

Bone & Joint

Mineral Protocol Guide

Which minerals actually support bone density and cartilage health, realistic dosing, and how to combine them without overshooting limits.

Evidence-based approach: NIH Office of Dietary Supplements; Nutrition Research (calcium-zinc-copper-manganese trial, postmenopausal bone density).

Why It's a Team, Not One Mineral

Bone is a living tissue that remodels constantly, and no single mineral drives that process alone. Calcium provides the mineral scaffold, but the enzymes that build the collagen and cartilage matrix bone mineralizes around depend on zinc, copper, and manganese. Supplementing calcium while ignoring these cofactors is a common, incomplete strategy.

A controlled trial published in Nutrition Research found that postmenopausal women given calcium plus zinc, copper, and manganese preserved spinal bone density significantly better over two years than women given calcium alone — the clearest human evidence that the supporting minerals are not optional extras.

Section 1 — The Core Four Minerals

— Calcium

The structural mineral of bone itself. Adult RDA is 1,000-1,200mg/day, ideally split across two doses of 500mg or less for absorption.

— Zinc

Cofactor for alkaline phosphatase, an enzyme required for bone mineralization. Adult RDA is 8-11mg/day.

— Copper

Required for lysyl oxidase, the enzyme that cross-links collagen and elastin in connective tissue. Adult RDA is 900mcg/day.

— Manganese

Activates the glycosyltransferases that build cartilage's proteoglycan matrix. Adequate intake is 1.8-2.3mg/day.

Section 2 — The Zinc-to-Copper Ratio

Zinc and copper compete for absorption at the same intestinal transporter. The guideline caps the zinc-to-copper ratio at roughly 10:1 — meaning if you supplement for at least 3mg of copper across your diet and supplements combined. Ignoring this is a common way well-intentioned zinc users develop a copper shortfall.

Section 3 — Common Mistakes

— Calcium alone, no cofactors

Taking a calcium-only supplement while assuming bone density is fully covered ignores the collagen and cartilage side of bone formation.

— Stacking manganese sources unknowingly

Multivitamins, greens powders, and joint formulas often already contain manganese — check totals before adding a standalone product.

— High-dose zinc without copper

Long-term high-dose zinc (over 40mg/day) without matched copper is a well-documented path to copper deficiency and its associated anemia.

— Treating manganese like other minerals

Manganese has a documented toxicity profile at high chronic intake. Stay close to the RDA rather than assuming more is better.

Putting It Together

Prioritize food sources first: dairy and leafy greens for calcium, oysters and nuts for copper, whole grains and legumes for manganese. Supplement only rather than stacking every mineral at maximum dose. If you already take a multivitamin, adding standalone products — double-dosing manganese and zinc is the most

Sources

NIH Office of Dietary Supplements — Manganese, Copper, Zinc, and Calcium Fact Sheets for Health Professionals.

Nutrition Research — Calcium plus zinc, copper, and manganese supplementation and spinal bone density in postmenopausal women.

Antioxidants (2022) — Copper metabolism and cardiovascular and connective tissue health, review.