spontaneous limb flexion and immobility. The hips are abducted and externally rotated, with knees flexed; mimicking the stance of a frog after pithing. Recognition of this posture, in conjunction with dietary history and clinical signs, is a valuable clue toward early diagnosis of vitamin C deficiency (Figure 6). (Pan et al., 2021; Cui, 2024).

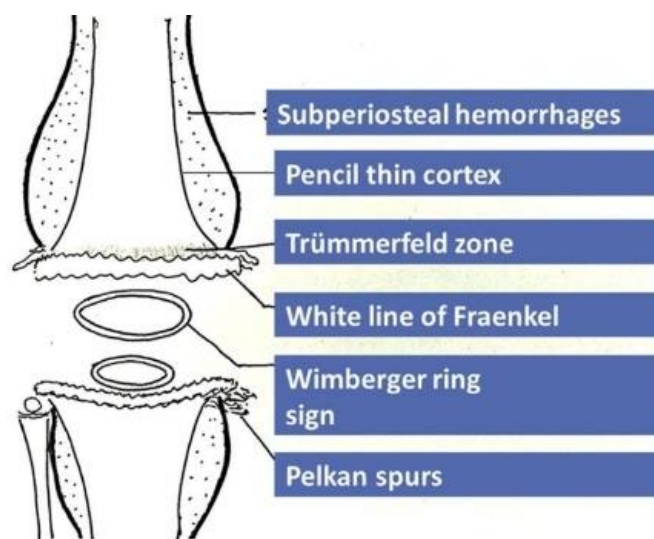


Figure 7. Schematic illustration demonstrating classical radiologic signs of pediatric scurvy, including subperiosteal hemorrhage, pencil-thin cortex, Trümmerfeld zone, white line of Fraenkel, Wimberger ring sign, and Pelkan spurs

Radiologic signs of scurvy reflect impaired collagen synthesis and defective bone formation due to vitamin C deficiency. The *white line of Fraenkel* appears as a dense metaphyseal band representing a zone of provisional calcification. Beneath it lies the *Trümmerfeld zone*; a lucent, fragmented area caused by deficient osteoid matrix formation. The *Wimberger ring sign* refers to a sclerotic ring surrounding the epiphysis due to peripheral calcification and central resorption (Biswas et al, 2022; Golriz et al, 2017). *Pelkan spurs* are metaphyseal outgrowths caused by subperiosteal lifting from hemorrhage at the metaphyseal edge. A *pencil-thin cortex* reflects severe osteopenia, while *subperiosteal hemorrhages* arise from fragile vascular support, leading to painful swelling and pseudoparalysis. Together, these features form a distinctive radiologic constellation for diagnosing pediatric scurvy (Figure 7). (Biswas et al., 2022; Bitonti et al, 2024).

Both patients presented with musculoskeletal complaints, including limb swelling, pseudoparalysis, and refusal to ambulate—features that often mimic osteomyelitis, juvenile arthritis, or neoplasm. Misdiagnosis is common when dietary history is not carefully explored, especially during early phases where clinical signs remain non-specific (Iamopas et al., 2022; Miraj et al., 2023). However, the coexistence of spontaneous gingival bleeding, oral ulceration, easy bruising, and severe anemia in both cases supports the classical triad of scorbutic features. Radiologic evidence, including generalized osteopenia, metaphyseal sclerotic bands (Frankel lines), and subepiphyseal fractures, further confirmed the diagnosis in the absence of serum ascorbate measurement (Du & Kulkarni, 2024; Thiemann et al., 2022). Rapid and sustained improvement following oral vitamin C therapy was observed in both patients, strongly supporting a clinical diagnosis of scurvy. This response reinforces existing literature reporting full resolution of symptoms within days of supplementation, without the need for invasive diagnostic procedures (Robin et al., 2023; Pope & Elder, 2023). These cases emphasize the diagnostic value of dietary assessment in children presenting with unexplained limb pain, anemia, and bleeding manifestations. In resource-limited settings, clinical acumen and targeted therapy remain crucial for the timely recognition and reversal of this preventable nutritional disorder (Sun et al., 2024).

## CONCLUSION

Scurvy remains a clinically relevant diagnosis in pediatric populations, particularly among children with highly selective diets devoid of fresh fruits and vegetables. Musculoskeletal symptoms such as limb swelling, refusal to walk, and joint pain may mimic infectious or neoplastic processes, often delaying recognition. Thorough dietary assessment, identification of classical mucocutaneous signs, and supportive radiologic findings are essential for timely diagnosis. Early vitamin C supplementation leads to rapid clinical improvement, underscoring the need for heightened clinical awareness of this preventable yet often overlooked nutritional disorder.

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