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SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

Vitamin D and Musculoskeletal Health

Overview

- Vitamin D supplementation effects on bone health and injury risk in elite athletes require further research [1].
- A diagnosis of vitamin D deficiency is associated with increased odds of anterior cruciate ligament tears and reconstruction failure [2].
- Vitamin D status should be assessed in high-risk populations, such as athletes and military personnel, to guide preventive strategies for stress fractures [3].
- Educational initiatives and revised guidelines may have improved vitamin D prescription rates after fragility fracture, but awareness remains needed for older adults [4].
- Vitamin D deficiency prevalence is higher among arthroplasty patients presenting in winter [5].
- Regular vitamin D supplementation significantly reduces the likelihood of deficiency in arthroplasty patients [5].
- Evidence suggests vitamin D may support tendon healing, particularly in rotator cuff repair, but studies are low quality and limited to a single tendon group [6].
- Vitamin D deficiency is associated with adverse body composition in adolescents [7].
- Targeted interventions are needed to optimize musculoskeletal and metabolic health in adolescents regarding vitamin D status [7].
- Preoperative vitamin D screening and potential supplementation strategies are important for patients receiving hip fracture surgery under general anesthesia who have vitamin D levels below 20 ng/mL [8].
- Preoperative vitamin D supplementation is a cost-effective intervention in arthroscopic rotator cuff repair [9].
- Nonselective vitamin D supplementation appears more cost-effective than selective supplementation in arthroscopic rotator cuff repair due to lower costs compared to serum assays [9].
- Hand grip strength, vitamin D status, and diets are predictors of bone health in 6–12 year old school children [23].
- Hand grip strength, vitamin D status, and diets might be considered diagnostic non-invasive predictors of bone health for clinical use in epidemiological contexts [23].

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How It Works

- Vitamin D supplementation effects on bone health and injury risk in elite athletes require further research [1].
- Vitamin D deficiency is associated with increased odds of anterior cruciate ligament tears and reconstruction failure [2].
- Vitamin D status assessment in high-risk populations (athletes and military personnel) guides preventive strategies for stress fractures [3].
- Educational initiatives and revised guidelines may have improved vitamin D prescription rates after fragility fracture, but awareness remains needed for older adults [4].
- Regular vitamin D supplementation significantly reduces the likelihood of deficiency in arthroplasty patients presenting in winter [5].
- Vitamin D may support tendon healing, particularly in rotator cuff repair, though evidence is low quality and limited to a single tendon group [6].
- Vitamin D deficiency is associated with adverse body composition in adolescents, highlighting the need for targeted interventions during development [7].
- Preoperative vitamin D screening and potential supplementation are important for patients receiving hip fracture surgery under general anesthesia with levels below 20 ng/mL [8].
- Nonselective preoperative vitamin D supplementation is more cost-effective than selective supplementation in arthroscopic rotator cuff repair due to lower costs compared to serum assays [9].
- Determining preoperative vitamin D levels and providing supplementation if deficient may be beneficial for preventing delayed wound healing after open carpal tunnel release surgery [10].
- Administering an oral 300,000 U single-dose vitamin D regimen to correct deficiency can positively impact outcomes following primary total joint arthroplasty [11].
- Further research is necessary to elucidate the direct role of vitamin D in rotator cuff tear pathogenesis and its impact on clinical outcomes after rotator cuff surgery and total shoulder arthroplasty [12].
- A nanofiber-based vitamin D sheet was compared to vitamin D supplementation for tendon-to-bone healing and muscle regeneration in a rabbit rotator cuff tear model [13].
- Supplementation with vitamin D 10,000 IU/day for 8 weeks can increase vitamin D levels >50 ng/dl to optimally act as an immunomodulator in tuberculosis spondylitis patients [14].
- Active vitamin D3 treatment promoted fracture healing by affecting immune factor levels in osteoporotic fracture patients [17].
- Combining systemic and localized vitamin D delivery via 3D-printed nanofiber sheets significantly enhanced tendon-to-bone healing, muscle regeneration, and biomechanical strength in a rabbit rotator cuff tear model compared to other treatment groups [19].

What the Evidence Shows

- Vitamin D supplementation effects on bone health and injury risk in elite athletes require further research [1].
- A diagnosis of vitamin D deficiency is associated with increased odds of anterior cruciate ligament tears and reconstruction failure [2].
- Vitamin D status should be assessed in high-risk populations, such as athletes and military personnel, to guide preventive strategies for stress fractures [3].
- Educational initiatives and revised guidelines may have improved vitamin D prescription rates after fragility fracture, but awareness remains low in older adults [4].
- Vitamin D deficiency is more prevalent among arthroplasty patients presenting in winter [5].
- Regular vitamin D supplementation significantly reduces the likelihood of vitamin D deficiency [5].
- Vitamin D deficiency is associated with adverse body composition in adolescents [7].
- Targeted interventions are needed to optimize musculoskeletal and metabolic health in adolescents regarding vitamin D status [7].
- Preoperative vitamin D screening and potential supplementation are important for patients with vitamin D levels below 20 ng/mL undergoing hip fracture surgery under general anesthesia [8].
- Vitamin D deficiency is associated with increased short- and long-term mortality in patients receiving hip fracture surgery under general anesthesia [8].
- Nonselective preoperative vitamin D supplementation is more cost-effective than selective supplementation in arthroscopic rotator cuff repair, likely due to lower costs compared to serum assays [9].
- Determining preoperative vitamin D levels and providing supplementation if deficiency is present may be beneficial for preventing delayed wound healing after open carpal tunnel release surgery [10].
- Administering an oral 300,000 U single-dose vitamin D regimen to correct deficiency can positively impact outcomes following primary total joint arthroplasty [11].
- Vitamin D deficiency is associated with increased risk of periprosthetic joint infection and complications after primary total joint arthroplasty [11].
- Further research is necessary to elucidate the direct role of vitamin D in the pathogenesis of rotator cuff tears and its impact on clinical outcomes after rotator cuff surgery and total shoulder arthroplasty [12].
- Vitamin D may support tendon healing, particularly in rotator cuff repair, but current studies are low quality and limited to a single tendon group [6].
- Supplementation with vitamin D 10,000 IU/day for 8 weeks can increase vitamin D levels to >50 ng/dl to optimally act as an immunomodulator in tuberculosis spondylitis patients [14].
- Sixteen weeks of high-intensity interval training and vitamin D consumption showed greater benefits for bone mineral density levels in women with osteoporosis than either intervention alone [15].
- Low-dose vitamin D supplementation was beneficial for vitamin D–sufficient total knee arthroplasty patients to achieve higher levels and maintain sufficiency [16].

- Deficient total knee arthroplasty patients benefited from medium-to-high dose vitamin D supplementation, though only 33.7% achieved repletion [16].
- Perioperative vitamin D supplementation may enhance early recovery and lower complication rates after total knee arthroplasty [20].
- Supplementation with 50,000 international units vitamin D3 on the day of surgery failed to demonstrate statistically significant differences in functional Knee Society Score, Timed Up and Go Test times, or complications in the early postoperative period compared to placebo [21].
- Regular sling core stabilization training based on calcium and vitamin D supplementation can improve bone mineral density and prevent low back pain in a patient with primary osteoporosis over a 6-year period [22].

Practical Considerations

- Vitamin D supplementation effects on bone health and injury risk in elite athletes require further research [1].
- A diagnosis of vitamin D deficiency is associated with increased odds of anterior cruciate ligament tears and reconstruction failure [2].
- Vitamin D status should be assessed in high-risk populations, such as athletes and military personnel, to guide preventive strategies for stress fractures [3].
- Educational initiatives and revised guidelines may have improved vitamin D prescription rates after fragility fracture, but awareness remains a need, particularly in older adults [4].
- Regular vitamin D supplementation significantly reduces the likelihood of vitamin D deficiency in arthroplasty patients presenting in winter [5].
- Evidence suggests vitamin D may support tendon healing, particularly in rotator cuff repair, but studies remain low quality and limited to a single tendon group [6].
- Vitamin D deficiency is associated with adverse body composition in adolescents, highlighting the need for targeted interventions to optimize musculoskeletal and metabolic health during this developmental window [7].
- Preoperative vitamin D screening and potential supplementation strategies are important for patients receiving hip fracture surgery under general anesthesia who have vitamin D levels below 20 ng/mL [8].
- Nonselective preoperative vitamin D supplementation appears to be more cost-effective than selective supplementation in arthroscopic rotator cuff repair, likely due to the lower cost of 25(OH)D supplementation compared to serum assays [9].
- Determining vitamin D levels preoperatively and providing supplementation if deficiency is present may be beneficial for preventing delayed wound healing after open carpal tunnel release surgery [10].
- Administering an oral 300,000 U single-dose vitamin D regimen to correct vitamin D deficiency can positively impact outcomes following primary total joint arthroplasty [11].

- Sixteen weeks of high-intensity interval training and vitamin D consumption showed greater benefits for bone mineral density levels in women with osteoporosis than either intervention alone [15].
- Low-dose vitamin D supplementation was beneficial for vitamin D–sufficient total knee arthroplasty patients to achieve higher levels and maintain sufficiency, while deficient patients benefitted from medium-to-high dose supplementation [16].
- Only 33.7% of vitamin D–deficient total knee arthroplasty patients achieved repletion with medium-to-high dose supplementation [16].
- Vitamin D deficiency is associated with adverse medical outcomes following total shoulder arthroplasty, including increased rates of readmission and periprosthetic fractures [18].

Key Evidence

- [L1] More research is needed to determine the effect of vitamin D supplementation on bone health and injury risk in this population. [1] (10.1177/23259671231220371)
- [L3] These results identify a population with increased odds of injury and provide valuable knowledge as we expand our understanding of the relationship between vitamin D and musculoskeletal health. [2] (10.1016/j.arthro.2023.04.011)
- [L3] These findings suggest that vitamin D status should be assessed in high-risk populations to guide preventive strategies focused on maintaining optimal levels. [3] (10.1177/03635465261441254)
- [L3] Educational initiatives and revised guidelines may have improved prescription rates, but there is a need to raise awareness about the importance of vitamin D for bone health, particularly in older adults. [4] (10.5435/jaaos-d-23-00932)
- [L3] Regular vitamin D supplementation significantly reduces the likelihood of deficiency. [5] (10.1186/s13018-025-06482-9)
- [L4] Although evidence suggests vitamin D may support tendon healing, particularly in rotator cuff repair, studies remain low quality and limited to a single tendon group. [6] (10.1177/23259671251371300)
- [L3] These findings highlight the need for targeted interventions to optimize musculoskeletal and metabolic health during this developmental window. [7] (10.1186/s13018-025-06091-6)
- [L2] These findings highlight the importance of preoperative vitamin D screening and potential supplementation strategies for patients who have vitamin D levels below 20 ng/mL. [8] (10.1016/j.arth.2025.04.080)
- [L4] Nonselective supplementation appears to be more cost-effective than selective supplementation, likely due to the lower cost of 25(OH)D supplementation compared to serum assays. [9] (10.1016/j.jse.2023.05.007)
- [L3] Determining vitamin D levels preoperatively and providing supplementation if deficiency is present may be beneficial for preventing delayed wound healing. [10] (10.5435/jaaos-d-25-00410)
- [L3] Administering an oral 300,000 U single-dose vitamin D regimen to correct vitamin D deficiency can positively impact outcomes following primary TJA. [11] (10.1016/j.arth.2024.05.012)

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- [L4] Further research is necessary to elucidate the direct role of vitamin D in the pathogenesis of rotator cuff tears and its impact on clinical outcomes after rotator cuff surgery and total shoulder arthroplasty. [12] (10.5397/cise.2024.00220)
- [L5] The study aimed to compare the efficacy of a nanofiber-based vitamin D sheet versus vitamin D supplementation on tendon-to-bone healing and muscle regeneration in a rabbit model, though specific conclusion statements were not fully provided in the text. [13] (10.1016/j.jse.2023.02.077)
- [L1] Supplementation with vitamin D 10,000 IU/day for 8 weeks can increase vitamin D levels >50 ng/dl to optimally act as an immunomodulator. [14] (10.1186/s13018-023-04445-6)
- [L1] Sixteen weeks of HIIT and vitamin D consumption showed greater benefits for BMD levels in women with osteoporosis than either vitamin D consumption or HIIT training alone. [15] (10.1186/s12891-025-08275-x)
- [L3] Low-dose vitamin D supplementation was beneficial for vitamin D–sufficient TKA patients to achieve higher levels and maintain sufficiency, while deficient patients benefitted from medium-to-high dose supplementation, though only 33.7% achieved repletion. [16] (10.5435/jaaos-d-24-00005)
- [L2] Active vitamin D3 treatment promoted fracture healing by affecting the levels of these immune factors. [17] (10.1186/s13018-023-03777-7)
- [L3] The observed association between vitamin D deficiency and increased rates of readmission and periprosthetic fractures suggests that addressing vitamin D levels may be linked to reduced future healthcare utilization. [18] (10.1016/j.jseint.2025.01.010)
- [L5] Combining systemic and localized vitamin D delivery significantly enhanced tendon-to-bone healing, muscle regeneration, and biomechanical strength in a rabbit rotator cuff tear model compared to other treatment groups. [19] (10.1016/j.jse.2025.12.003)
- [L2] Our study demonstrated that perioperative vitamin D supplementation may enhance early recovery and lower complication rates after TKA. [20] (10.1177/23259671261432670)
- [L1] Supplementation with 50,000 international units vitamin D3 on the day of surgery failed to demonstrate statistical significant differences in functional KSS, TUGT times, or complications in the early postoperative period compared to placebo. [21] (10.1016/j.arth.2022.08.020)
- [L4] Regular sling core stabilization training based on calcium and vitamin D supplementation can improve bone mineral density and prevent low back pain in a patient with primary osteoporosis over a 6-year period. [22] (10.1186/s12891-023-06896-8)
- [L4] These parameters might be considered diagnostic non-invasive predictors of bone health for clinical use in epidemiological contexts. [23] (10.1186/s12891-023-06960-3)

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[1] Effects of Vitamin D Supplementation in Elite Athletes: A Systematic Review. *Orthopaedic Journal of Sports Medicine*. 2024. DOI: 10.1177/23259671231220371 [2] A Diagnosis of Vitamin D Deficiency Is Associated With Increased Rates of Anterior Cruciate Ligament Tears and Reconstruction Failure. *Arthroscopy*. 2023. DOI: 10.1016/j.arthro.2023.04.011 [3] Vitamin D and the Risk of Stress Fractures in Athletes and Military

Personnel: A Systematic Review and Meta-analysis. *The American Journal of Sports Medicine*. 2026. DOI: 10.1177/03635465261441254 [4] Forgetting the Frail: National Trends in Vitamin D Prescription After Fragility Fracture—A Large Insurance Claims Database Study. *Journal of the American Academy of Orthopaedic Surgeons*. 2024. DOI: 10.5435/jaaos-d-23-00932 [5] Higher prevalence of vitamin D deficiency among arthroplasty patients presenting in winter. *Journal of Orthopaedic Surgery and Research*. 2025. DOI: 10.1186/s13018-025-06482-9 [6] The Role of Vitamin D in Postoperative Tendon Healing: A Scoping Review. *Orthopaedic Journal of Sports Medicine*. 2025. DOI: 10.1177/23259671251371300 [7] Vitamin D deficiency and adverse body composition in adolescents. *Journal of Orthopaedic Surgery and Research*. 2025. DOI: 10.1186/s13018-025-06091-6 [8] Impact of Vitamin D Deficiency on Short- and Long-Term Mortality in Patients Receiving Hip Fracture Surgery Under General Anesthesia: A Matched Cohort Study. *The Journal of Arthroplasty*. 2025. DOI: 10.1016/j.arth.2025.04.080 [9] Preoperative vitamin D supplementation is a cost-effective intervention in arthroscopic rotator cuff repair. *Journal of Shoulder and Elbow Surgery*. 2023. DOI: 10.1016/j.jse.2023.05.007 [10] The Effect of Serum Vitamin D Level on Wound Healing Process After Open Carpal Tunnel Release Surgery: Clinical Outcomes of 55 Cases. *Journal of the American Academy of Orthopaedic Surgeons*. 2025. DOI: 10.5435/jaaos-d-25-00410 [11] Effect of Vitamin D Deficiency on Periprosthetic Joint Infection and Complications After Primary Total Joint Arthroplasty. *The Journal of Arthroplasty*. 2024. DOI: 10.1016/j.arth.2024.05.012 [12] The role of vitamin D in shoulder health: a comprehensive review of its impact on rotator cuff tears and surgical results. *Clinics in Shoulder and Elbow*. 2024. DOI: 10.5397/cise.2024.00220 [13] The Effect Of Nanofiber-Based Vitamin D Sheet For Tendon-To-Bone Healing And Muscle Regeneration In A Rabbit Rotator Cuff Tear Model. *Journal of Shoulder and Elbow Surgery*. 2023. DOI: 10.1016/j.jse.2023.02.077 [14] Randomized controlled trial of vitamin d supplementation on toll-like receptor-2 (tlr-2) and toll-like receptor-4 (tlr-4) in tuberculosis spondylitis patients. *Journal of Orthopaedic Surgery and Research*. 2023. DOI: 10.1186/s13018-023-04445-6 [15] Concurrent effects of high-intensity interval training and vitamin D supplementation on bone metabolism among women diagnosed with osteoporosis: a randomized controlled trial. *BMC Musculoskeletal Disorders*. 2025. DOI: 10.1186/s12891-025-08275-x [16] Vitamin D Supplementation May Prevent or Treat Deficiency After Total Knee Arthroplasty: A Retrospective Cohort Analysis. *Journal of the American Academy of Orthopaedic Surgeons*. 2024. DOI: 10.5435/jaaos-d-24-00005 [17] Determination of immune factor levels in serum and local hematoma samples of osteoporotic fracture patients and clinical study of the effect of active vitamin D3 treatment on immune factor levels. *Journal of Orthopaedic Surgery and Research*. 2023. DOI: 10.1186/s13018-023-03777-7 [18] Vitamin D deficiency is associated with adverse medical outcomes following total shoulder arthroplasty. *JSES International*. 2025. DOI: 10.1016/j.jseint.2025.01.010 [19] Localized vitamin D delivery via 3D-printed nanofiber sheets combined with systemic supplementation enhances tendon-to-bone healing in a rabbit rotator cuff tear model: a preclinical study. *Journal of Shoulder and Elbow Surgery*. 2026. DOI: 10.1016/j.jse.2025.12.003 [20] Effect of Vitamin D Supplementation on Total Knee Arthroplasty Outcomes: A Systematic Review. *Orthopaedic Journal of Sports Medicine*. 2026. DOI: 10.1177/23259671261432670 [21] Vitamin D3 Supplementation Prior to Total Knee Arthroplasty: A Randomized Controlled Trial. *The Journal of Arthroplasty*. 2023. DOI: 10.1016/j.arth.2022.08.020 [22] Regular sling core stabilization training improves bone density based on calcium and vitamin D supplementation. *BMC Musculoskeletal Disorders*. 2023. DOI: 10.1186/s12891-023-06896-8 [23] Hand grip strength, vitamin D status, and diets as predictors of bone health in 6–12 years old school children. *BMC Musculoskeletal Disorders*. 2023. DOI: 10.1186/s12891-023-06960-3

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